

ADOLESCENT ALCOHOL USE AND DATING VIOLENCE PERPETRATION:
THREE STUDIES EXAMINING CONCURRENT AND LONGITUDINAL
RELATIONS ACROSS GRADES 8 THROUGH 12

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A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill
in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the
Department of Health Behavior and Health Education

Chapel Hill
2009

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ABSTRACT

Heathe Luz McNaughton Reyes—Adolescent alcohol use and dating violence
perpetration: Three studies examining concurrent and longitudinal relations across grades
8 through 12

(Under the direction of Vangie A. Foshee, Susan T. Ennett, Daniel J. Bauer, Carolyn T.
Halpern and J. Michael Bowling)

Numerous studies suggest a link between alcohol use and adult partner violence, but research on how this relationship unfolds during adolescence is limited. The three studies comprising this dissertation each used a different theoretical lens to guide an empirical examination of the relations between alcohol use and physical dating violence perpetration using data from a longitudinal study spanning grades 8 through 12.

Study one (n=2272) used autoregressive latent curve models to examine several different theoretical models of the linkages between alcohol use and dating violence perpetration over time. Trajectories of alcohol use and dating violence were correlated and this correlation was reduced substantially after adjusting for the effects of common predictors. However, concurrent associations between the two behaviors persisted across nearly all grades. There was no evidence of prospective relations from alcohol use to dating violence or vice-versa.

Study two (n=2311) examined the role of heavy alcohol use in the developmental process of desistance from dating violence perpetration. Growth models were used to test

the hypotheses that both early and continuing alcohol use would hinder desistance from dating violence during late adolescence. Contrary to expectations, the effects of early alcohol use on dating violence diminished over time. Although the contemporaneous effects of alcohol use on dating violence were significant across most grades, effects weakened during late adolescence and were stronger in the spring than in the fall semesters.

Study three (n=2311) examined the hypothesis that increased exposure to violence would strengthen the relationship between heavy alcohol use and dating violence. Growth models were used to examine the main and joint effects of alcohol use and exposure to family, peer, and neighborhood violence on levels of dating violence across grades 8 through 12. Across all grades, the relationship between alcohol use and dating violence was stronger for teens exposed to higher levels of family conflict and friend dating violence.

Prevention programs that target risk factors common to both dating violence and alcohol use may reduce involvement in both behaviors. Programs that seek to reduce alcohol-related dating violence should target younger teens and those exposed to family conflict or friend dating violence.

To Rodrigo and Bella Lani

ACKNOWLEDGEMENTS

Completion of this dissertation would not have been possible without the unerring love, patience and encouragement of my husband Rodrigo. Thank you for all of the sacrifices you made that allowed me to complete this work.

I am grateful to all of my committee members for their wonderful support and mentorship. Over the past five years each of you have generously opened your doors to me whenever I needed guidance and have provided me with challenges and opportunities that have made me a better scholar and teacher. I feel very fortunate to have been able to work with you.

Support for this dissertation research was provided by an individual National Research Service Award Pre-doctoral Fellowship awarded by the National Institute on Alcohol Abuse and Alcoholism (F31AA017015), and by an institutional National Research Service Award Pre-Doctoral Fellowship awarded by the National Institute on Child and Human Development (T32 HD07376) to the Carolina Consortium on Human Development at the Center for Developmental Science. The study that provided the data for this research was funded by the National Institute on Drug Abuse (R01DA16669, S. T. Ennett, PI) and the Centers for Disease Control and Prevention (R49CCV423114, V. A. Foshee, PI)

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Overview

Whereas a large body of research has established a consistent and robust link between alcohol use and partner violence perpetration in adulthood (Foran & O’Leary, 2008), little research has examined their relationship during adolescence. Given that patterns of relationship conflict that are established during adolescence may carry over into adulthood (Bouchey & Furman, 2003; Gidycz, Orchowski, King & Rich, 2008; Magdol, Moffitt, Caspi & Silva, 1998; Smith, White & Holland, 2003), studies that clarify how the relationship between the two behaviors unfolds during adolescence may help to inform primary prevention efforts that reduce partner violence across the lifespan. To this end, each of the three studies that comprise this dissertation research used a different theoretical lens to guide an empirical examination of the relationship between alcohol use and physical dating violence perpetration using longitudinal data collected from adolescents in grades 8 through 12.

Study one was guided by theoretical models that suggest that: (i) alcohol use will be concurrently related to dating aggression through its effects on cognitive function (proximal effects model), (ii) alcohol use will be prospectively related to dating violence (indirect effects model), (iii) dating violence will be prospectively related to alcohol use (reverse indirect effects model), and (iv) the two behaviors are both manifestations of a general propensity towards deviance driven by common risk factors (common cause model; Foran & O’Leary, 2008; Klosterman & Fals-Stewart, 2006; Leonard & Quigley, 1999; White, Brick & Hansell, 1993). An autoregressive latent curve modeling approach

was used to examine each of the pathways implied by these theoretical models in the context of a single analytic framework (Curran & Bollen, 2001; Bollen & Curran, 2004). Specifically, we simultaneously modeled correlations between latent growth trajectories describing change in alcohol use and dating violence across grades 8 through 12 (correlations implied by the common cause model), as well as concurrent and prospective effects between the repeated measures of each behavior (pathways implied by the proximal and indirect effects models). In addition, we examined the extent to which baseline measures of several risk factors (family conflict, peer aggression, social bonding and emotional distress) that are common to both alcohol use and dating violence accounted for linkages between the two behaviors over time.

Study two was informed by Moffitt's (1993) theory of antisocial behavior and the work of Hussong, Curran, Moffitt and Caspi (2004) which propose that heavy alcohol use acts as a developmental snare that hinders desistance from dating aggression during late adolescence and young adulthood. Specifically, based on the work of Hussong, et al. (2004), we hypothesized that higher levels of heavy alcohol use early in adolescence would be associated with higher overall levels of dating violence and decreased deceleration from dating violence perpetration during late adolescence. In addition, we hypothesized that higher levels of heavy alcohol use during assessment points in late adolescence, when the normative pattern is one of desistance from dating violence, would be concurrently associated with higher levels of dating violence perpetration during those time points. To test these hypotheses, study two used a random coefficients growth modeling approach to examine the effects of both early (baseline) and continuing (time-

varying) heavy alcohol use on desistance (i.e. deceleration) from dating violence perpetration during late adolescence.

Study three was motivated by empirical evidence and theoretical models that suggest that individual and contextual or situational factors moderate the relationship between alcohol use and dating aggression (Klosterman & Fals-Stewart, 2006). In particular, several theoretical models suggest that the proximal relationship between alcohol intoxication and dating violence may be stronger among individuals who have aggressive propensities and in contexts or situations that facilitate (rather than constrain) aggressive behavior (Chermack & Giancola, 1997; Klosterman & Fals-Stewart, 2006; Parker, 1995). Based on social cognitive theory (Bandura, 1973; 1977), we reasoned that higher levels of exposure to family, peer and neighborhood violence would, through processes of modeling and reinforcement, each be associated with the development of aggressive perceptual and behavioral tendencies. As such, we expected that the concurrent relationship between heavy alcohol use and dating violence perpetration would be stronger for teens who were exposed to higher as compared to lower levels of family, peer and neighborhood violence. To test the hypotheses implied by this expectation, we examined the main and joint effects of time-varying measures of heavy alcohol use and exposure to family, peer and neighborhood violence on repeated measures of dating violence perpetration across grades 8 through 12.

The data for this dissertation research come from a multi-wave cohort sequential study of adolescent health risk behaviors that spanned middle and high school (National Institute on Drug Abuse, R01DA16669, S. T. Ennett, PI; Centers for Disease Control and Prevention, R49CCV423114, V. A. Foshee, PI). Four waves of data were used starting

when participants were in the 8th, 9th and 10th grades (wave one) and ending when participants were in the 10th, 11th, and 12th grades (wave four). Data were collected at six-month time intervals for the first three waves and there was a one-year time interval between waves three and four. Participants were enrolled in two public school systems located in two predominantly rural counties with higher proportions of African Americans than in the general United States (U.S. Census Bureau, 2001).

Paper 1: Developmental Associations between Adolescent Alcohol Use and Dating Violence Perpetration

Abstract

Although numerous studies suggest alcohol use is associated with adult partner violence, few studies have examined how this relationship unfolds during adolescence. The current study examined the interrelations between alcohol use and physical dating violence perpetration across grades 8 through 12 using four waves of data from a longitudinal study of adolescent health risk behaviors. Autoregressive latent curve models were used to estimate associations between developmental trajectories of alcohol use and dating violence while also examining time-specific concurrent and bidirectional prospective relations. On average, higher levels of alcohol use were associated with higher levels of dating violence across all grades. Consistent with the common cause model, associations between trajectories of alcohol use and dating violence were reduced substantially after controlling for psychosocial predictors common to both behaviors. However, consistent with the proximal effects model, significant concurrent associations between the two behaviors persisted across nearly all grades. There was no evidence of prospective relations from prior alcohol use to subsequent dating violence or vice-versa. Results suggest that primary prevention efforts should target shared determinants of alcohol use and dating violence including family conflict, peer aggression, emotional distress and low social bonding.

Introduction

Whereas a large body of research has documented a consistent and robust link between alcohol use and adult intimate partner violence (for reviews, see Foran & O’Leary, 2008; Lipsey, Wilson, Cohen & Derzon, 1997; Stith, Smith, Penn, Ward & Tritt, 2004; Testa, 2004), few studies have examined the relationships between alcohol use and dating violence perpetration during adolescence. Both dating violence and alcohol use become increasingly prevalent during the middle and high school years and can have serious negative consequences for adolescent health and well-being (Ackard, Eisenberg & Neumark-Sztainer, 2007; Chassin, et. al, 2004; Roberts, Klein & Fisher, 2003; Windle & Windle, 2004). Moreover, patterns of relationship conflict that are established during this period are likely to carry over into adulthood (Bouchey & Furman, 2003; Gidycz, Orchowski, King & Rich, 2008; Magdol, Moffitt, Caspi & Silva, 1998; Smith, White & Holland, 2003). Therefore, a better understanding of how the relationship between alcohol use and dating violence unfolds during adolescence may inform prevention efforts across the lifespan. To this end, the current study provides an empirical examination of the concurrent and longitudinal relationships between alcohol use and dating violence across middle and late adolescence.

Empirical Studies of the Relationship between Alcohol Use and Dating Violence

There is extensive empirical evidence documenting an association between alcohol use and adult intimate partner violence perpetration (Foran & O’leary, 2008; Stith, et al., 2004; Lipsey, et al., 1997). For example, in their recent meta-analysis, Foran and O’leary (2008) found a small to moderate effect size for the association between alcohol use/abuse and male-to-female violence and a small effect size for female-to-male

violence. However, only five studies, three cross-sectional and two longitudinal, have examined the associations between adolescent alcohol use and dating violence perpetration. Each of the three cross-sectional studies examined the concurrent association of alcohol use with a dichotomous measure of any dating violence perpetration in the past year. Malik, Sorenson, and Anehensel (1997) found that a past year measure of alcohol use frequency was not associated with involvement in physical dating violence perpetration. Similarly, Hird (2000) found that a lifetime measure of any alcohol use was not associated with girls' involvement in physical, psychological or sexual dating violence perpetration. In contrast, Champion, Long Foley, Sigmon-Smith, Sutfin, & DuRant (2008) found that past 30-day alcohol use involvement was associated with involvement in date fighting perpetration in the past year (starting a fight with or hitting a boyfriend, girlfriend or date).

Both longitudinal studies of the association between alcohol use and dating violence perpetration examined the relationship between alcohol use among non-perpetrators at time one and onset of perpetration at time two. In the first study, past-30 day frequency of alcohol use was found to predict perpetration onset among girls, but not boys, one year later (Foshee, MacDougall, Linder, & Bangdiwala, 2001). In the second study, a lifetime measure of alcohol use frequency was not found to predict onset of perpetration by either boys or girls six months later (Foshee, Reyes, & Ennett, in press). Other cross-sectional (O'Keefe, 1997) and longitudinal (Simons, Lin, and Gordon, 1998; Lavoie, et al., 2001) studies have found that measures of substance use and antisocial behavior that combine indicators of alcohol use with indicators of other types of substance use and/or delinquent behavior are both concurrently and prospectively

associated with dating violence perpetration. However, because alcohol use was measured as a composite with other behaviors, it is impossible to determine whether alcohol use was uniquely related to dating violence in those studies.

Overall, the few studies that have examined the relationship between adolescent alcohol use and dating violence have been hampered by limited alcohol use measures which likely do not tap into the kind of heavy or problematic use more likely to be associated with aggression (Foran and O’Leary, 2008; O’Leary & Schumacher, 2003). Furthermore, no studies have examined interrelations between the two behaviors across more than two points in time.

Theoretical Models of the Linkages between Alcohol Use and Dating Violence

Three primary theoretical explanations have been posited to explain the observed relationship between alcohol use and partner violence: (a) the proximal effects model, (b) the indirect effects model, and (c) the common cause or spurious effects model (Foran & O’Leary, 2008; Klosterman & Fals-Stewart, 2006; Leonard & Quigley, 1999). The proximal effects model posits that alcohol intoxication plays a causal role in increasing risk of dating abuse perpetration through its psychopharmacological effects on cognitive function. Specifically, intoxication can intensify feelings of excitement and curiosity, lead a person to overreact to perceived provocation, and decrease the saliency of cues that aggressive behavior will have negative consequences (i.e., threat inhibition), thereby increasing risk of confrontation and violence (Phil and Hoaken, 2002). This model implies that alcohol use increases risk of dating violence exclusively during the time frame when alcohol is exerting a pharmacological effect.

The indirect effects model posits that the causal relationship between alcohol use and dating violence is mediated by other variables such as relationship quality. For example, several researchers have suggested that elevated alcohol use by one or both partners in a dating relationship leads to relationship dissatisfaction and greater frequency of interpersonal conflict and, in turn, to increased risk of dating violence perpetration (Fagan & Browne, 1994; Fischer, et al., 2005; Quigley & Leonard, 2000; White & Chen, 2000). In contrast to the proximal effects model, which implies that alcohol use and dating violence will be concurrently associated, the indirect effects model implies that the causal influence of alcohol use on dating violence may be studied over a longer time-window. That is, the indirect effects model suggests that elevated alcohol use during one time period may prospectively predict dating violence perpetration measured at a subsequent time period.

Another version of the indirect effects model suggests that prior aggression, including dating violence, may indirectly lead to subsequent alcohol use (White, Brick, and Hansell, 1993). Mechanisms explaining this relationship (from prior aggression to subsequent alcohol use) include the notions that: (i) involvement in aggression may lead to delinquent peer affiliations and, in turn, to substance use (e.g., Fite, Colder, Lochman & Wells, 2007) and (ii) involvement in aggression may lead to alcohol use as a means for coping with the negative social and emotional consequences of being abusive (White, et al., 1993).

Regardless of the specific mediating mechanism, indirect effects models imply that elevated alcohol use during one time period may lead to increased dating violence at a subsequent time period and/or vice-versa. Indeed, longitudinal studies of the

developmental associations between substance use and non-dating aggression have found some evidence that elevated levels of substance use prospectively predict increased aggression and vice versa, supporting the notion of a reciprocal relationship between the two behaviors (Huang, White, Kosterman, Catalano & Hawkins, 2001; White, Loeber, Stouthamer-Loeber, & Farrington, 1999).

A third conceptual model that has been posited to explain the link between alcohol use and dating violence is the common cause model. This model suggests that alcohol use and dating violence are linked because they share causal determinants. For example, several risk factors have been found to predict both alcohol use and dating or partner violence among adolescents and young adults including: peer aggression or antisocial behavior (e.g., Andrews, Foster, Capaldi & Hops, 2000; Fite, et al., 2007), emotional distress (e.g., Wolfe, Wekerle, Scott, Straatman, & Grasley, 2004; Tschann, Flores, Pasch & Van Oss, 2005), and aspects of the family environment including poor parenting practices (e.g., Hotton & Haans, 2004; Lavoie et al., 2001) and family conflict (e.g., Bray, Adams, Getz, & Baer, 2001; Ehrensaft et al., 2003).

The notion that alcohol use and dating violence share etiological origins is also consistent with several theories of adolescent health risk behavior (e.g., problem behavior theory, general deviance theory, primary socialization theory), that suggest that alcohol use and dating violence perpetration are both manifestations of an underlying propensity towards deviance. These theories identify numerous general causal determinants (e.g., low social bonding, negative family environment) that can lead to involvement in a range of problem behaviors, including substance use and aggression (see Jessor, Donovan &

Costa, 1991; Jessor & Jessor, 1977; Oetting & Donnermeyer, 1998; Osgood, Johnson, O'Malley, & Bachman, 1988).

Specifying the Relations between Dating Violence and Alcohol Use over Time

Taken together, the theoretical models reviewed above suggest there may be any one of a number of pathways linking a set of repeated measures of dating abuse and alcohol use over time. To clarify the nature of these pathways and to help map each pathway onto the modeling framework used in the current study, we classify the theoretical relationships between dating violence and alcohol use into two types: (i) time-specific relations and (ii) time-stable relations. Time-specific relations comprise associations between levels of alcohol use at a particular time point and levels of dating violence at a particular time point. Time-specific relations between repeated measures of alcohol use and dating violence are implied by both the proximal effects and indirect effects models. The proximal effects model suggests that elevated levels of alcohol misuse at a given time-point will be concurrently associated with elevated levels of dating violence perpetration at that same time-point. Indirect effects models suggest that elevated alcohol use at a given time-point may prospectively predict dating violence perpetration at a later time point and/or vice-versa.

In contrast to the time-specific relations suggested by the proximal and indirect effects models, theories that view both alcohol use and dating violence as forms of deviant behavior driven by common causes suggest that there may be an overall time-stable association between levels of alcohol use and levels of dating violence over time. That is, it follows from these theories that overall levels of and changes in ones' propensity towards deviance will influence levels of involvement in both alcohol use and

dating violence over time, resulting in time-stable correlations between the underlying trajectories for both behaviors. These correlations are referred to as “time-stable” because they represent the overall associations between levels of and changes in alcohol use and dating violence across the time period assessed. It also follows from these theories that correlations between trajectories of alcohol use and dating violence would be attenuated once the influence of shared risk factors is accounted for.

The Current Study

The current study used an autoregressive latent trajectory modeling approach to examine both time-specific and time-stable relations between repeated measures of dating violence and alcohol use using data from a multi-wave longitudinal study of adolescent boys and girls that spanned grades 8 through 12. Following from theories that view alcohol use and dating aggression as manifestations of an underlying propensity towards deviant behavior, we examined the correlations between the underlying growth processes governing trajectories of alcohol use and dating violence perpetration over time. In addition, based on the common-cause model, we examined relations between the two behaviors both before and after controlling for baseline psychosocial risk factors that have been identified as contributors to both alcohol use and dating violence including: family conflict, social bonding, emotional distress and peer aggression. Based on the proximal and indirect effects models, we also simultaneously examined concurrent and bidirectional prospective relations between the repeated measures for each behavior. Finally, because many studies suggest that dating violence perpetration is as prevalent for girls as for boys (Foshee & Reyes, 2009), and that the etiological processes leading to

dating violence may differ for boys and girls (Foshee, et al., 2001; Foshee, et al., in press), we tested for sex differences in the pathways relating the two behaviors over time.

Method

Participants

The sample for this study was drawn from a multi-wave cohort sequential examination of adolescent health risk behaviors that spanned middle and high school (National Institute on Drug Abuse, R01DA16669, S. T. Ennett, PI; Centers for Disease Control and Prevention, R49CCV423114, V. A. Foshee, PI). Dating violence was assessed beginning when participants were in the 8th, 9th and 10th grades. As such, the current study uses four waves of data starting when participants were in the 8th, 9th and 10th grades (wave one) and ending when participants were in the 10th, 11th, and 12th grades (wave four). Data were collected at six-month time intervals for the first three waves and there was a one-year time interval between waves three and four. Participants were enrolled in two public school systems located in two predominantly rural counties with higher proportions of African Americans than in the general United States (U.S. Census Bureau, 2001).

At each assessment all enrolled students in the targeted grades who were able to complete the survey in English and who were not in special education programs or out of school due to long-term suspension were eligible for the study. Parents had the opportunity to refuse consent for their child's participation by returning a written form or by calling a toll-free telephone number. Adolescent assent was obtained from teens whose parents had consented immediately prior to the survey administration. Trained data collectors administered the questionnaires in student classrooms on at least two

occasions to reduce the effect of absenteeism on response rates. To maintain confidentiality, teachers remained at their desks while students completed questionnaires and the students placed questionnaires in envelopes before returning them to the data collectors. The Institutional Review Board for the School of Public Health at the University of North Carolina at Chapel Hill approved the data collection protocols.

At wave one, 6% of parents refused consent, 6% of adolescents declined to participate and 8% were absent on the days when data were collected for a total of 2636 students completing a survey at wave one. The response rate, calculated as the proportion of adolescents who completed a survey out of those eligible for the survey at wave 1 was 79%. For this study, analyses excluded students who; (1) did not report their age or who reported being out of the typical age range of 12-19 for the grades studied (n=50, 2%), (2) did not report their dating status or reported never dating across all of the assessments (n=247, 9%) or (3) were missing data on the alcohol use or dating violence measures across all waves of the study (n=67, 3%), yielding a sample size of 2272. Almost all students participated in at least two waves of data collection (n=2127, 94%), with 75% participating in 3 or more waves (n=1722).

Approximately half of the sample was male (47%) and the self-reported race/ethnicity distribution was 49% White, 43% Black and 5% other race/ethnicity. Approximately 29% of participants reported that the highest education attained by either parent was high school or less across all waves of the study. At wave 1, prevalence of any alcohol use in the past three months was 28% and prevalence of any physical dating violence perpetration in the past three months was 18%.

Measures

Measures included the two outcomes of interest, alcohol use and dating violence perpetration as well as psychosocial and demographic covariates. The alcohol and dating violence measures were collected at all waves. Measures of the psychosocial covariates (family conflict, emotional distress, social bonding and peer aggression) were drawn from the baseline assessment to be consistent with the common cause model, which views these variables as precursors to alcohol use and dating violence.

Alcohol use. Alcohol use was measured as a composite of frequency, quantity and heavy use. For all measures, alcoholic beverages were defined as including beer, wine, wine coolers and liquor and a “drink” was defined as a glass of wine, a can of beer, a bottle or can of wine cooler, a shot glass of liquor or a mixed drink. The frequency item assessed the number of days that the adolescent had one or more drinks of alcohol in the past three months with six response categories ranging from 0 days to 20 days or more. The quantity item assessed how many drinks the adolescent usually consumed on a typical drinking occasion in the past three months with six response categories ranging from less than one drink to five or more drinks. Heavy alcohol use was assessed by five items asking adolescents how many times they had: 3 or 4 drinks in a row, 5 or more drinks in a row, gotten drunk or very high from drinking alcohol, drunk alcohol while alone or been hung over. Each item had five response categories that ranged from 0 to 10 or more times in the past 3 months. The heavy use items were averaged to create a scale and then the frequency, quantity and heavy use measures were standardized and summed to create a composite measure of alcohol use at each wave (average Cronbach’s $\alpha = .92$).

Physical dating violence perpetration. Dating violence perpetration was measured each wave using a short version of the Safe Dates Physical Perpetration Scale (Foshee, et al., 1996). Adolescents were asked, “During the past 3 months, how many times did you do each of the following things to someone you were dating or on a date with? Don’t count it if you did it in self-defense or play.” Six behavioral items were listed: “slapped or scratched them,” “physically twisted their arm or bent back their fingers,” “pushed, grabbed, shoved, or kicked them,” “hit them with your fists or with something else hard,” “beat them up,” and “assaulted them with a knife or a gun.” Each item had five response categories ranging from 0 to 10 times or more in the past three months. Responses were summed across items to create a physical dating violence perpetration scale measure (average Cronbach’s alpha=.93).

Psychosocial covariates. We measured *peer aggression* using six items that assessed how many times in the past three months the respondent had pushed, slapped or kicked someone, physically twisted someone’s arm or bent back their fingers, hit someone with their fist or something else hard, beat someone up or assaulted someone with a knife or gun. Adolescents were specifically asked to exclude acts that they had perpetrated against a date. Scores were averaged across the items to create a composite scale of adolescent physical aggression (Cronbach’s $\alpha = .87$).

Family conflict was assessed by three items from Bloom’s (1985) self-report measure of family functioning. Adolescents were asked how strongly they agreed or disagreed with the following three items when thinking about their family life in the past three months: we fight a lot in our family, family members sometimes get so angry they throw things and family members sometimes hit each other. Response options ranged

from strongly agree (4) to strongly disagree (0). Items were averaged to create a measure of baseline exposure to family conflict (Cronbach's $\alpha = .87$).

Emotional distress was measured as a composite of three scales assessing anger, anxiety and depression in the past three months. Anger was assessed by three items drawn from the revised Multiple Affective Adjective Checklist (MAACL-R) that asked adolescents how often they felt mad, angry or furious in the past three months (Zuckerman & Lubin, 1985). Four response categories ranged from never or almost never to almost always. Anxiety was measured using a shortened version of the Revised Children's Manifest Anxiety scale (Reynolds & Richmond, 1979) and depression was measured using three items from the Short Mood and Feelings Questionnaire (Angold, Costello, & Messer, 1995). Both anxiety and depression were assessed by presenting adolescents with a list of statements describing how they may have felt in the past three months. The statements listed seven symptoms of anxiety (e.g., I felt sick to my stomach) and three symptoms of depression (e.g., I did everything wrong). Each item had five response categories that ranged from strongly disagree to strongly agree. Items were averaged to create a scale score for each construct. Cronbach's alphas were satisfactory for each of the individual subscales ($\alpha = .88$ for anger, $\alpha = .88$ for anxiety, $\alpha = .92$ for depression) and subscale scores were significantly correlated ($p < .001$ for all correlations). A composite measure of emotional distress was created by standardizing and averaging subscale scores.

Social bonding was operationalized to be consistent with Hirschi's (1969) social control theory (SCT). According to this theory social bonds play a key role in deterring antisocial behavior by encouraging conformity to conventional values and attitudes.

Following the definition of social bonding suggested by SCT, degree of social bonding was assessed as a composite of teen's endorsement of conventional beliefs, commitment to pro-social values, and degree of religiosity. Endorsement of conventional beliefs was measured by asking adolescents how strongly they agreed or disagreed with the following statements; it is good to be honest, people should not cheat on tests and, in general, police deserve respect. Commitment to pro-social values was measured by assessing how important or unimportant adolescents felt it is to: finish high school, go to college, have a happy family life and have a close group of friends. Degree of religiosity was assessed by three items assessing frequency of religious service attendance, the importance of religion to the adolescent and the extent to which religious beliefs influence the adolescent's actions. Items were averaged to create a scale score for each construct. Cronbach's alphas for each of the individual scales were acceptable ($\alpha=.73$ for prosocial values, $\alpha=.74$ for conventional beliefs, $\alpha=.76$ for religiosity), and subscale scores were significantly correlated ($p<.001$ for all correlations). A composite measure of social bonding was created by standardizing and averaging subscale scores.

Demographic covariates. Sex was coded such that 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, and other race/ethnicity (including Latinos). Parent education ranged from less than high school (0) to graduate school or more (3) and was measured as the highest education attained by either parent across all waves. Family structure (two parent vs. other) and age were also examined as a potential control variables but were not found to be significantly associated with trajectories of alcohol use or dating violence and their inclusion in the

models did not change the pattern of findings, therefore neither family structure nor age are included in the analyses reported below.

Missing Data

All analyses for this study used maximum likelihood estimation techniques which make use of all available information in the data and may be used under the assumption that data are missing at random (MAR). For this study, missing data on the outcomes of interest, alcohol use and dating violence, are considered missing at random if the probability of missingness on the outcome variable is not dependent on the value of the outcome variable after adjusting for observed covariates in the analysis model. There is no empirical means through which the MAR assumption can be tested because the value of the outcome variable cannot be determined for the assessments where that variable was missing. Nonetheless, we did examine patterns of missing data by assessing the associations between study drop-out (coded as “1” for adolescents who did not participate in the study at one or more waves and “0” for adolescents who participated in all four waves), demographic covariates and observed scores on alcohol use and dating violence at baseline. Adolescents who were missing data at one or more waves were significantly more likely to be male, Black or of other race/ethnicity, have parents with lower education and report higher levels of baseline alcohol use and dating violence perpetration compared with those who participated in all waves. However, in multivariate models of drop-out, the associations between drop-out and baseline alcohol use and between drop-out and baseline dating violence were not significant ($p > .20$), after adjusting for the effects of sex, parent education and race/ethnicity. These analyses

suggest that study drop-out was not related to baseline levels of alcohol use and dating violence after adjusting for the effects of demographic covariates.

Analytic Approach

The overarching goal of this study was to examine several different models of the interrelations between dating violence and alcohol use over time. To fully explore each of the theoretical relationships between the two behaviors within the same analytic framework we used an autoregressive latent curve (ALT) modeling approach (for a more detailed description of ALT models, see Bollen & Curran, 2004; Curran & Bollen, 2001). The ALT modeling approach presupposes that the two outcomes of interest (dating violence and alcohol use in this case) are each governed by separate developmental processes. These developmental processes are modeled through the estimation of separate latent curve models for each outcome. Latent curve models assume that the repeated observations over time of a given behavior (such as alcohol use or dating violence) were generated by an unobserved underlying trajectory unique to each individual (Curran and Willoughby, 2003). Parameters (i.e. means and variances) describing the unobserved (or “latent”) factors that govern the underlying alcohol use and dating violence trajectories are empirically inferred from the observed repeated measures.

After determining the best-fitting unconditional latent curve model for each behavior, relationships between the repeated measures for the two outcomes are modeled at two different levels. First, the latent factors that govern the developmental trajectories for each outcome are allowed to covary. These covariances represent the shared stable associations between alcohol use and dating violence over time (implied by the common cause model). Second, the time-specific repeated measures for each outcome are related

both cross-sectionally (by allowing the alcohol use and dating violence measures to correlate within each time-point) and prospectively (by estimating cross-lagged pathways between the repeated measures for each construct). In the context of the current study, the cross-sectional associations are implied by the proximal effects model, and the cross-lagged associations are implied by the indirect effects models.

Curran and Bollen (2001) observe that, by allowing for the simultaneous estimation of both time-stable and time-specific relations between two outcomes, the ALT model combines the strengths of two common analytic approaches to the statistical analysis of panel data, the autoregressive model and the random coefficients growth curve model. Furthermore, the ALT model enables one to avoid biases that can be associated with using either an autoregressive or growth modeling approach alone when theory suggests the potential for both time-stable and time-specific relations between two behaviors (Curran & Bolen, 2001).

Analyses for this study proceeded in several phases. First, to take advantage of the cohort sequential design of this study, data were reorganized such that the grade level of the child was used as the primary metric of time rather than wave of assessment. This allowed for trajectories to be continuously modeled across grades eight through twelve. Information was available across eight discrete data points: grade 8 fall (n=778), grade 8 spring (n=663), grade 9 fall (n=1317), grade 9 spring (n=667), grade 10 fall (n= 1814), grade 10 spring (n=586), grade 11 fall (n=1037) and grade 12 fall (n=426).

We examined potential cohort differences in growth patterns using the multiple-group method proposed by Duncan and Duncan (1994) and found no evidence of cohort differences in the latent trajectories for either of our outcomes. We also examined

potential biases in our models due to the fact that data were collected from students nested within schools. Nesting of the alcohol use and dating violence outcomes within schools was assessed at each wave. There were negligible design effects (DEFF) and non-significant intraclass correlations (ICC) for both outcomes across all waves (for both outcomes the average ICC was $<.01$ and the average DEFF was < 2.00). Furthermore, adjusting for nesting had no effect on the latent curve factor means or variances for either outcome. As such, the models reported below do not account for this nested structure, but are likely not biased by this omission.

In the first phase of analysis, flat, linear, quadratic and completely non-linear “free-loading” models (for a description of “free-loading” models see Bollen and Curran, 2006) were estimated and compared to identify the functional form of the latent growth curve that best fit the repeated measures for alcohol use and for dating violence. Within each functional form, chi-square difference tests of nested models were performed to identify the optimal structure for the growth factor variances and for the residual variances of the repeated measures. The best-fitting model was selected based on the criteria of parsimony, component and overall fit.

After identifying the best fitting latent curve model for each outcome, we examined the relations between the underlying growth processes for alcohol use and dating violence using a multivariate growth model. Specifically, the multivariate growth model linked the latent curves for alcohol use and dating violence through the estimation of time-stable covariances among the latent factors for each outcome. Residual covariances were also allowed to correlate across behaviors and to vary over time. As noted earlier, time-stable covariances between the latent factors are implied by theories

that suggest that dating violence and alcohol use are both manifestations of a propensity towards deviance driven by common causes and residual covariances denote the within-time associations between alcohol use and dating violence implied by the proximal effects model. Demographic and baseline psychosocial controls (common causes) were incorporated into the multivariate growth model by regressing each covariate on each of the latent growth factors for each outcome. Covariance parameter estimates were compared across the unconditional and conditional models to assess whether and how the addition of the covariates affected the strength of the relationships between alcohol use and dating violence.

Next, we specified an autoregressive latent trajectory model by adding cross-lagged prospective pathways between the repeated measures for alcohol use and dating violence to the multivariate growth model. As previously noted, in the context of the current study, the lagged effects reflect the reciprocal prospective associations between alcohol use and dating violence implied by the indirect effects models. A multiple-group approach was then used to determine if the parameter estimates relating the two behaviors differed for boys and girls.

All analyses for this study were conducted using M-Plus version 5.1 (Muthén and Muthén, 2007). The repeated measures for alcohol use and dating violence perpetration were logged and all models were fit using the maximum likelihood robust estimator to adjust for non-normality in the distributions of the outcomes. Nested models were compared using the Satorra-Bentler scaled chi-square difference test (Satorra, 2000). Overall model fit was assessed using the comparative fit index (CFI), Tucker-Lewis Index (TLI) and the root mean square error of approximation (RMSEA) and its 90%

confidence interval (for a review of these fit indices see Bollen & Curran, 2006). The RMSEA score was subtracted from 1 to put it on the same metric as the other fit indices. Good model fit was indicated where levels on these indices were greater than 0.95.

Results

Table 1 provides the means, standard deviations and correlations of the repeated measures of alcohol use and dating violence for each cohort. Adolescent alcohol use and dating violence perpetration were moderately correlated both within and across grade levels, with the strongest inter-behavior correlations occurring in the spring of grade 8 ($r=.44$, $p<.001$) and the spring of grade 10 ($r=.34$, $p<.001$). Consistent with expectations based on previous research (e.g., Foshee, et al., 2005; Foshee, et al., 2009), averaging across cohorts, observed means for dating violence generally increased over time up until the spring of grade 10 and then decreased thereafter. Observed means for alcohol use increased across each grade level, but increases were smaller in the later grade levels as compared to the earlier grade levels.

Univariate Latent Curve Models for Alcohol Use and Dating Violence

Alcohol use. The best fitting model for alcohol use was a quadratic model with the variance of the quadratic factor constrained to zero and heteroscedastic variance over time for the repeated measures. This model fit very well ($\chi^2(18)=38.36$, $p=.004$; CFI=0.97; TLI=0.97; 1-RMSEA=0.98); parameter estimates are provided in column 1 of Table 2. The estimated means for the latent factors indicate that the model-implied mean trajectory for the sample was characterized by an initial alcohol use score of 0.30 ($p<.001$), a significant positive linear growth component ($b=0.17$, $p<.001$), and a significant negative quadratic component ($b=-0.02$, $p<.01$). Taken together, these results

reflect that the average developmental trajectory of adolescent alcohol use is increasing over time and that the magnitude of change decreases at later grades. The top graph of Figure 1 presents the model-implied curve, which bends downwards as grade-level increases due to the negative effect of the quadratic growth factor.

In addition to these significant fixed effects, the latent factor variance estimates for the model indicate that there was substantial individual variability in initial levels of alcohol use ($b=0.24$, $p<.001$), but not in rates of change in alcohol use over time. We also note that, although estimates of the slope factor variance and intercept-slope covariance were not significant, constraining the slope factor variance and intercept-slope covariance to zero led to a significant decrement in model fit ($\chi^2(2)=12.06$, $p<.01$), therefore these parameters were retained in the model. Estimates of residual variance in the repeated measures of alcohol use (variability in alcohol use not explained by grade level) were significantly different from zero across all grade levels (see Table 2, column 1).

Dating violence. The best fitting model for dating violence was a quadratic model with slope and quadratic factor variances constrained to zero and heteroscedastic variance over time. This model also fit the data very well ($\chi^2(32)=64.41$, $p=.001$; CFI=0.96; TLI=0.96; 1-RMSEA=0.98); parameter estimates are provided in column 2 of Table 2. The estimated means of the latent factors indicate that the model-implied was characterized by an initial perpetration score of 0.19 units ($p<.001$), a significant positive linear growth component ($b=0.07$, $p<.001$), and a significant negative quadratic component ($b=-0.02$, $p<.001$). The bottom graph of Figure 1 graphically depicts the model-implied mean curve, which peaks in grade 10 and then decreases through grades 11 and 12. The variance estimate for the latent intercept factor further suggests there was

substantial variability in initial levels of dating violence perpetration ($b=0.14$, $p<.001$). However, slope and quadratic variances were constrained to zero because estimates for these parameters were negligible and non-significant, and constraining the slope and quadratic variances and covariances to zero did not significantly affect model fit ($\chi^2(5)=5.35$, $p=.63$). Estimates of residual variance in the repeated measures of dating violence perpetration (variability in dating violence not explained by grade-level) were significant across all grades (see Table 2, column 2).

Multivariate Growth Model

To assess relations between the growth processes governing alcohol use and dating violence a multivariate growth model was specified in which covariances were estimated between the latent growth factors for each outcome (see Figure 2). Specifically, cross-behavior covariances were estimated between the intercept factors for each behavior and between the intercept factor for dating violence and the slope factor for alcohol use. Because the univariate models found negligible variance in the dating violence slope factor and in the quadratic factors for both outcomes, covariances were not estimated with these latent factors. Residual variances were allowed to correlate across behaviors and were allowed to vary over time.

The unconditional multivariate growth model fit the data well ($\chi^2(116)=186$, $p<.001$; CFI=0.96; TLI=0.95; 1-RMSEA=0.98) and is presented in Figure 2. The latent intercept factors for alcohol use and dating violence were strongly positively correlated ($r=.39$, $p<.001$), suggesting that, on average, individuals who reported higher levels of alcohol use also reported higher levels of dating violence across all grades. This finding is consistent with theories that suggest that the two behaviors are both manifestations of a

general propensity towards deviant behavior. Estimates of the covariance between the dating violence intercept and alcohol use slope ($b=-0.01$, $p=.12$) and between the alcohol use intercept and alcohol use slope ($b=0.004$, $p=.76$) were small and not statistically significant, indicating that neither initial levels of dating violence nor initial levels of alcohol use were significantly associated with individual differences in rates of change in alcohol use. Consistent with the proximal effects model, within time-point associations (i.e. residual covariances) between the repeated measures for each behavior were generally positive and statistically significant across nearly all grade levels (grade 11 was the only exception).

Multivariate growth model with demographic and psychosocial controls. Each demographic (race, sex, and parent education) and baseline psychosocial (family conflict, social bonding, peer aggression and emotional distress) covariate was regressed on all of the latent curve factors for alcohol use and dating violence. Two models were estimated, one with just the demographic controls and one with both the demographic and psychosocial controls. Correlations between the latent intercepts for alcohol use and dating violence and within time-point concurrent relations were examined for each model. In addition, the amount of variance explained in the latent intercepts for alcohol use and dating violence was examined for each model using an r-square measure.

Fit statistics, r-square measures for the latent intercepts, and standardized parameter estimates, which denote the estimated correlations between the trajectories for alcohol use and dating violence and between the repeated measures at each grade level, are presented in Table 3 for the conditional multivariate growth models. Consistent with the common cause model, inclusion of the psychosocial controls led to a substantial

decrease in the strength of the correlation between the dating violence and alcohol use intercepts from $r=.41$ ($p<.001$) to $r=.24$ ($p<.01$). Furthermore, consistent with the proximal effects model, residual correlations between the repeated measures for the two behaviors remained significant and positive across nearly all grade levels after incorporation of both sets of covariates (grade 11 was again the only exception). Inclusion of the demographic covariates explained a small but significant amount of individual variability in the dating violence intercepts ($r^2 =.09$, $p<.001$), but did not explain a significant amount of variance in the alcohol use intercepts ($r^2=.01$, $p=.25$). In contrast, inclusion of the psychosocial covariates led to a substantial increase in the amount of variance explained in both the dating violence (r^2 increment $=.32$) and alcohol use (r^2 increment $=.24$) intercepts.

The effects of the demographic covariates on the latent curve factors for alcohol use and dating violence were generally consistent with expectations based on prior research. Sex was not related to initial levels of alcohol use but was significantly related to initial levels of dating violence such that females reported higher initial levels of perpetration than boys ($p<.001$). Race was significantly related to initial levels of both outcomes but in the opposite direction such that Blacks reported *higher* initial levels of dating violence than Whites ($p<.001$), whereas they reported *lower* initial levels of alcohol use than Whites ($p=.03$). Higher levels of parent education were negatively associated with initial increases in dating violence perpetration ($p=.03$), but were not associated with trajectories of alcohol use.

The pattern of psychosocial covariate effects on alcohol use and dating violence was also consistent with expectations based on prior research. Higher levels of family

conflict and peer aggression and lower levels of social bonding were each significantly positively associated with initial levels of dating violence ($p=.02$ for family conflict, $p=.001$ for bonding, $p<.001$ for peer aggression) and alcohol use ($p=.03$ for family conflict, $p<.001$ for bonding and peer aggression). Emotional distress was not related to trajectory intercepts, but was significantly positively related to faster initial increases in both behaviors ($p=.04$ for dating violence and alcohol use).

Autoregressive Latent Trajectory (ALT) Model

The ALT model built on the multivariate growth model described above by adding prospective cross-lagged pathways between the repeated measures for alcohol use and dating violence. At baseline an unconditional multivariate growth model was specified as described previously. Next, prospective pathways were added from alcohol use to dating violence, which did not lead to a significant improvement in model fit ($\chi^2(7)=11.01$, $p=.16$). Next, prospective pathways from dating violence to alcohol use were added, which again did not lead to a significant improvement in model fit ($\chi^2(7)=9.39$, $p=.23$). Parameter estimates for cross-lagged pathways were generally positive, but not statistically significant. Contrary to expectations based on the indirect effects model, these results suggest that alcohol use does not prospectively predict dating violence or vice-versa after controlling for associations between their underlying trajectories and concurrent associations between the repeated measures for each behavior.

Multiple group ALT model. A multiple group framework was used to examine sex differences in the ALT model parameter estimates. Parameter estimates were first allowed to vary across groups (i.e., parameter estimates were allowed to differ for boys and girls), and then sets of parameter estimates were systematically constrained to be

equal for boys and girls in the following order; latent factor means, cross-lagged pathways, latent factor variances and covariances, latent factor residual variances and covariances. Multi-parameter Wald tests were used to test each set of equality constraints.¹ If the multi-parameter Wald test was significant at $\alpha=.05$, it indicated that one or more of the parameter estimates in the set differed significantly for boys and girls. Individual Wald tests were then performed to determine which of the parameters differed significantly across groups. If a Wald test of a parameter constraint or set of constraints was not significant, the parameter or parameter set was constrained before proceeding to the next test.

Several of the dating violence and alcohol use latent factor means and variances differed for boys and girls. Girls reported higher initial levels of and steeper initial increases in dating violence compared to boys. In addition, there was greater individual variability in girls' initial levels of dating violence as compared to boys. There were no sex differences in initial levels of alcohol use; however boys reported steeper initial increases in alcohol use compared to girls. Individual variability in initial levels of and rates of change in alcohol use did not vary by sex. Most importantly, all of the Wald tests for sex differences in the pathways relating alcohol use and dating violence (i.e., cross-lags, latent factor covariances, residual covariances) were not significant, indicating that associations *between* the two behaviors did not differ for boys and girls.

Discussion

This study examined several different theoretical models of the interrelations between alcohol use and dating violence over time. Consistent with the notion that

¹ Wald tests were used to test for sex differences instead of nested chi-square difference tests because we could not obtain a robust chi-square and scaling factor from the multiple-group model due to low covariance coverage.

alcohol use and dating violence are both manifestations of a general propensity towards deviance driven by common causes, findings suggest that, on average, adolescents who reported higher levels of alcohol use also reported higher levels of dating violence across all grade levels (i.e. trajectory intercepts were significantly correlated). Moreover, this time-stable association was substantially reduced after taking into account the influence of baseline psychosocial risk factors that are posited to be common causes of both behaviors. Consistent with the proximal effects model, even after accounting for the time-stable association between trajectories of alcohol use and dating violence and after adjusting for demographic and psychosocial covariates, within time-point correlations between alcohol use and dating violence were of moderate size and were statistically significant across nearly all grade levels, with the highest correlations occurring in the spring of grades 8 ($r=.42$) and 10 ($r=.36$). However, contrary to expectations based on the indirect effects model, no evidence was found for a prospective relationship from prior alcohol use to subsequent dating violence or vice-versa. Furthermore, findings suggest that while trajectories of alcohol use and dating violence differ for boys and girls, time-stable and time-specific relations *between* the trajectories and repeated measures for the two behaviors do not vary by sex. Each of these findings will be discussed in turn.

The finding that overall levels of alcohol use and dating violence are linked is consistent with theories that view aggression and substance use as manifestations of an underlying tendency towards deviance (Jessor, et. al, 1991; Osgood, et al., 1988). It follows from these theories that individuals with a greater (or lesser) propensity towards deviant behavior would tend to report greater (or lesser) levels of involvement in both alcohol use and dating violence perpetration across all of the grade levels we assessed.

We also found that associations between the latent trajectories for each behavior were substantially reduced when baseline psychosocial risk factors posited to be common causes of both behaviors were included in the model (from $r=.42$ in the demographics only model to $r=.24$ in the psychosocial covariates model). This result is also consistent with the aforementioned theories and with the common cause model of the relationship between alcohol use and dating violence, which suggests that associations between the two behaviors are driven by shared causal determinants.

The finding that elevated levels of alcohol use were significantly concurrently associated with elevated levels of dating violence perpetration within nearly all grade-levels assessed (grade 11 was the only exception) is consistent with the proximal effects model, which posits that alcohol intoxication increases risk of dating violence perpetration through its acute psychopharmacological effects. That is, based on the proximal effects model one would expect to see concurrent (i.e. within time-point) associations between the behaviors, reflecting the effects of higher use of alcohol use (a marker for intoxication) in that time period on levels of dating violence in that same time period. Furthermore, consistent with our findings, the proximal effects model implies that these unique time-specific associations will persist after accounting for relations between the underlying trajectories for each behavior and after adjusting for shared causal determinants that predict both behaviors.

This study did not find evidence of cross-lagged prospective effects from alcohol use to dating violence or vice versa, using a six-month window between the first three waves of data collections and a one-year window between waves three and four. Cross-lagged effects were examined based on indirect effects models, which suggest that the

causal relationship between alcohol use and dating violence may be bidirectional and is mediated by other psychosocial variables (such as relationship quality), and therefore elevated alcohol use at one time point may prospectively predict dating violence at another time-point and vice-versa. We posit three alternative explanations for the lack of cross-lagged effects. First, the six-month gap between assessments may have been too long a time-window for studying the indirect effects of alcohol use on dating violence (and vice-versa), particularly given that adolescent dating relationships are known to be sporadic and short-term (Furman & Shaffer, 2003).

Second, the indirect effects model may only apply to adolescents who are involved in severe forms of alcohol use and/or partner aggression. For example, relationship quality may be only affected by alcohol use and, in turn, lead to dating violence, when one or both dating partners are involved in serious alcohol misuse/abuse. Conversely, dating violence may only lead to emotional distress and, in turn, to alcohol use, amongst adolescents who are involved in severe levels or forms of perpetration.

Third, indirect effects models of the relationship between alcohol use and dating violence may simply not apply in adolescent populations. Florsheim and Moore (2008) note that the relationship between substance use and interpersonal processes may differ for adolescent couples as compared to adult couples. The authors observe that adolescent dating couples may be less likely than adult couples to view substance use (including alcohol use) as a problem, possibly because they have yet to experience serious negative consequences of long-term misuse. In addition, because adolescent relationships are generally characterized by lower levels of commitment, interdependence and stability than adult relationships, the association between individual level problems (such as

alcohol use) and couple-level problems (such as disagreements and conflict) may be weaker for adolescent couples than for adult couples (Florsheim & Moore, 2008).

Finally, we note that the findings from this study suggest that associations between alcohol use and dating violence perpetration are similar for girls and boys. This finding is largely consistent with studies of adult partner violence, which have found a significant association between alcohol use and both male-to-female and female-to-male partner aggression (Foran & O’leary, 2008). Accordingly, prevention efforts that seek to prevent alcohol-related dating violence should address perpetration by both males and females.

Limitations and Future Directions

There are several important limitations of the current study that should be noted. First, the current study was not designed to directly test the proximal effects model because the temporal precedence of alcohol use in episodes of dating violence could not be determined. At each wave, measures assessed levels of alcohol use and dating violence perpetration in the past three months. Therefore, although we posit that the concurrent associations between alcohol use and dating violence within each grade level are likely reflective of a proximal effect of alcohol use on dating violence, the associations may also be due to indirect effects of alcohol use on dating violence (and/or vice-versa) or to third variables that were not controlled for in the analysis.

To better establish temporal ordering, future studies of adolescent alcohol use and dating violence should take advantage of innovative new methods, including ecological momentary assessment methods or daily diary studies, which enable the assessment of proximal relationships between the two behaviors over short time-periods (e.g., Fals-

Stewart, 2003; Hussong, Hicks, Levy, & Curran, 2001). These types of studies can examine the day-to-day relationships between alcohol use and dating violence perpetration and can be sensitive to appropriate time windows for determining the timing of effects. For example, these types of studies can assess whether the odds of dating violence are higher on days of alcohol use compared to days of abstinence (as predicted by the proximal effects model), and also can potentially assess whether the effects of elevated alcohol use on dating violence perpetration (or vice-versa) also carry over into subsequent days or weeks as predicted by indirect effects models. In addition, these types of studies can assess the consequences of drinking on potential mediators of the relationship between alcohol use and aggression such as relationship communication and conflicts (e.g., Fischer, et al., 2005).

Second, while this study focused on examining the linkages between alcohol use and dating violence over time, theories and research suggest that alcohol use may be related to dating violence in some contexts or circumstances but not in others (Fals-Stewart, Leonard, & Birchler, 2005; Klosterman & Fals-Stewart, 2006). Future studies should therefore examine individual, relationship, and contextual factors that may contribute to moderate relations between the two behaviors.

Conclusions

This study makes an original and important contribution to the dating violence literature. As far as we know, it is the first study to explicitly examine the interrelations between repeated measures of adolescent dating violence and alcohol use, and findings provide novel information about how these behaviors are related during adolescence. By using an ALT modeling approach we were able to examine both time-stable and time-

specific relations between repeated measures of the two behaviors over time. This approach provided for a conservative statistical test of study hypotheses because each of the theoretical relationships was examined simultaneously within the same modeling framework, strengthening our confidence in the findings (Curran & Bollen, 2001).

The results of this study support the argument that alcohol use and dating violence perpetration are linked in part because they share common risk factors. From a prevention science perspective this finding underscores the importance of early interventions that target causal determinants of multiple risk behaviors. Early interventions that prevent or reduce family conflict, peer aggression, emotional distress and/or increase social bonding may lead to decreased levels of both alcohol use and dating violence perpetration during adolescence.

Findings also support the notion that alcohol use and dating violence share a unique concurrent relationship even after controlling for shared precursors. This relationship could reflect the acute effects of alcohol intoxication on dating abuse perpetration; however more research is needed to understand the causal mechanisms underlying this relationship in order to inform the design of effective preventive programs.

Table 1: Alcohol Use and Dating Violence Perpetration Correlations by Grade-level and Cohort

<i>Cohort 1 (n=778)</i>									
Outcome	Grade	1.	2.	3.	4.	5.	6.	7.	8.
1. Alcohol use	8	--							
2. Alcohol use	8.5	0.51	--						
3. Alcohol use	9	0.42	0.39	--					
4. Alcohol use	10	0.37	0.41	0.48	--				
5. Dating violence	8	0.32	0.17	0.11	<i>0.08</i>	--			
6. Dating violence	8.5	0.22	0.44	0.13	<i>0.11</i>	0.39	--		
7. Dating violence	9	0.18	0.20	0.25	<i>0.01</i>	0.33	0.45	--	
8. Dating violence	10	0.11	0.14	0.12	<i>0.09</i>	0.31	0.36	0.41	--
<i>M</i>		0.29	0.33	0.46	0.54	0.20	0.23	0.22	0.28
<i>SD</i>		0.61	0.65	0.76	0.80	0.52	0.63	0.60	0.62
<i>Cohort 2 (n=777)</i>									
Outcome	Grade	1.	2.	3.	4.	5.	6.	7.	8.
1. Alcohol use	9	--							
2. Alcohol use	9.5	0.54	--						
3. Alcohol use	10	0.44	0.47	--					
4. Alcohol use	11	0.33	0.46	0.47	--				
5. Dating violence	9	0.27	0.09	0.13	0.10	--			
6. Dating violence	9.5	0.24	0.26	0.22	0.23	0.49	--		
7. Dating violence	10	0.13	0.12	0.25	0.23	0.25	0.41	--	
8. Dating violence	11	0.18	0.13	0.13	<i>0.10</i>	0.42	0.49	0.40	--
<i>M</i>		0.50	0.51	0.58	0.60	0.25	0.27	0.23	0.26
<i>SD</i>		0.78	0.79	0.82	0.81	0.59	0.65	0.64	0.60
<i>Cohort 3 (n=717)</i>									
Outcome	Grade	1.	2.	3.	4.	5.	6.	7.	8.
1. Alcohol use	10	--							
2. Alcohol use	10.5	0.50	--						
3. Alcohol use	11	0.50	0.49	--					
4. Alcohol use	12	0.38	0.43	0.45	--				
5. Dating violence	10	0.14	0.11	0.10	-0.04	--			
6. Dating violence	10.5	0.12	0.34	0.21	0.13	0.39	--		
7. Dating violence	11	<i>0.02</i>	0.12	0.15	<i>0.11</i>	0.31	0.37	--	
8. Dating violence	12	<i>-0.04</i>	<i>-0.01</i>	<i>-0.05</i>	0.05	0.31	0.39	0.36	--
<i>M</i>		0.58	0.64	0.73	0.70	0.24	0.29	0.23	0.19
<i>SD</i>		0.82	0.87	0.88	0.86	0.58	0.70	0.59	0.50

Note: All correlations were significant at $p < .05$ except for coefficients that are italicized.

Table 2. Parameter Estimates (Robust Standard Errors) and Fit Indices for Unconditional Latent Curve Models of Alcohol Use and Dating Violence

Parameter	Alcohol Use	Dating Violence
<i>Latent Factor Means</i>		
Intercept	0.30 (.02)***	0.19 (.02)***
Slope	0.17 (.02)***	0.07 (.02)***
Quadratic	-0.02 (.006)**	-0.02 (.01)**
<i>Latent Factor Variances</i>		
Intercept	0.24 (.03)***	0.14 (.01)***
Slope	0.01 (.01)	--
Intercept and Slope Covariance	0.004 (.02)	--
<i>Residual Variances</i>		
Grade 8	0.16 (.03)**	0.16 (.03)***
Grade 8.5	0.22 (.03)***	0.24 (.05)***
Grade 9	0.34 (.03)***	0.21 (.03)***
Grade 9.5	0.30 (.03)***	0.24 (.05)***
Grade 10	0.36 (.02)***	0.25 (.03)***
Grade 10.5	0.40 (.04)***	0.32 (.07)***
Grade 11	0.37 (.03)***	0.21 (.03)***
Grade 12	0.41 (.05)***	0.14 (.04)***
<i>Fit indices</i>		
X ² (DF)	38.36 (18), p=.004	23.45 (20), p=.27
CFI, TLI	0.97; 0.97	0.98; 0.99
1-RMSEA (90% CI)	0.98 (0.97-0.99)	0.99 (0.98-1.00)

Note: Quadratic factor variances and the variance of the dating violence slope factor were constrained to zero.

*p<.05, **p<.01, ***p<.001

Table 3. Parameter Estimates (Robust Standard Errors) and Fit Indices for Conditional Multivariate Growth Models of Alcohol Use and Dating Violence

Parameter or pathway	Model 2: Demographic Controls	Model 3: Demographic and Psychosocial Controls
<i>Latent growth factor correlations</i>		
DV intercept with AL intercept	0.41 (.07)***	0.24 (.08)**
DV intercept with AL slope	-0.08 (.15)	0.04 (.16)
AL intercept with AL slope	0.06 (.31)	0.18 (.38)
<i>Residual correlations</i>		
Grade 8	0.29 (.10)***	0.20 (.09)*
Grade 8.5	0.41 (.08)***	0.42 (.08)***
Grade 9	0.22 (.06)***	0.18 (.06)**
Grade 9.5	0.18 (.09)*	0.18 (.09)*
Grade 10	0.11 (.05)*	0.11 (.04)*
Grade 10.5	0.36 (.07)***	0.36 (.06)***
Grade 11	0.02 (.06)	0.03 (.06)
Grade 12	0.20 (.09)*	0.21 (.09)*
<i>Intercept factor r-square</i>		
Alcohol use	0.02 (.01)	0.25 (.05)***
Dating violence	0.09 (.03)***	0.41 (.06)***
<i>Fit Indices</i>		
X2 (DF)	168.20 (108)***	210.63 (148)***
CFI; TLI	0.97; 0.96	0.97; 0.96
1-RMSEA (90% CI)	0.98 (0.98,0.99)	0.99 (0.98, 0.99)

Note: AL=Alcohol Use, DV=Dating Violence. Each covariate was regressed on all of the latent curve factors for each behavior. Demographic covariates were sex, race and parent education; psychosocial covariates were family conflict, peer violence, social bonding and emotional distress. The intercept factor r-square denotes the amount of variance explained in the latent intercepts for each behavior by the covariates in the model.

*p<.05, **p<.01, ***p<.001

Figure 1. Mean Trajectories for Alcohol Use and Dating Violence Perpetration across Grades 8 through 12. Top: Alcohol Use; Bottom: Dating Violence

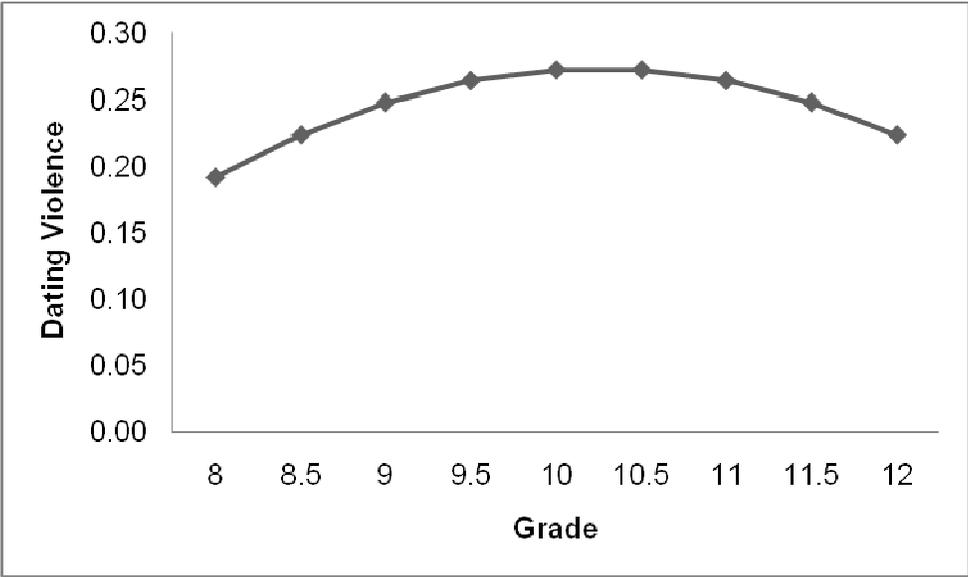
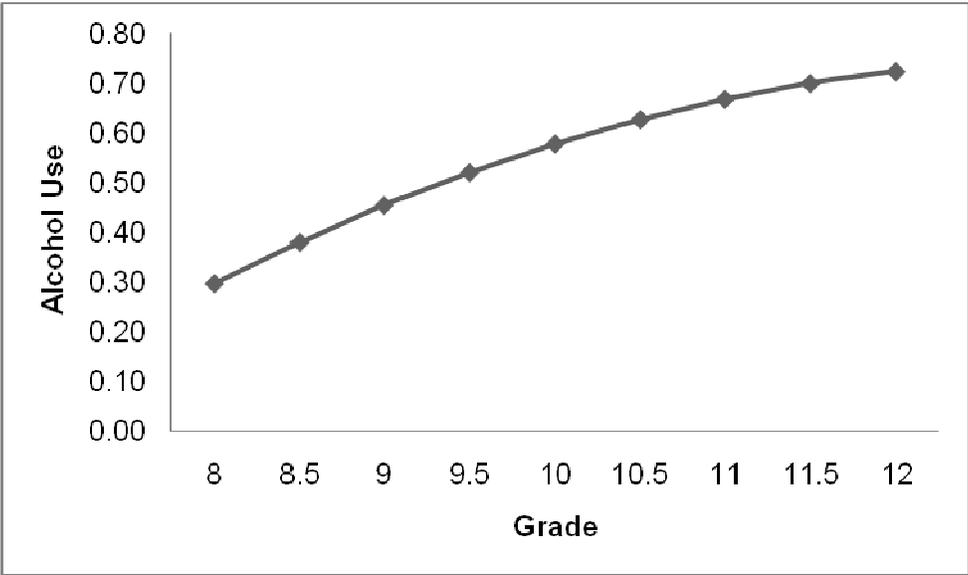
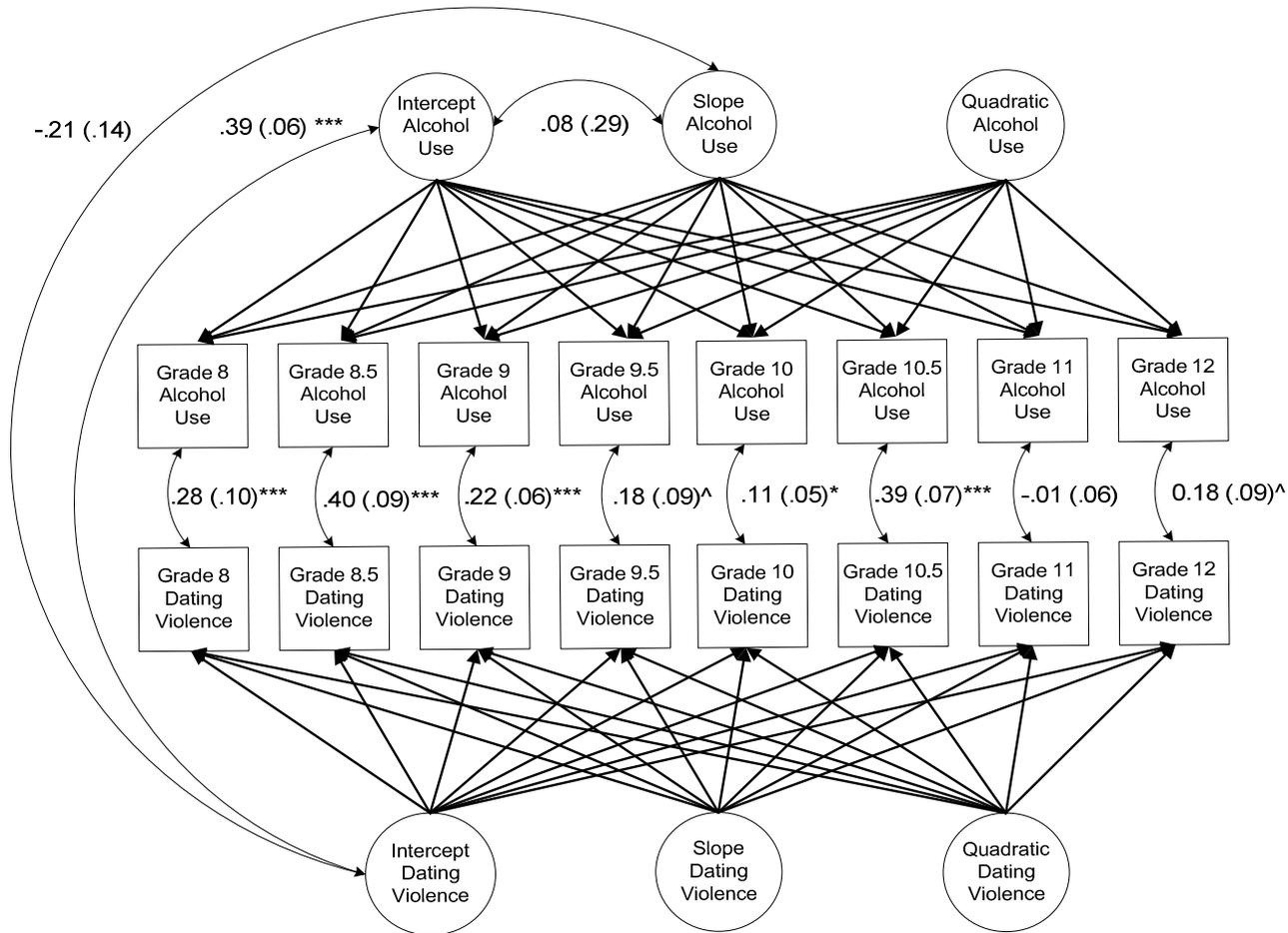


Figure 2. Unconditional Multivariate Latent Curve Model of Adolescent Alcohol Use and Dating Violence Perpetration.



Note: Model $\chi^2(68)=97.92, p=.01$; CFI=0.98; TLI=0.98; 1-RMSEA (90% CI)=0.99 (0.98, 0.99). Quadratic factor variances and the slope factor variance for dating violence were constrained to zero. Parameter estimates are standardized. Latent factor means, residual variances and fixed factor loadings not shown.
 ^ $p < .10$; * $p < .05$; ** $p < .01$; *** $p < .001$

**Paper 2: The Role of Heavy Alcohol Use in the Developmental Process of Desistance
from Dating Violence Perpetration during Adolescence**

Abstract

This study examined the role of heavy alcohol use in the developmental process of desistance from dating violence perpetration during adolescence. Using longitudinal data that spanned grades 8 through 12 we tested the hypotheses that (a) higher levels of early (baseline) heavy alcohol use would be associated with decreased deceleration from dating violence perpetration during late adolescence (launch hypothesis) and (b) higher levels of heavy alcohol use during time-points in late adolescence would be contemporaneously associated with elevated levels of dating violence perpetration at those same time points (snares hypothesis).

Contrary to the launch hypothesis, the effects of early heavy alcohol use on dating violence perpetration diminished over time such that, by late adolescence, early alcohol use was no longer associated with individual differences in dating violence perpetration levels. The contemporaneous effect of alcohol use on dating violence was significant across most grade levels and was significantly stronger in the spring than in the fall semesters. However, effects tended to diminish over time and, contrary to the snares hypothesis, the effect of alcohol use on dating violence was not significant in grade 12. Implications for prevention and for the developmental relations between alcohol use and dating violence are discussed.

Introduction

Studies of physical aggression (Farrell, 2005; Karriker-Jaffe, Foshee, Ennett & Suchindran, 2008), youth violence (Office of the Surgeon General, 2001; Sampson, Morenoff, & Raudenbush, 2005) and delinquency (Windle, 2000) suggest that these behaviors generally follow a curvilinear trajectory over time, in which perpetration increases up until middle (for physical aggression) or late (for violence and delinquency) adolescence and then drops off as adolescents transition into young adulthood. These studies further suggest that levels of and rates of acceleration and deceleration in antisocial behavior over time differ systematically across individuals. That is, while the normative pattern is one of increasing and then decreasing involvement in antisocial behavior over time, individual growth processes vary such that, for example, some individuals may report faster (or slower) rates of acceleration and/or deceleration relative to the average trajectory. In particular, researchers have posited that desistance (i.e., deceleration) in antisocial behavior over time is an individualized process that is influenced by individual and contextual risk and protective factors that may hinder or hasten the desistance process (Mulvey, et al., 2008).

Recently, findings from longitudinal studies of adolescent dating violence suggest that trajectories of physical perpetration follow a curvilinear trajectory similar to that of other antisocial behaviors, with levels increasing up until middle to late adolescence and decreasing thereafter (Foshee, et al., 2005; Foshee, et al., 2008; Foshee, Reyes, & Ennett, in press; Reyes, 2009). The finding that a similar developmental pattern holds across different forms of antisocial behavior suggests that similar factors may play a role in influencing processes of desistance from these behaviors over time. However, whereas

numerous studies have examined factors associated with desistance from antisocial behavior, only a handful of studies have examined trajectories of dating aggression (Foshee, et al. 2005; Foshee, et al., 2008; Foshee, et al., 2009; Reyes, 2009), and none of these have explicitly examined factors associated with desistance from dating violence.

One key risk factor that has been posited to influence the process of desistance in antisocial behavior is substance use, including heavy alcohol use. Specifically, elevated levels of substance use may act as a developmental snare (Moffitt, 1993), trapping individuals into elevated patterns of antisocial behavior during time periods when desistance is normative (Hussong, Curran, Moffitt, Caspi, & Carrig, 2004; Moffitt, 1993). For example, Hussong, Curran, Moffitt, Caspi, and Carrig (2004) found that both early and continuing substance abuse worked to hinder desistance from antisocial behavior during young adulthood. In the present article, we build from the work of Moffitt (1993) and Hussong et al. (2004) by examining the role of heavy alcohol use in desistance from physical dating violence perpetration using a multi-wave longitudinal sample of adolescents that spans grades 8 through 12. This time period captures the period of increase and desistance from dating abuse, as studies of adolescent dating violence have found that trajectories of physical perpetration tend to peak at age 16 or in the spring of 10th grade (Foshee, et al., 2008; Foshee, et al., 2009; Reyes, 2009).

Desistance from Antisocial Behavior and Dating Violence

Moffitt's (1993) theory of antisocial behavior specifically addresses the phenomenon of desistance from antisocial behavior during late adolescence and early adulthood. In particular, Moffitt's (1993) theory posits that most adolescents tend to desist from antisocial activities as they transition into young adulthood because the

consequences of involvement in these behaviors shift from rewarding to punishing. That is, whereas during early adolescence teens may view antisocial behavior as a means of acquiring mature social status and privilege, in late adolescence and early adulthood this view shifts as there is increasing recognition that involvement in antisocial behavior limits job and relationship opportunities.

Although Moffitt's (1993) theory of antisocial behavior does not refer explicitly to adolescent dating violence perpetration, many of the developmental forces that shape trajectories of antisocial behavior that the theory describes may also work to influence levels of dating violence perpetration over time. For example, consistent with Moffitt's theory, adolescents may initiate and increase their use of dating abuse during early to middle adolescence to mimic the abusive dating behaviors of antisocial youth who are perceived as more mature, autonomous, and experienced with dating and with sex (Moffitt, 1993, p. 687). That is, as with antisocial behavior, during early to middle adolescence teens may begin using dating abuse to acquire mature social status and privilege. In addition, dating abuse may increase during early to mid-adolescence because young teens have not yet developed skills related to interpersonal communication (Furman & Shomaker, 2008), conflict resolution (Furman & Shomaker, 2008; Larson, Clore, & Wood, 1999) and emotional control (Shulman, 2003) that are needed to navigate the complex challenges involved in establishing relations with the other sex, such as the negotiation of intimacy, connectedness, exclusivity and sexual desire.

During late adolescence, the same developmental forces that drive desistance from antisocial behavior may also influence desistance from dating violence. For example, over time adolescents gain social, emotional and intellectual maturity. As a

result, they become less susceptible to peer influence, less impulsive and emotionally reactive, and more oriented towards the future, all of which may work to encourage desistance from antisocial behavior, including dating violence (Mulvey, et al., 2004; Steinberg, 2008). In addition, as teens gain experience over time with interacting with the other sex, desistance from dating violence may occur due to increasing proficiency with the interpersonal communication and conflict resolution skills needed to maintain healthy relationships and/or due to accumulating experience with the negative consequences associated with the use of dating violence. In particular, teens may become increasingly aware of the negative influence of dating violence on their ability to initiate and maintain romantic relationships, a key developmental task (Furman & Shaffer, 2003; Sullivan, 1953).

As for other forms of antisocial behavior, developmental snares (e.g., substance abuse, interrupted education, incarceration), may work to hinder desistance from dating violence during adolescence. Specifically, snares can work to make it less likely that an adolescent will recognize the negative consequences of abusive behaviors, develop the interpersonal communication and conflict resolution skills needed to maintain healthy relationships, and/or reduce teen's access to and ability to take advantage of opportunities to take on conventional adult roles. In the following we explicate the specific role of substance use in desistance from dating violence perpetration, which is the focus of the current study.

The Role of Substance Use in Desistance from Dating Violence Perpetration

Based on Moffitt's (1993) notion of substance use as a developmental snare, Hussong et al. (2004) proposed that both early and continuing (time-varying) substance

abuse may be related to desistance from antisocial behavior over time. First, the authors suggest that baseline substance use/abuse may be an early marker that identifies individuals who are on a long-term course of elevated antisocial behavior. Applied to the current study, this reasoning suggests that heavy alcohol use during early adolescence may be symptomatic of a broader syndrome of involvement in antisocial behavior that has its roots in early childhood and is characterized by persistence across the lifespan. We posit that the violent behavior of these “life-course persistent antisocial” youth (identified based on their alcohol use early in adolescence) may generalize to their romantic relationships as they begin to date. This notion is consistent with the cultural spillover theory of criminal violence (Baron & Straus, 1984; Baron & Straus, 1987) and with the idea of heterotypic continuity in antisocial behavior over time (underlying continuity in dysfunction that manifests as different behavioral forms over time; Angold, Costello & Erklani, 1999; Rhule-Louie, 2007).

Moffitt’s (1993) theory further suggests that these life-course persistent antisocial teens experience numerous problems (e.g., neuropsychological dysfunction, cognitive impairment, deviant peer involvement and lack of opportunities to develop prosocial skills) that trap them into a deviant lifestyle and make it less likely they will be able to respond to the forces driving desistance from antisocial behavior, including dating violence, during late adolescence. In sum, this model of the relationship between substance use and desistance from dating violence behavior, called the “launch” model (Hussong, et al., 2004) views early adolescent heavy alcohol use as a marker that presages life-course persistence in dating violence behavior.

Hussong et al. (2004) also propose that substance use may have a proximal

influence on antisocial behavior that interferes with desistance during time periods of normative deceleration in antisocial behavior at the population level. This model, called the “snares model” (Hussong, et al. 2004), posits that elevated substance use exerts a short-term or time-specific effect on antisocial behavior, “such that the local effects of [substance use] alter the normative course of antisocial behavior when they or their sequelae are present” (p. 1032). The *snares* model is therefore concerned with the time-specific effects of substance misuse during time points when desistance is normative on levels of antisocial behavior at those same time points. Applied to this study, the *snares* model suggests that teens who report elevated levels of heavy alcohol use during time points in late adolescence will also report higher levels of involvement in dating violence perpetration than one would expect during those time points, given their overall pattern of dating violence involvement.

Several potential mechanisms may explain why heavy alcohol use during late adolescence may snare teens into elevated patterns of dating violence perpetration. First, heavy alcohol use is posited to be proximally related to aggression, including dating aggression, through its psycho-pharmacological effects on cognitive function (Klosterman & Fals-Stewart, 2006; Phil & Hoaken, 2002). In particular, intoxication can intensify feelings of excitement and curiosity, lead a person to overreact to perceived provocation, and decrease the saliency of cues that aggressive behavior will have negative consequences (i.e. threat inhibition), thereby increasing risk of confrontation and violence (Phil and Hoaken, 2002). Second, the acute and chronic effects of alcohol on cognitive function may decrease teens’ ability to recognize and adapt their behavior to reduce the negative consequences of dating violence and/or make it more difficult for

teens to recognize and take advantage of opportunities to adopt conventional adult roles (e.g., by increasing the likelihood of incarceration and interrupted education; Hussong, et al., 2004). Failure to adopt conventional adult roles, in turn, has been strongly associated with persistence in criminal and antisocial behavior. Third, evidence suggests that heavy alcohol use in late adolescence serves a social function (Bradizza, Reifman & Barnes, 1999), and may contribute to maintain relations with deviant peers who condone or encourage antisocial behavior (Hussong, et al., 2004), including abusive dating behavior.

In sum, both the *launch* and *snares* models suggest that heavy alcohol use may diminish the likelihood that an adolescent will respond to the developmental forces that normally work to extinguish antisocial behavior, including dating violence perpetration, during late adolescence. The *launch* model is concerned with early heavy alcohol use as a distal marker that explains inter-individual differences in trajectories of dating violence. In contrast, the *snares* model is concerned with the time-specific, intra-individual effects of substance use during time points of normative desistance on dating violence perpetration at those same time points. As suggested by the findings of Hussong, et al. (2004), both models may operate to influence processes of desistance from dating violence.

A better understanding of the relationship between alcohol use and desistance from dating violence perpetration may help inform dating violence prevention efforts. For example, if elevated levels of heavy alcohol use during early adolescence predict maintenance of elevated levels of dating aggression over time, it suggests that young teen alcohol users are an important target group for violence prevention efforts. Furthermore, if heavy alcohol use is proximally associated with elevated levels of dating violence at

time points during late adolescence, when perpetration tends to desist, it suggests the importance of prevention efforts that target alcohol-related dating violence among older adolescents and young adults.

The Current Study

Based on the models described above, the current study examined two primary hypotheses about the effect of heavy alcohol use on desistance from dating violence perpetration using longitudinal data from a multi-wave study of adolescents spanning grades 8 through 12. First, based on the *launch* model, we hypothesized that higher levels of heavy alcohol use during early adolescence would be associated with higher overall levels of dating violence and decreased deceleration from dating violence perpetration during late adolescence. Second, based on the *snares* model, we hypothesized that higher levels of heavy alcohol use during assessment points in late adolescence, when the normative pattern is one of desistance from dating violence, would be concurrently associated with higher levels of dating violence perpetration during those time points relative to an individual's expected level of dating violence perpetration. That is, the snares hypothesis predicts that higher levels of heavy alcohol use during late adolescence will result in time-specific elevations in perpetration levels, leading an individual to deviate off of their expected trajectory. Because research on dating violence suggests that some of the processes influencing dating violence perpetration may differ for boys and girls (Foshee, et al., in press, Foshee, et al., 2001), across both models we tested for sex differences in the pathways relating alcohol use to dating violence perpetration. In addition, we controlled for demographic and psychosocial risk factors associated with both alcohol use and dating violence perpetration.

Method

Participants

The sample for this study was drawn from a multi-wave cohort sequential examination of adolescent health risk behaviors that spanned middle and high school (National Institute on Drug Abuse, R01DA16669, S. T. Ennett, PI; Centers for Disease Control and Prevention, R49CCV423114, V. A. Foshee, PI). Dating violence was assessed beginning when participants were in the 8th, 9th and 10th grades. As such, the current study uses four waves of data starting when participants were in the 8th, 9th and 10th grades (wave one) and ending when participants were in the 10th, 11th, and 12th grades (wave four). Participants were enrolled in two public school systems located in two predominantly rural counties with higher proportions of African Americans than in the general United States (U.S. Census Bureau, 2001).

Data were collected at six-month time intervals for the first three waves and there was a one-year time interval between waves three and four. Table 4 depicts the data collection points for the study by grade level, cohort and wave of assessment. At each assessment all enrolled students in the targeted grades who were able to complete the survey in English and who were not in special education programs or out of school due to long-term suspension were eligible for the study. Parents had the opportunity to refuse consent for their child's participation by returning a written form or by calling a toll-free telephone number. Adolescent assent was obtained from teens whose parents had consented immediately prior to the survey administration. Trained data collectors administered the questionnaires in student classrooms on at least two occasions to reduce the effect of absenteeism on response rates. To maintain confidentiality, teachers

remained at their desks while students completed questionnaires and the students placed questionnaires in envelopes before returning them to the data collectors. The Institutional Review Board for the School of Public Health at the University of North Carolina at Chapel Hill approved the data collection protocols.

At wave one, 6% of parents refused consent, 6% of adolescents declined to participate and 8% were absent on the days when data were collected for a total of 2636 students completing a survey at wave one. The response rate, calculated as the proportion of adolescents who completed a survey out of those eligible for the survey at wave 1 was 79%. For this study, analyses excluded students who; (1) reported being out of the typical age range of 12-19 for the grades studied (n=33, 1%), (2) did not report their dating status (n=83, 3%), (3) reported never dating across all of the assessments (n=171, 6%) or (4) were missing data on the dating violence measures across all waves of the study (n=38, 1%), yielding a sample size of 2311. Nearly all students participated in at least two waves of data collection (n=2157, 93%), with 75% participating in 3 or more waves (n=1741).

Approximately half of the sample was male (47%) and the self-reported race/ethnicity distribution was 45% White, 47% Black and 8% other race/ethnicity. At wave one, 40% of participants reported that the highest education obtained by either parent was high school or less. Baseline prevalence of any heavy alcohol use in the past three months was 19% and prevalence of any physical dating violence perpetration in the past three months was 18%.

Measures

Measures included heavy alcohol use, physical dating violence perpetration, three demographic covariates (race, sex and parent education) and four psychosocial covariates

(family conflict, emotional distress, peer aggression and social bonding). The psychosocial covariates were included in analyses to control for potential confounding given that both theory and empirical evidence suggests that each of these variables are associated with both dating violence and alcohol use (Reyes, 2009). Measures of heavy alcohol use, dating violence and the four psychosocial covariates were collected at all waves. Time-invariant measures of heavy alcohol use and the psychosocial covariates were drawn from the baseline assessment for analyses of the *launch* hypothesis and time-varying measures were used for analyses of the *snares* hypothesis. Demographic control variables (race, sex and parent education) were time invariant.

Heavy alcohol use. Heavy alcohol use was assessed by four items asking adolescents how many times they had: 3 or 4 drinks in a row, 5 or more drinks in a row, gotten drunk or very high from drinking alcohol, or been hung over in the past three months. Each item had five response categories that ranged from 0 to 10 or more times. Responses to the four items were averaged to create a composite scale of heavy alcohol use (average Cronbach's $\alpha = .95$).

Physical Dating Violence Perpetration. Dating violence perpetration was measured each wave using a short version of the Safe Dates Physical Perpetration Scale (Foshee, et al., 1996). Adolescents were asked, "During the past 3 months, how many times did you do each of the following things to someone you were dating or on a date with? Don't count it if you did it in self-defense or play." Six behavioral items were listed: "slapped or scratched them," "physically twisted their arm or bent back their fingers," "pushed, grabbed, shoved, or kicked them," "hit them with your fists or with something else hard," "beat them up," and "assaulted them with a knife or a gun." Each

item had five response categories ranging from 0 to 10 times or more in the past three months. Responses were summed across items to create a physical dating violence perpetration scale measure (average Cronbach's $\alpha = .93$).

Psychosocial Covariates. We assessed *peer aggression* using six items that assessed how many times in the past three months the respondent had pushed, slapped or kicked someone, physically twisted someone's arm or bent back their fingers, hit someone with their fist or something else hard, beat someone up or assaulted someone with a knife or gun. Adolescents were specifically asked to exclude acts that they had perpetrated against a date. Scores were averaged across the items to create a composite scale of adolescent physical aggression (average Cronbach's $\alpha = .91$).

Family conflict was assessed by three items from Bloom's (1985) self-report measure of family functioning. Adolescents were asked how strongly they agreed or disagreed with the following three items when thinking about their family life in the past three months; we fight a lot in our family, family members sometimes get so angry they throw things and family members sometimes hit each other. Response options ranged from strongly agree (4) to strongly disagree (0). Items were averaged to create a measure of baseline exposure to family violence (average Cronbach's $\alpha = .87$).

Emotional distress was measured as a composite of three scales assessing anger, anxiety and depression in the past three months. Anger was assessed by three items drawn from the revised Multiple Affective Adjective Checklist (MAACL-R) that asked adolescents how often they felt mad, angry or furious in the past three months (Zuckerman & Lubin, 1985). Four response categories ranged from never or almost never to almost always. Anxiety was measured using a shortened version of the Revised

Children's Manifest Anxiety scale (Reynolds & Richmond, 1979) and depression was measured using three items from the Short Mood and Feelings Questionnaire (Angold, Costello, & Messer, 1995). Both anxiety and depression were assessed by presenting adolescents with a list of statements describing how they may have felt in the past 3 months. The statements listed seven symptoms of anxiety (e.g., I felt sick to my stomach) and three symptoms of depression (e.g., I did everything wrong). Each item had five response categories that ranged from strongly disagree to strongly agree. Items were averaged to create a scale score for each construct. At each wave Cronbach's alphas were satisfactory for each of the individual subscales (average $\alpha = .89$ for anger, $\alpha = .89$ for anxiety, $\alpha = .92$ for depression) and subscale scores were significantly correlated ($p < .001$ for all correlations). A composite measure of emotional distress was created by standardizing and averaging subscale scores.

Social bonding was operationalized to be consistent with Hirschi's (1969) social control theory (SCT). According to this theory social bonds play a key role in deterring antisocial behavior by encouraging conformity to conventional values and attitudes. Following the definition of social bonding suggested by SCT, degree of social bonding was assessed as a composite of teen's endorsement of conventional beliefs, commitment to pro-social values, and degree of religiosity. Endorsement of conventional beliefs was measured by asking adolescents how strongly they agreed or disagreed with the following statements; it is good to be honest, people should not cheat on tests and, in general, police deserve respect. Commitment to pro-social values was measured by assessing how important or unimportant adolescents felt it is to: finish high school, go to college, have a happy family life and have a close group of friends. Degree of religiosity was assessed by

three items assessing frequency of religious service attendance, the importance of religion to the adolescent and the extent to which religious beliefs influence the adolescent's actions. The items assessing conventional beliefs, prosocial values and religiosity all had at least four response option categories. Items were averaged to create a scale score for each construct. Cronbach's alphas for each of the individual scales were acceptable (average $\alpha = .75$ for prosocial values, $\alpha = .72$ for conventional beliefs, $\alpha = .78$ for religiosity), and subscale scores were significantly correlated ($p < .001$ for all correlations). A composite measure of social bonding was created by standardizing and averaging subscale scores.

Demographic covariates. Sex was coded such that 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, and other race/ethnicity (including Latinos). Parent education ranged from less than high school (0) to graduate school or more (5) and was measured as the highest education attained by either parent at baseline. Family structure (two parent vs. other) was also examined as a potential control variable but was not found to be significantly associated with trajectories of alcohol use or dating violence and its inclusion in the models did not change the pattern of findings, therefore family structure was not included in the analyses reported below. Grade level was used as the primary metric of time and ranged from grade 8 (0) to grade 12 (4).

Analytic Approach

The overarching goal of this study was to examine the early and continuing effects of heavy alcohol use on processes of desistance from dating violence perpetration

over time. To address this goal, we used multilevel growth curves to model the effects of baseline and time-varying measures of heavy alcohol use on trajectories of dating violence perpetration across grades 8 through 12. Data analysis occurred in several phases involving the reorganization of data based on grade rather than wave, imputation of missing data, centering of variables, estimation of unconditional trajectories of dating violence perpetration and hypothesis testing.

First, to take advantage of the cohort sequential design of this study, data were reorganized such that the grade level of the child was used as the primary metric of time rather than wave of assessment (see Table 4). This allowed for trajectories to be continuously modeled across grades eight through twelve. After combining across cohorts and reorganizing the data by grade, information was available across eight discrete data points: grade 8 fall (n=795), grade 8 spring (n=795), grade 9 fall (n=1586), grade 9 spring (n=791), grade 10 fall (n= 2311), grade 10 spring (n=725), grade 11 fall (n=1516) and grade 12 fall (n=725). In previous analyses using this sample we found no evidence of cohort differences in dating violence perpetration growth trajectories, suggesting that data from each of the cohorts could be combined to estimate a single developmental curve across grades 8 through 12 (Reyes, 2009). We also note that descriptive analyses of the data organized by grade suggested that correlations between heavy alcohol use and dating violence were stronger in the spring than in the fall semesters. Consequently we included an interaction between heavy alcohol use and semester in our testing of the *snares* model (described further below).

Next, we addressed the issue of missing data in our time-invariant and time-varying covariates through multiple imputation (Rubin 1987) using SAS PROC MI (SAS

Institute, 2003). Following standard recommendations (Rubin 1996), the imputation equation included all of the independent covariates and dependent variables assessed at each of the eight grade levels. Ten sets of missing values were imputed using multiple chain Markov Chain Monte Carlo methods. Models were fit to each of the ten imputed datasets and parameter estimates and standard errors were combined using SAS PROC MIANALYZE (SAS Institute, 2003), which implements the procedures developed by Rubin (1987) to ensure that statistical inference takes into account uncertainty in the imputation process.

As noted earlier, whereas the *launch* hypothesis is concerned with the distal between-person effects of early heavy alcohol use on trajectories of dating violence perpetration, the *snares* hypothesis is concerned with the within-person, time-varying effects of heavy alcohol use on the repeated measures of dating violence perpetration at each grade level. We followed the recommendations of Raudenbush and Bryk (2002, p. 183) for centering time-invariant and time-varying variables to ensure that our measures of early heavy alcohol use (drawn from wave 1) and time-varying alcohol use (drawn from all waves) did not confound between- and within-person effects. Specifically, wave one heavy alcohol use was centered at the sample mean (grand-mean centered) and time-varying heavy alcohol use was person-mean centered. Similarly, across all models all other time-invariant covariates were grand-mean centered and time-varying covariates were person-mean centered, with the exception of grade level, which was centered at grade 8.

We next used a multilevel growth modeling approach to examine the functional form and error structure of unconditional trajectories characterizing dating violence

perpetration behavior across grades 8 through 12. We compared the fit of flat, linear, spline and quadratic models and examined models with different specifications of the random effects and residual error structure. The Bayesian Information Criterion, multivariate Wald tests and component fit were used to determine the best-fitting model. Similar preliminary analyses using the same dataset are reported in Reyes (2009) and are not the focus of the current study. As such, we briefly present the replication of this trajectory analysis and refer the reader to our previous study for more detail on our process for determining the best-fitting trajectory model for dating violence perpetration. We also note that preliminary analysis using this sample reported in Reyes (2009) found that dependence induced by nesting of students within schools is negligible (average Intraclass Correlation $< .01$, average Design Effect < 2.00) and that adjusting for nesting had no effect on the growth factor means or variances. As such the models reported below do not account for the nested structure, but are likely not biased by this omission.

To test the *launch* and *snares* hypotheses we estimated a series of conditional multilevel models. The *launch* hypothesis was tested by formulating a conditional model that included wave one heavy alcohol use and the interactions of alcohol use with grade and grade-squared. This model produced parameter estimates that denoted the effects of wave one heavy alcohol use on: (1) initial levels of dating violence perpetration (intercept effect denoted by the main effect of alcohol use), (2) initial linear increases in perpetration (slope effect denoted by the interaction of alcohol use with grade) and (3) deceleration in perpetration (quadratic effect denoted by the interaction of alcohol use with grade-squared). Demographic covariates and wave one measures of the psychosocial covariates were included as control variables. The potential for sex differences in the

effects of early heavy alcohol use was examined by including interaction terms between (1) sex and alcohol use, (2) sex, alcohol use and grade and (3) sex, alcohol use and grade-squared. A multivariate Wald test was used to assess test the joint contribution of the interaction terms to the model.

The *snares* hypothesis was tested by formulating a conditional model that included time-varying heavy alcohol use as a predictor of the repeated measures of dating violence perpetration. Demographic and time-varying psychosocial covariates were included in the model as control variables. To clarify the role of time-varying covariates in random coefficients (multilevel) growth models it helps to first consider the unconditional model in which time (grade in this case) is used to predict variance in the repeated measures of the outcome (dating violence perpetration). The unconditional growth model assumes that the repeated measures of perpetration are completely governed by the underlying trajectory process, which is driven by grade-level (Curran & Willoughby, 2003). As such, deviations of the repeated measures of perpetration from the underlying trajectory are treated as residual error. That is, across each grade-level and for each individual, there is some residual variance between the observed level of the outcome and the predicted level of the outcome based on time. This residual variance is treated as error in the unconditional model. Analytically, the *snares* model suggests that this residual variance may be explained, in part, by time-specific measures of heavy alcohol use. In particular, the model posits that a significant proportion of residual variance in measures of perpetration assessed at time points during late adolescence will be explained by heavy alcohol use at those same time points.

Our initial *snares* model included a main effect for the time-varying heavy

alcohol use measure as well as the demographic and psychosocial controls. This model produced a parameter estimate for heavy alcohol use that indexed the average within-person effect of heavy alcohol use at each grade on dating violence perpetration at each grade. This initial model assumed that the within-person effect of heavy alcohol use on dating violence perpetration was the same at each grade. We next examined variability in the effects of heavy alcohol use over time by including interaction terms between heavy alcohol use and grade and between heavy alcohol use and semester. The interaction between heavy alcohol use and grade indexed linear change in the effect of alcohol use as grade-level increases. For example, in the context of a significant main effect for heavy alcohol use on the repeated measures of dating violence perpetration, a significant positive interaction between heavy alcohol use and grade would indicate that the effect of heavy alcohol use on dating violence perpetration tended to increase over time. A significant negative interaction would indicate that the within-person effects of heavy alcohol use on dating violence perpetration tended to decrease over time.

Because preliminary descriptive analyses suggested that correlations between heavy alcohol use and dating violence were stronger in the spring than in the fall semesters, we also examined the interaction between heavy alcohol use and semester in predicting dating violence perpetration where semester was coded as “0” for the fall semester and “1” for the spring semester. A significant positive interaction between heavy alcohol use and semester would indicate that the within-person effects of heavy alcohol use on dating violence perpetration were stronger in the spring semesters than in the fall semesters. A multivariate Wald test was used to test the joint significance of the interactions of semester and grade with heavy alcohol use.

Finally, we examined the potential for sex differences in the time-varying effects of heavy alcohol use by including 2- and 3-way interaction terms between sex and; (1) heavy alcohol use, (2) heavy alcohol use and grade, and (3) heavy alcohol use and semester. Again, a multivariate Wald test was performed to test the joint significance of the interaction terms.

Results

The unconditional model describing the average trajectory of physical dating violence perpetration is presented in Column 1 of Table 5. Replicating previous analyses (Reyes, 2009), the best fitting model was quadratic in the fixed effects, included a random intercept and allowed for heteroscedastic residual variance over time. The model-implied mean trajectory for the sample suggests that the developmental trajectory for dating violence perpetration first increases during early adolescence, peaks at the end of grade 10, and then desists during late adolescence. Further, the variance estimate for the intercept indicated significant individual variability in initial levels of dating violence perpetration ($b=0.09$, $p<.001$). Residual variances in the repeated measures of perpetration were significant across all grade levels at $p<.001$, indicating that there was substantial variability in the repeated measures of perpetration that was not explained by the underlying trajectory process.

Launch. Parameter estimates from the *launch* model are presented in Column 2 of Table 5. Heavy alcohol use was significantly positively associated with the trajectory intercepts ($b =0.23$, $p<.001$), significantly *negatively* associated with the linear trajectory component ($b=-0.11$, $p<.001$), and significantly positively associated with the quadratic trajectory component ($b=0.01$, $p<.05$). There was no evidence of sex differences in this

pattern of effects ($F(3)=1.22$; $p=.30$). The pattern of results from the *launch* model is graphically depicted in Figure 3, where we plot the model-implied mean trajectories of dating violence perpetration for individuals who at baseline reported no heavy alcohol use, average levels of heavy alcohol use and high levels of heavy alcohol use (set as +1 standard deviation above the mean). On average, individuals who reported high levels of heavy alcohol use at baseline tended to report relatively high levels of perpetration early in adolescence, but their levels of perpetration diminished significantly over time such that, by late adolescence, the perpetration levels for these adolescents did not differ from individuals who reported no heavy alcohol use in early adolescence.

Although the effect of heavy alcohol use on the quadratic term, which indexes deceleration in perpetration, indicates that desistance in perpetration during late adolescence is slower for adolescents who report higher levels of early alcohol use (consistent with our hypothesis), the effect is fairly weak ($b=0.01$), and is not strong enough to offset the significant negative effect of early alcohol use on initial rates of acceleration (i.e., the linear trajectory component; $b=-0.11$). As such, taken together, the results from the model suggest that the distal effects of heavy alcohol use on dating violence perpetration diminished over time such that, by late adolescence, baseline levels of heavy alcohol use no longer explained individual differences in levels of dating violence perpetration (see Figure 3). Accordingly, findings are not consistent with our hypothesis that heavy alcohol use early in adolescence identifies youth who are on a long-term course of persistent dating violence behavior across grades 8 through 12 (the *launch* hypothesis).

Snares. The results of the *snares* models are presented in Table 6. There was a

significant positive main effect of the time-varying measure of heavy alcohol use on dating violence perpetration ($b=0.13$, $p<.001$), and there were significant interactions between heavy alcohol use and both grade ($b=-0.03$, $p<.05$), and semester ($b=.08$, $p<.05$). Again, there were no sex differences in the pattern of effects ($F(3)=0.55$; $p=.65$). In the context of the positive main effect for alcohol use, the negative interaction of alcohol use with grade suggests that the strength of the proximal (within-grade level) effect of heavy alcohol use on dating violence perpetration diminished as grade level increased. In contrast, the significant positive interaction between alcohol use and semester suggests that the strength of the proximal effect of heavy alcohol use on repeated measures of perpetration was stronger in the spring than in the fall semesters.

To further probe these interactions we modified the model so that the variable indexing grade level in the interaction with heavy alcohol use was treated as a categorical classification variable. That is, rather than treat grade level as a continuous variable in the interaction with heavy alcohol use, we treated it as a categorical variable with eight different levels (grade 8 fall, grade 8 spring, grade 9 fall, etc.).² This enabled us to produce separate parameter estimates for the effect of heavy alcohol use on dating violence perpetration within each grade level. The results of this model are graphically presented in Figure 4, which shows the parameter estimates and 95% confidence intervals for the effects of heavy alcohol use on dating violence perpetration within each grade-level. The findings suggest that teens who reported elevated levels of heavy alcohol use also reported higher levels of dating violence perpetration than one would expect given their overall pattern of perpetration, across all but two grade-time points (grade 10 fall

² While this approach is not typically used with random coefficients growth models, it is quite standard for closely related latent curve models that use a structural equation modeling approach.

semester and grade 12 fall semester). As suggested by the significant interaction terms between grade and heavy alcohol use and semester and heavy alcohol use, parameter estimates for the effect of heavy alcohol use on perpetration were generally higher in the spring than in the fall semesters but tended to decrease in strength over time. This pattern of results provides limited support for our hypothesis that heavy alcohol use in late adolescence snares teens into elevated levels of perpetration during time-periods of normative desistance. That is, consistent with the *snares* hypothesis, heavy alcohol use was related to elevated levels of perpetration in grades 10.5 and 11, when perpetration levels top off and begin to decline; however, contrary to expectations, no effects were found in grade 12.

Other Findings. We also note that the pattern of covariate effects in both the *launch* and *snares* models were generally consistent with the dating violence literature. In the *launch* model demographic and wave one psychosocial covariates were included as predictors of trajectory intercepts, slopes and quadratic factors. Findings suggest that initial levels of perpetration were higher for females than for males ($p < .001$) and for Blacks than for Whites ($p < .001$). In addition, initial levels of perpetration were positively associated with baseline peer aggression ($p < .001$) and negatively associated with baseline social bonding ($p < .01$). Parent education, baseline family conflict and baseline emotional distress were not associated with initial levels of perpetration. Furthermore, none of the demographic or psychosocial covariates predicted individual differences in rates of change (i.e. slopes, quadratic factors) in dating violence perpetration. In the *snares* model the psychosocial covariates were treated as within-person, time-varying predictors of dating violence perpetration. In these models, higher levels of family conflict ($p < .05$),

emotional distress ($p=.05$) and peer aggression ($p<.001$) were positively associated with levels of dating violence perpetration, and higher levels of social bonding ($p<.001$) were negatively associated with perpetration levels.

Discussion

Overall, results suggest that both early (baseline) and continuing (time-varying) heavy alcohol use are significantly related to higher levels of adolescent dating violence perpetration (particularly during early adolescence) even after controlling for psychosocial variables that have been associated with both behaviors, including family conflict, social bonding, emotional distress and peer aggression. Moreover, across all models, the effects of alcohol use on dating violence perpetration did not vary by sex. However, findings do not fully support our two primary hypotheses that both early (the *launch* hypothesis) and time-varying (the *snares* hypothesis) heavy alcohol use hinder desistance from dating violence perpetration during late adolescence. Findings related to each of the two hypotheses will be discussed in turn.

Launch. As applied to the current study, the *launch* hypothesis posits that heavy alcohol use during early adolescence is an indicator of a broader pattern of involvement in antisocial behavior that begins in childhood, generalizes into dating violence as teens begin to date, and then persists across late adolescence, when the normative pattern is one of desistance from dating violence. As such, we expected that higher levels of early (wave one) heavy alcohol use would be associated with higher levels of dating violence perpetration across grades 8 through 12. The findings of the current study do not fully support this hypothesis. Although higher levels of heavy alcohol use at baseline were associated with higher levels of perpetration in early and middle adolescence (consistent

with our hypothesis), effects faded over time such that, by late adolescence, early heavy alcohol use was no longer predictive of individual differences in levels of dating violence perpetration (contrary to our hypothesis). Following, we propose several potential explanations for this finding.

First, early adolescent heavy alcohol use alone may not be a sufficiently precise indicator of life-course persistent involvement in antisocial behavior, including dating violence. Indeed Moffitt's (1993) theory describes a number of early, cumulative and continuing forces (e.g., genetic factors, neurologic dysfunction, child maltreatment) that together with heavy alcohol use may contribute to set adolescents on a trajectory of life-course persistence in antisocial behavior. As such, there may be some heterogeneity in the types of teens who engage in heavy alcohol use during early adolescence such that, for teens with multiple risk factors (e.g., child maltreatment, neurologic dysfunction), early heavy alcohol use presages a life-course persistent pattern of antisocial behavior (as we hypothesized), whereas for others early heavy alcohol use may be indicative of a more short-term pattern of early involvement in problem behavior, including dating violence, that desists across middle and late adolescence. Accordingly, we recommend that future studies of the *launch* model examine interactions among multiple risk factors measured during childhood and early adolescence in predicting patterns of desistance from dating violence perpetration over time.

A second explanation for the diminishing effects of early heavy alcohol use on levels of dating violence perpetration over time is developmental. Specifically, while it is clear that early experiences have an effect on later psychopathology, researchers have suggested that their influences are likely mediated, moderated and sometimes reversed by

later, more proximal, experiences (Schulenberg, Sameroff & Cicchetti, 2004). Indeed, research on developmental risk factors for youth violence (Herrenkohl, et al., 2000) and delinquency (Whites, Bates, & Buyske, 2001) suggests that proximal risk factors may have stronger effects than distal risk factors in predicting persistence in antisocial behavior over time. In the context of the current study, this reasoning suggests that the influence of early heavy alcohol use on trajectories of dating violence may diminish over time because other, more proximal, experiences gain importance in distinguishing levels of dating violence perpetration during late adolescence.

A third explanation for the pattern of findings in the *launch* model is that, over time, individuals who engage in heavy alcohol use early in adolescence may tend to date less frequently and therefore have fewer opportunities to engage in abusive dating behaviors. Although there is no research available to support this notion, it is possible that early heavy alcohol users may increasingly be seen as unattractive to potential romantic partners. Unfortunately while individuals who did not date across the study period were eliminated from the analysis sample for this study, we did not measure dating frequency and therefore could not control for this variable in our analyses.

Snares. As applied to the current study, the *snares* hypothesis posits that higher levels of heavy alcohol use during assessment points in late adolescence, when the normative pattern is one of desistance from dating violence, will be concurrently associated with higher levels of dating violence perpetration during those time points relative to an individual's expected level of dating violence perpetration. The findings from this study provide limited support for this hypothesis. In particular, consistent with our hypothesis, heavy alcohol use was significantly positively associated with dating

violence perpetration across most of the grade-time points assessed in the study, including in grades 10.5 and 11 when dating violence perpetration slows and then begins to desist. This finding is consistent with the notion that heavy alcohol use during late adolescence can actively hinder the desistance process, snaring individuals into elevated levels of perpetration during time periods of normative deceleration.

However, contrary to expectations, we also found that the proximal effect of heavy alcohol use on dating violence perpetration at each time point tended to diminish as grade level increased, and was not significant in grade 12. This finding is consistent with results from longitudinal studies of adolescent alcohol use and non-dating aggression that have also found that the strength of the correlation between the two behaviors tends to diminish over time (e.g., Huang, White, Kosterman, Catalano, & Hawkins, 2001; White, Loeber, Stouthamer-Loeber, & Farrington, 1999).

Perhaps these findings can be explained by developmental changes in teens' levels of aggressive inhibitions and/or their self regulatory capacities (Steinberg, 2008). In particular, researchers focused on the direct effects of alcohol use on aggression (i.e., the pharmacological effects of intoxication) have suggested that cognitive (e.g., acceptance of dating violence), social (e.g., friends' acceptance of dating abuse) and neuropsychological (e.g., ability to generate non-aggressive responses to provocative situations) factors may work synergistically with alcohol use to lower aggressive inhibitions and increase the likelihood of violent behavior (Chermack & Giancola, 1997; Klosterman & Fals-Stewart, 2006; Parker & Auerhahn, 1998). We reason that, as dating violence perpetration becomes increasingly non-normative during late adolescence, teens' acceptance of dating violence may decrease and their ability to appropriately

respond to (due to increased self-regulatory capacities; Steinberg, 2008) and resolve conflict (due to accumulating experience with interacting with romantic partners; Schulman, 2003) may increase, contributing to higher inhibitions against the use of dating violence and leading to a weakening of the overall relationship between alcohol use and use of dating violence.

The pattern of results from the snares model could also reflect changes in the risk profile that characterizes heavy alcohol users over time. That is, during early adolescence, when heavy alcohol use is non-normative, teens who are involved in heavy alcohol use may generally tend to have aggressive perceptual and behavioral propensities (i.e. they may have relatively low inhibitions against the use aggression), thereby increasing the likelihood that the disinhibiting effects of alcohol use will lead to dating aggression. In contrast, during late adolescence alcohol use becomes increasingly normative. As such, older teen heavy alcohol users may be a much more heterogeneous group than younger teens in terms of their aggressive inhibitions, weakening the overall relationship between heavy alcohol use and dating violence perpetration.

Finally, we note that the *snares* model suggests an interesting pattern of periodicity in the effects of heavy alcohol use on dating violence perpetration such that effects tended to be stronger in the spring than in the fall semesters. Adolescent suicide and homicide have also been found to vary across seasonal periods, such that homicide event rates are highest near the start of the fall and spring semesters and suicide event rates are highest during the spring semester (Centers for Disease Control and Prevention [CDC], 2001). In the current study, our fall assessment covered the period from August through October and our spring assessment covered the period from January through

March. One potential explanation for the pattern of effects is that over the course of the school year teens renew, develop and solidify social relations with their peers and romantic partners such that by the spring semester they have increased exposure to social opportunities in which dating violence and heavy alcohol use co-occur. Also, romantic relationships that develop in the fall and persist into the spring semester may be characterized by greater commitment and intimacy (including, for example, sexual intimacy) that may intensify alcohol-related conflict and lead to greater risk of alcohol-related dating violence. While we are reluctant to put too much emphasis on this finding given that it was unearthed as part of the modeling process and was not hypothesized *a priori*, the findings from this study suggest that researchers and practitioners should pay attention to the potential for seasonal differences in the relationship between alcohol and dating abuse.

Limitations and Future Directions

The current study has several important limitations that should be noted. First, although our hypotheses suggest a direction of influence from alcohol use to dating violence perpetration, our study was not designed to distinguish amongst the various causal mechanisms that may explain covariation between alcohol use and dating violence, which include the causal influence of alcohol use in leading to dating violence, the causal influence of dating violence in leading to alcohol use and covariance due to common risk factors. Although our models do control for shared risk factors, because of the contemporaneous nature of the predictions implied by the snares hypothesis and how the questions were asked, we cannot infer causality or temporal ordering between alcohol

use and dating violence nor can we determine whether adolescents were drinking at the time of their involvement in dating violence perpetration.

Second, while the time-span encompassed by this study (grade 8 fall to grade 12 fall) includes much of the adolescent developmental period, we did not assess teens during the spring of grades 11 or 12 or during the transition to young adulthood. As such, there were a limited number of assessment points during the period when the normative pattern is one of desistance from dating violence. Indeed, the periodicity findings suggest that we might have found stronger evidence for the *snares* model had we included assessment points in the spring semesters of grades 11 and 12. Future longitudinal research should build on the current study by examining the relationship between alcohol use and dating violence perpetration across multiple time points during late adolescence and the transition to young adulthood.

Finally, our study examined the influence of only one type of substance use (heavy alcohol use) on processes of desistance from dating violence perpetration. However, research suggests that other types of substance use (e.g., marijuana use, hard drug use) are associated with partner violence perpetration (Moore, et al., 2008) and with processes of desistance from antisocial behavior (Hussong, et al., 2004). Future research should expand on the current study by examining the individual and combined effects of other types of substance use on desistance from dating violence perpetration.

Implications

To our knowledge, the current study is the first to examine the role of alcohol use in influencing processes of desistance from adolescent dating violence perpetration. By using a growth modeling approach we were able to distinguish between the distal and

time-varying effects of heavy alcohol use on levels of dating violence perpetration over time. Findings suggest that interventions that prevent or reduce heavy alcohol use during early adolescence may also reduce dating violence perpetration during early and middle adolescence by both boys and girls. In addition, prevention efforts that target heavy alcohol use during late adolescence may reduce dating violence perpetration among older teens, hasten desistance and facilitate the transition from adolescence to young adulthood. Results also suggest that school personnel and practitioners implementing programs designed to prevent alcohol-related dating violence should be aware that the spring semester may be the period of highest risk, though more research is needed to corroborate these findings.

Finally, our findings highlight the importance of applying a developmental perspective to increase understanding of how the interrelations among health risk behaviors and their determinants are embedded in the life-course (Cicchetti & Rogosch, 2002). In particular, contrary to the notion that perpetrators of physical dating violence during adolescence will inevitably end up perpetrating partner violence during young adulthood, accumulating evidence suggests that, on average, physical dating violence perpetration tends to desist during late adolescence (Foshee, et al., 2005; Foshee, et al., 2008; Foshee, in press; Reyes, 2009). A better understanding of this developmental pattern, which mirrors that of other antisocial behaviors, will require more theorizing and research into the mechanisms that explain this normative shift towards desistance from dating violence and further study of both the distal and proximal risk and protective factors that may influence the desistance process during adolescence and young adulthood.

Table 4. Study Assessment Points by Grade, Cohort and Data Collection Wave

Grade	Semester	Cohort	Cohort	Cohort
		1 n=795	2 n=791	3 n=725
8	Fall	Wave 1	--	--
8.5	Spring	Wave 2	--	--
9	Fall	Wave 3	Wave 1	--
9.5	Spring	--	Wave 2	--
10	Fall	Wave 4	Wave 3	Wave 1
10.5	Spring	--	--	Wave 2
11	Fall	--	Wave 4	Wave 3
12	Fall	--	--	Wave 4

Table 5. Results for the Unconditional Trajectory Model and for the Conditional (Launch) Model of the Effects of Early Heavy Alcohol Use on Trajectories of Dating Violence Perpetration

Parameter	Model	
	Unconditional	Launch
<i>Fixed effects</i>		
Intercept	0.20 (.02)***	0.23 (.03)***
Grade	0.07 (.02)**	0.05 (.03)
Grade*Grade	-0.02 (.01)**	-0.01 (.01)
Heavy alcohol use	--	0.23 (.03)***
Heavy alcohol use*grade	--	-0.11 (.03)***
Heavy alcohol use*grade*grade	--	0.01 (.01)*
<i>Random effects</i>		
Intercept	0.09 (.01)***	0.05 (.01)***

Note: The unconditional model constrained the random effects for the slope (grade) and quadratic (grade*grade) factors to zero. Residual errors were allowed to vary over time and were significant ($p < .001$) across all grade levels. In the *launch* model early (baseline) heavy alcohol use was grand-mean centered and demographic (race, sex and parent education) and baseline psychosocial covariates (family conflict, emotional distress, social bonding, and peer aggression) were included as controls.

* $p < .05$; ** $p < .01$; *** $p < .001$

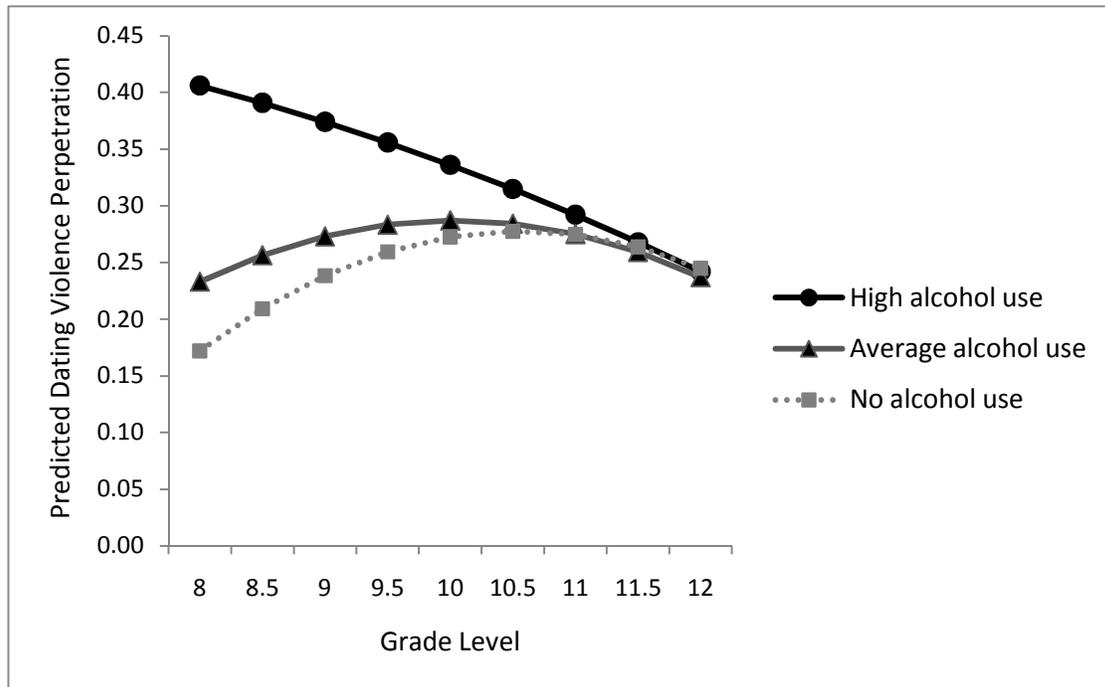
Table 6. Results for the Conditional (Snares) Model of the Contemporaneous Effects of Heavy Alcohol Use on Dating Violence Perpetration across Grades 8 through 12.

Parameter	b (se)
Intercept	0.23 (.03)***
Grade	0.04 (.03)
Grade*Grade	-0.01 (.01)
Heavy alcohol use	0.13 (.03)***
Heavy alcohol use*grade	-0.03 (.01)*
Heavy alcohol use*semester	0.08 (.03)**

Note: Random effects for the slope (grade) and quadratic (grade*grade) factors were constrained to zero. Residual errors were allowed to vary over time and were significant ($p < .001$) across all grade levels. Alcohol use was time-varying and was person-mean centered. The model controlled for demographic (race, sex and parent education) and time-varying psychosocial (family conflict, emotional distress, social bonding, and peer aggression) covariates.

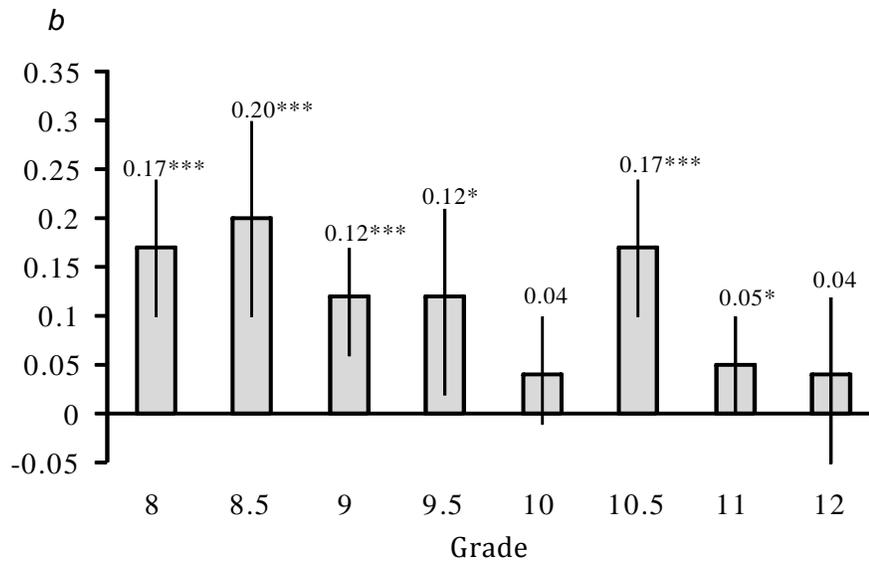
* $p < .05$; ** $p < .01$; *** $p < .001$

Figure 3. Predicted Mean Trajectories of Dating Violence Perpetration across Grades 8 through 12 at Different Levels of Early (Baseline) Heavy Alcohol Use.



Note: To produce the predicted mean trajectories baseline heavy alcohol use was set at zero (no alcohol use), the sample mean at baseline (mean alcohol use) and one standard deviation above the mean (high alcohol use). The model controls for demographic (race, sex and parent education) and psychosocial (family conflict, peer aggression, social bonding, emotional distress) covariates.

Figure 4. Regression Coefficients and 95% Confidence Intervals for the Contemporaneous Effects of Heavy Alcohol Use on Dating Violence Perpetration across Grades 8 through 12.



Note. Heavy alcohol use is time-varying and person-mean centered. The model controls for demographic (race, sex, parent education) and time-varying psychosocial (family conflict, peer aggression, social bonding, emotional distress) covariates.

* $p < .05$; ** $p < .01$; *** $p < .001$

**Paper 3: Alcohol Use and Dating Violence Perpetration during Adolescence:
Exposure to Family, Peer and Neighborhood Violence as Moderators**

Abstract

We examined the hypothesis that increased exposure to family, peer or neighborhood violence would strengthen the relationship between heavy alcohol use and physical dating violence perpetration during adolescence. Random coefficients growth models were used to examine the main and joint effects of heavy alcohol use and four measures of violence exposure (family violence, friend dating violence, friend peer violence and neighborhood violence) on levels of physical dating violence perpetration across grades 8 through 12. Consistent with expectations, findings indicate that, across all grades, the relationship between heavy alcohol use and dating violence perpetration was stronger for teens exposed to higher levels of family conflict and friend dating violence. However, neither exposure to friend peer violence nor exposure to neighborhood violence moderated the relation between alcohol use and dating violence. Taken together, findings suggest that, as adolescents grow older, moderators may play an increasingly important role in explaining individual differences in the relation between alcohol use and dating violence. Implications for the design and evaluation of dating abuse prevention programs are discussed.

Introduction

Numerous studies have documented a consistent and robust link between alcohol use and adult intimate partner violence (for reviews, see Foran & O’Leary, 2008; Lipsey, Wilson, Cohen & Derzon, 1997; Testa, 2004). The predominant theoretical explanation for this association, often called the proximal effects model (Leonard & Quigley, 1999), suggests that alcohol intoxication plays a causal role in increasing risk of partner aggression through its psychopharmacological effects on cognitive function (Murphy, Winters, O’Farrell, Fals-Stewart, & Murphy, 2005). Specifically, alcohol intoxication can impair information-processing capacity, lead a person to overreact to perceived provocation and decrease the saliency of inhibitory cues, thereby increasing risk of violence (Phil and Hoaken, 2002).

Although accumulating evidence from different lines of research provides strong support for the proximal effects model (e.g., see Fals-Stewart, 2003; Murphy, et. al, 2005), studies also indicate that for many individuals heavy drinking does not culminate in partner aggression (Kantor, & Straus, 1987; Schumaker, Fals-Stewart, & Leonard, 2003), and that aggression may occur in the absence of alcohol use (Fals-Stewart, 2003; Kantor, & Straus, 1990; Quigley & Leonard, 2000). Taken together these findings suggest that other factors may moderate the relation between alcohol use and partner violence. Indeed, several investigators have posited that the relation between the two behaviors likely varies considerably as a function of both individual (e.g., temperament, cognitive functioning), and contextual or situational (e.g., setting, relationship type) characteristics (Chermack & Giancola, 1997; Foran & O’leary, 2008; Klosterman & Fals-Stewart, 2006; Lipsey, Wilson, Cohen, & Derzon, 1997; Parker & Auerhahn, 1998).

Despite a compelling empirical rationale for examining factors that may moderate the relationship between alcohol use and partner violence, few studies have done so (Foran & O’leary, 2008; Klosterman & Fals-Stewart, 2006; Schumacher, Homish, Leonard, Quigley, & Kearns-Bodkin, 2009). Moreover, to our knowledge, no studies have examined moderators of the relationship between alcohol use and dating violence during adolescence. Adolescence is an important developmental period for studying the relation between alcohol use and dating violence given that both behaviors initiate and then become increasingly prevalent during this period and both can have serious negative consequences for health and well-being (Ackard, Eisenberg & Neumark-Sztainer, 2007; Chassin, et. al, 2004; Roberts, Klein & Fisher, 2003; Windle & Windle, 2004). Furthermore, patterns of relationship conflict that are established during this period may carry over into young adulthood (Bouchey & Furman, 2003; Gidycz, Orchowski, King & Rich, 2008; Magdol, Moffitt, Caspi & Silva, 1998; Smith, White & Holland, 2003). As such, a better understanding of how alcohol use and other risk factors act together to contribute to dating violence may inform primary prevention efforts that reduce levels of partner violence perpetration across the life-span. To this end, the current study used longitudinal data spanning grades 8 through 12 to examine the relation between heavy alcohol use and dating violence perpetration with respect to potential moderating factors drawn from the family, peer and neighborhood contexts.

Moderators of the Relationship between Alcohol Use and Partner Violence

In their review, Klosterman and Fals-Stewart (2006) suggest that the most consistent moderator of the link between alcohol use and partner violence appears to be the presence of other factors that are causally related to aggression. This conclusion is

consistent with theoretical models of the relationship between alcohol use and partner violence that account for the role of moderating factors including the selective disinhibition model (Parker, 1995), the biopsychosocial model (Chermack & Giancola, 1997; Moore, et al., 2008), and the multiple threshold model (Fals-Stewart, Leonard & Birchler, 2005).

While these models differ in scope and focus, they all put forth the basic hypothesis that alcohol will have a more pronounced effect on individuals who have aggressive propensities and/or in contexts or situations that facilitate or encourage aggressive behavior (e.g., for individuals with low aggressive inhibitions, trait anger or hostility, or an impaired capacity for behavioral regulation, in contexts where there are permissive social norms regarding the use of aggression). In essence, the reasoning underlying this hypothesis suggests that: (i) everyone has a different threshold at which they are likely to engage in violence (holding level of provocation constant), (ii) alcohol intoxication increases risk of violence by weakening the cognitive controls that would otherwise constrain aggressive behavior (i.e., intoxication lowers the threshold at which aggression will occur) and, (iii) accordingly, alcohol use will be even more likely to lead to aggression among individuals who have aggressive behavioral propensities (and/or in situations or contexts that facilitate aggressive behavior) because their aggression threshold will already be relatively low (but see Fals-Stewart, et al., 2005 for a more nuanced discussion of how multiple thresholds may be set depending on violence severity and level of provocation).

One factor that may moderate the relation between adolescent alcohol use and dating violence is exposure to violence. Social cognitive models (Bandura, 1973, 1977)

and empirical research suggest that adolescents who are exposed to violence (and associated rewards) internalize norms that are generally more accepting of violence and are less likely to expect negative sanctions to be imposed on their use of violence by institutions and others (Allwood & Bell, 2008; Delsol & Margolin, 2004; Foshee, Bauman, & Linder, 1999; Kinsfogel & Grych, 2004). In addition, teens embedded in violent contexts may have diminished opportunities for learning constructive conflict resolution skills (Delsol & Margolin, 2004; Foshee, et al., 1999). As such, teens who are exposed to violence may develop lower inhibitions against the use of aggression (due to permissive individual and social norms) and a propensity to resort to aggressive response options when provoked (due to a lack of constructive conflict resolution skills). Accordingly, following the reasoning described above, the relation between alcohol use and dating abuse may be stronger for teens who have been exposed to violence because these teens are more likely to have aggressive behavioral and perceptual propensities (i.e., their threshold for using aggression is relatively low).

The Current Study

The current study drew on the theoretical framework described above to determine if exposure to violence moderates the relationship between heavy alcohol use and physical dating violence perpetration among adolescents across grades 8 through 12. Exposure to violence may occur in the context of a teen's home, peer network, and/or community, each of which are key socialization contexts responsible for the transmission and reinforcement of behavioral norms during adolescence (Bronfenbrenner, 1979; Oetting & Donnermeyer, 1998). Indeed, empirical research has found that family, peer and neighborhood (or community) violence are each associated with adolescent dating

violence perpetration (Arriaga & Foshee, 2004; Capaldi, Dishion, Stoolmiller, & Yoerger, 2001; Foshee, et al., 1999; Foshee, Reyes, & Ennett, in press; Kinsfogel & Grych, 2004; Malik, Sorenson, & Anehensel, 1997). Accordingly, we hypothesized that, across grades 8 through 12, the relationship between heavy alcohol use and physical dating violence perpetration would be stronger for adolescents who reported higher levels as compared to lower levels of exposure to family, peer and neighborhood violence.

To test our hypotheses, we examined the main effects and interactions between heavy alcohol use and four measures of violence exposure (family violence, friend dating violence, friend peer violence and neighborhood violence) on levels of dating violence perpetration across grades 8 through 12. Within the peer context, we examined both exposure to friend dating violence and exposure to friend peer violence as potential moderators because modeling and reinforcement of either of these behaviors may contribute to increase one's propensity to aggress against a dating partner. Because many studies suggest that dating violence perpetration is as prevalent for girls as for boys (Foshee & Reyes, 2009) and that the etiological processes leading to dating violence may differ for boys and girls (Foshee, et al., 2001; Foshee, et al., in press; Kinsfogel & Grych, 2004; Malik, et al., 1997), we also examined whether there were sex differences in the main and joint effects of heavy alcohol use and each exposure measure on dating violence perpetration. In addition, because previous research using this sample found that the main effects of heavy alcohol use on dating violence tend to diminish over time and are stronger in the spring than in the fall semesters (Reyes, 2009), we determined whether the strength of the main and joint effects of alcohol use and each exposure measure

changed (i.e., increased or decreased) across the grade levels assessed and whether effects varied across semesters.

Method

Participants

The sample for this study was drawn from a multi-wave cohort sequential examination of adolescent health risk behaviors that spanned middle and high school (National Institute on Drug Abuse, R01DA16669, S. T. Ennett, PI; Centers for Disease Control and Prevention, R49CCV423114, V. A. Foshee, PI). Dating violence was assessed beginning when participants were in the 8th, 9th and 10th grades. As such, the current study uses four waves of data starting when participants were in the 8th, 9th and 10th grades (wave one) and ending when participants were in the 10th, 11th, and 12th grades (wave four). Data were collected at six-month time intervals for the first three waves and there was a one-year time interval between waves three and four. Participants were enrolled in two public school systems located in two predominantly rural counties with higher proportions of African Americans than in the general United States (U.S. Census Bureau, 2001).

At each assessment all enrolled students in the targeted grades who were able to complete the survey in English and who were not in special education programs or out of school due to long-term suspension were eligible for the study. Parents had the opportunity to refuse consent for their child's participation by returning a written form or by calling a toll-free telephone number. Adolescent assent was obtained from teens whose parents had consented immediately prior to the survey administration. Trained data collectors administered the questionnaires in student classrooms on at least two

occasions to reduce the effect of absenteeism on response rates. To maintain confidentiality, teachers remained at their desks while students completed questionnaires and the students placed questionnaires in envelopes before returning them to the data collectors. The Institutional Review Board for the School of Public Health at the University of North Carolina at Chapel Hill approved the data collection protocols.

At wave one, 6% of parents refused consent, 6% of adolescents declined to participate and 8% were absent on the days when data were collected for a total of 2636 students completing a survey at wave one. The response rate, calculated as the proportion of adolescents who completed a survey out of those eligible for the survey at wave 1 was 79%. For this study, analyses excluded students who; (1) reported being out of the typical age range of 12-19 for the grades studied (n=33, 1%), (2) did not report their dating status (n=83, 3%), (3) reported never dating across all of the assessments (n=171, 6%) or (4) were missing data on the dating violence measures across all waves of the study (n=38, 1%), yielding a sample size of 2311. Nearly all students participated in at least two waves of data collection (n=2157, 93%), with 75% participating in 3 or more waves (n=1741).

Approximately half of the sample was male (47%) and the self-reported race/ethnicity distribution was 45% White, 47% Black, and 8% other race/ethnicity. At wave one, 40% of participants reported that the highest education obtained by either parent was high school or less. Wave one prevalence of any heavy alcohol use in the past three months was 19% and prevalence of any physical dating violence perpetration in the past three months was 18%.

Measures

Measures included physical dating violence perpetration, heavy alcohol use, four

measures of exposure to violence (family violence, friend perpetration of peer violence, friend perpetration of dating violence, and neighborhood violence) and three demographic controls (race, sex and parent education). Measures of heavy alcohol use and exposure to violence were collected at each wave and were modeled as time-varying covariates. The values of the demographic controls were determined based on available data across all four waves of the survey and were modeled as time-invariant covariates. All measures were based on adolescent self-report except for measures indexing friends use of peer and dating violence, which were constructed using sociometric methods described below.

Physical Dating Violence Perpetration. Dating violence perpetration was measured each wave using a short version of the Safe Dates Physical Perpetration Scale (Foshee, et al., 1996). Adolescents were asked, “During the past 3 months, how many times did you do each of the following things to someone you were dating or on a date with? Don’t count it if you did it in self-defense or play.” Six behavioral items were listed: “slapped or scratched them,” “physically twisted their arm or bent back their fingers,” “pushed, grabbed, shoved, or kicked them,” “hit them with your fists or with something else hard,” “beat them up,” and “assaulted them with a knife or a gun.” Each item had five response categories ranging from 0 to 10 times or more in the past three months. Responses were summed across items to create a physical dating violence perpetration scale measure (average Cronbach’s $\alpha = .93$).

Heavy alcohol use. Heavy alcohol use was assessed by four items asking adolescents how many times they had: 3 or 4 drinks in a row, 5 or more drinks in a row, gotten drunk or very high from drinking alcohol, or been hung over in the past three

months. Each item had five response categories that ranged from 0 to 10 or more times. Responses to the four items were averaged to create a composite scale of heavy alcohol use (average Cronbach's $\alpha = .95$).

Family violence. Family violence was assessed by three items from Bloom's (1985) self-report measure of family functioning that asked adolescents how strongly they agreed or disagreed with statements about their family life (family members sometimes hit each other, we fight a lot in our family, family members sometimes get so angry they throw things). Response options ranged from strongly agree (4) to strongly disagree (0). Items were averaged to create a composite scale of family violence (average Cronbach's $\alpha = .87$).

Friend perpetration of peer and dating violence. Measures of each respondent's friends' use of violence against dates and peers were constructed using sociometric methods. At each wave, adolescents were provided with a student directory that listed all enrolled students along with a four-digit peer identification number for each student. Participants were asked to use the identification number in the roster to identify up to five of their closest friends. Because the respondent's friends in school were included in the data collection, their friends' reports of violence rather than the respondent's perceptions of their friends' violence, were used to create measures that indexed friends' dating violence perpetration (based on the measure of dating violence described above) and friends' peer violence perpetration at each wave. Peer violence was measured using six items that assessed how many times in the past three months the respondent had pushed, slapped or kicked someone, physically twisted someone's arm or bent back their fingers, hit someone with their fist or something else hard, beat someone up or assaulted someone

with a knife or gun. Adolescents were specifically asked to exclude acts that they had perpetrated against a date. Scores were averaged across the items to create a composite scale of peer violence at each wave (average Cronbach's $\alpha = .91$).

To create each friend perpetration measure, we dichotomized the dating violence and peer violence measures for each friend and summed the number of friends who reported any perpetration of dating violence and the number who reported any perpetration of peer violence. To adjust for differential exposure to peer models due to variability in the number of friends nominated, a time-varying variable denoting the total number of friends in the adolescent's friendship network at each wave was included as a control variable in all models.

Neighborhood violence. Teens responded to four items assessing their agreement or disagreement with statements about fear, violence and antisocial behavior in their neighborhood (people are afraid to come to my neighborhood, people there have violent arguments, people feel safe there, people sell illegal drugs in my neighborhood). Response options ranged from strongly agree (4) to strongly disagree (0). Items were reverse coded as necessary and summed to create a composite scale of neighborhood violence (average Cronbach's $\alpha = .94$).

Demographic covariates. Sex was coded such that 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, and other race/ethnicity (including Latinos). Parent education ranged from less than high school (0) to graduate school or more (5) and was measured as the highest education attained by either parent across all waves. Grade level was used as the metric of time and ranged

from grade 8 (0) to grade 12 (4). Semester was coded as fall (0) and spring (1).

Analytic Strategy

The main purpose of this study was to determine if the effect of heavy alcohol use on adolescent dating violence perpetration varies depending on levels of exposure to family, peer and neighborhood violence. To address this goal, we first used random coefficients (multilevel) growth curves to model trajectories of dating violence perpetration across grades 8 through 12. We then assessed the main and joint effects of time-varying measures of heavy alcohol use and exposure to violence on the repeated measures of dating violence perpetration. Data analysis occurred in several phases involving the reorganization of data based on grade rather than wave, imputation of missing data, centering of variables, estimation of unconditional trajectories of dating violence perpetration and hypothesis testing.

First, to take advantage of the cohort sequential design of this study, data were reorganized such that the grade level of the child was used as the primary metric of time rather than wave of assessment. This allowed for trajectories of dating violence perpetration to be continuously modeled across grades eight through twelve. After combining across cohorts and reorganizing the data by grade, information was available across eight discrete data points: grade 8 fall (n=795), grade 8 spring (n=795), grade 9 fall (n=1586), grade 9 spring (n=791), grade 10 fall (n= 2311), grade 10 spring (n=725), grade 11 fall (n=1516) and grade 12 fall (n=725). In previous analyses using this sample we found no evidence of cohort differences in dating violence perpetration growth trajectories, suggesting that data from each of the cohorts could be combined to estimate a single developmental curve across grades 8 through 12 (Reyes, 2009). We also note

that preliminary analyses using this sample found that dependence induced by nesting of students within schools is negligible (average Intraclass Correlation < .01, average Design Effect < 2.00), and that adjusting for nesting had no effect on the growth factor means or variances (Reyes, 2009). As such the models reported below do not account for nesting of dating violence within schools, but are likely not biased by this omission.

We addressed the issue of missing data in our time-invariant and time-varying covariates through multiple imputation (Rubin 1987) using SAS PROC MI (SAS Institute, 2003). Following standard recommendations, the imputation equation included all of the independent covariates (including the interactions between heavy alcohol use and each exposure variable), and dependent variables assessed at each of the grade levels (Allison, 2001, Rubin 1996). Ten sets of missing values were imputed using multiple chain Markov Chain Monte Carlo methods. Models were fit to each of the ten imputed datasets and parameter estimates and standard errors were combined using SAS PROC MIANALYZE (SAS Institute, 2003), which implements the procedures developed by Rubin (1987) to ensure that statistical inference takes into account uncertainty in the imputation process.

Following the recommendations of Raudenbush and Bryk (2002, p. 183) for disaggregating within- and between-person effects, we person-mean centered all time-varying measures (heavy alcohol use and all measures of exposure to violence) and grand-mean centered the time-invariant demographic controls (race, sex and parent education). Next, we determined the functional form and error structure of the trajectory model that best fit our repeated measures of dating violence perpetration by comparing several different models (i.e. flat vs. linear vs. quadratic; homoscedastic vs

heteroscedastic residual error structure). Replicating previous analyses using this same sample (Reyes, 2009), the best fitting model was a quadratic model with time-varying (heteroscedastic) residual errors and a random intercept component. The slope and quadratic factor variances were negligible and non-significant and were therefore constrained to zero.

To test our hypotheses, we estimated a series of conditional multilevel models. We first estimated a baseline model that included the main effects of heavy alcohol use and each of the violence exposure measures, the demographic controls, and interactions between alcohol use and grade and between alcohol use and semester. Next, we added various groups of interactions to the baseline model and determined the joint significance of their contribution to the model using multivariate Wald tests. The first set of interactions tested were those between heavy alcohol use and each of the violence exposure measures (four interaction terms). Next, to examine potential sex differences, we added two- and three-way interaction terms between sex, heavy alcohol use and each violence exposure measure (Sex x Alcohol Use, Sex x Violence Exposure, Sex x Alcohol Use x Violence Exposure). Next, to examine whether the strength of the moderated effect varied across grades and/or semesters, we added two- and three-way interactions between heavy alcohol use, each violence exposure measure and grade (Grade x Violence Exposure, Alcohol Use x Grade x Violence Exposure) and between heavy alcohol use, each violence exposure measure and semester (Semester x Violence Exposure, Alcohol Use x Semester x Violence Exposure). To produce a final reduced model we dropped all sets of two- and three-way interactions that did not significantly contribute to the model according to the multivariate Wald test ($\alpha=.05$). In addition, within each set of

interactions that did contribute significantly to the model, we examined the individual t-tests of the parameter estimates for each interaction term and dropped all interactions that were not significant from the model.

Results

Replicating previous analysis (Reyes, 2009), the unconditional model-implied mean trajectory for the sample indicates that the developmental trajectory for dating violence perpetration first increased over time, peaked at the end of grade 10, and then desisted during late adolescence. This trend is reflected in Table 7, which presents the observed means and standard deviations for dating violence perpetration across each of the grade levels that were assessed. The variance estimate for the intercept indicated there was significant individual variability in initial levels of dating violence perpetration ($p < .001$). Furthermore, residual variances in the repeated measures of perpetration were significant across all grade levels ($p < .001$ across all grades), suggesting that there was substantial variability in the repeated measures of perpetration that was not explained by the underlying trajectory process.

The results of the baseline model assessing the main effects of heavy alcohol use and each of the violence exposure measures are presented in the first column of Table 8. Heavy alcohol use, family violence and friend dating violence were each significantly positively related to levels of dating violence perpetration, whereas neighborhood violence (marginally significant) and friend peer violence were not. Consistent with previous research (Reyes, 2009), the results also indicate that the main effect of heavy alcohol use varied over time. Specifically, the main effect of heavy alcohol use on dating violence diminished across the grade levels assessed (Alcohol Use x Grade; $b = -0.03$,

$p < .05$), but also was much stronger in the spring than in the fall semesters (Alcohol Use x Semester; $b = 0.13$, $p < .001$).

The multivariate Wald test for the model that added all Alcohol Use x Violence Exposure interactions was significant ($F(4) = 13.19$; $p < .001$), and the parameter estimates from this model are presented in the second column of Table 8 (Full Model). Consistent with study hypotheses, there were significant positive interactions between alcohol use and family violence ($p < .001$) and between alcohol use and friend dating violence ($p < .001$) but, contrary to hypotheses, there were not significant interactions between heavy alcohol use and neighborhood violence or friend peer violence. Tests of all other two- and three-way interactions between alcohol use and each of the exposure variables and sex, grade and semester were not significant indicating that: (i) the main effects of heavy alcohol use and each of the exposure variables as well as the interactions between heavy alcohol use and each of the exposure variables did not differ significantly for boys and girls and, (ii) the main effects of each of the exposure variables and the interactions between each of the exposure variables and alcohol use did not vary significantly across grade levels or semesters.

The results of the final reduced model are presented in the third column of Table 8. Removing the non-significant interactions did not change the pattern of findings and had a minimal impact on parameter estimates. The positive interactions between heavy alcohol use and family violence ($b = 0.03$, $p < .001$) and between heavy alcohol use and friend dating violence ($b = 0.09$, $p < .001$) indicate that, across all grade levels, the relationship between alcohol use and levels of dating violence perpetration increased in strength as levels of family violence and friend dating violence increased.

To further probe the pattern of moderated effects over time, we estimated the effect of alcohol use at high (one standard deviation above the mean) and low (one standard deviation below the mean) levels of family violence and friend dating violence within each grade level assessed in the study (by setting grade level to grade 8 fall, grade 8 spring, etc.). Results are presented in Figure 5 (for family violence) and Figure 6 (for friend dating violence). Each figure graphs the effect of heavy alcohol use on dating violence perpetration (i.e., the regression coefficient associated with heavy alcohol use) at high and low levels of each exposure variable across grades 8 through 12. Although we did not assess individuals in grades 11.5 or 12.5 (the spring semesters of grade 11 and 12) we include the model-implied effects for these grade levels to show the predicted pattern from grade 8 fall semester through grade 12 spring semester.

As shown in both figures, the *difference* between the effects of heavy alcohol use at high and low levels of each exposure variable was the same across all grade levels. That is, in each figure the lines depicting the effects of heavy alcohol use at high and low levels of exposure are parallel, reflecting the finding that the strength of each of the interaction effects ($b=0.03$ for family violence and $b=0.09$ for friend dating violence) did not change over time. However, also depicted in each figure by the jagged pattern and the downward tilt of each line, are the findings that the strength of the effect of heavy alcohol use on dating violence at *both* high and low levels of each exposure variable was generally higher in the spring than in the fall semesters (Alcohol Use x Semester, $b=0.12$) and tended to diminish across the grade levels assessed (Alcohol Use x Grade, $b=-0.02$). As a final step, we conducted significance tests of the parameter estimates for heavy alcohol use at high and low levels of family conflict and friend dating violence at each

grade level. At high levels of family conflict and at high levels of friend dating violence the effects of heavy alcohol use on dating violence perpetration were significant across nearly all grade levels (the fall semester of grade 12 is the only exception). In contrast at low levels of family conflict and at low levels of friend dating violence the effects of heavy alcohol use on dating violence were significant only in the spring semesters.

Discussion

Consistent with our hypotheses, we found that the relationship between heavy alcohol use and dating violence perpetration became more pronounced as levels of family conflict and friend involvement in dating violence increased and that this pattern of effects persisted across grades 8 through 12. In contrast, neighborhood violence and friend involvement in peer violence were not significantly associated with levels of dating violence perpetration (marginal main effects for neighborhood violence) and, contrary to expectations, neither of these variables moderated the effect of heavy alcohol use on dating violence. Furthermore, we found no evidence of sex differences in the direct or joint effects of heavy alcohol use and each of the violence exposure measures (family, friend peer violence, friend dating violence and neighborhood violence) on dating violence perpetration.

The finding that the effects of heavy alcohol use on dating violence perpetration are more pronounced for teens who are embedded in family and peer contexts where higher levels of relationship violence occur is consistent with the notion that these exposures contribute to the development of aggressive behavioral and perceptual propensities that work synergistically with alcohol use to increase risk of dating aggression. Specifically, social cognitive theory suggests that teens who are exposed to

family and peer dating violence may, through processes of modeling and reinforcement, internalize norms that are more accepting of the use of dating aggression, develop more positive expectancies and fewer negative expectancies regarding the consequences of using dating violence (e.g., because they observe the mature social status or privilege conferred upon friends or family members who use violence and/or because they do not expect to be sanctioned by their peers for using dating violence), and have fewer opportunities to learn constructive conflict resolution strategies than teens who are not exposed to family or friend dating violence (Bandura, 1973; Foshee, et al., 1999). In turn, teens who have developed aggressive perceptual or behavioral tendencies as a result of their exposure to family and/or friend dating violence may be more susceptible to the disinhibiting effects of intoxication on dating violence perpetration because these teens already have a relatively low threshold at which they will engage in aggression.

Replicating previous research (Reyes, 2009), findings also indicate that the main effect of heavy alcohol use on dating violence diminished over time, whereas the strength of the moderating influences of exposure to family and friend dating violence on the relation between heavy alcohol use and dating violence persisted across all grade levels. Taken together these findings suggest that, over time, moderating factors such as exposure to family and friend dating violence may play an increasingly important role in explaining individual differences in relationship between alcohol use and dating violence. That is, because the *overall* effect of heavy alcohol use on dating violence is stronger in early adolescence, heavy alcohol use tends to increase risk of dating violence perpetration for all young teens (though effects are stronger for those exposed to family and peer dating violence). In contrast, because the *overall* effect of heavy alcohol use tends to be

weaker during late adolescence, heavy alcohol use may only increase risk of dating violence perpetration among older teens who have aggressive perceptual or behavioral propensities as a result of exposure to family and friend dating violence or other risk factors (this general time trend is depicted in Figures 5 and 6).

We also briefly note that, regardless of exposure level, the main effects of alcohol use on dating violence were much stronger in the spring semesters than in the fall semesters. This finding was reported in an earlier study using this sample (Reyes, 2009), and may be explained by spring semester increases in social activities in which alcohol use and dating violence may co-occur, overall stress levels (e.g., due to academic pressures), and/or by differences in the types of romantic relationships that are prevalent in the spring as compared to the fall semesters (for example, spring relationships may tend to be more committed and/or sexually intimate, thereby intensifying alcohol-related dating conflict).

The finding that family violence and friend dating violence moderated the effects of alcohol use on dating violence whereas friend peer violence and neighborhood violence did not is particularly interesting. One potential explanation for this finding is that only violence exposures that work specifically to influence norms, expectancies and/or conflict resolution skills concerning interactions within the context of intimate or romantic relationships contribute to moderate the effect of alcohol use on dating violence perpetration. That is, because exposure to interparental conflict and friend dating violence provide opportunities for observational learning and reinforcement of norms and behaviors that take place in the context of romantic relationships, these exposures may be more likely to moderate the effects of alcohol use on dating violence perpetration

specifically than exposure to peer violence or neighborhood violence, which may influence cognitions related to aggression that targets peers or strangers, but not dates. This reasoning is consistent with Bandura's (1973) observation, based on Social Learning theory, that disinhibition of aggression tends to be selective rather than indiscriminate (Bandura, 1973, p.190). As applied to this study, the notion of selective disinhibition suggests that modeling and reinforcement of non-dating aggression in community or peer contexts may weaken restraints against the use of non-dating aggression, but will not necessarily lower inhibitions against the use of dating aggression (Bandura, 1973, p. 190).

Limitations and Future Directions

There are several important limitations to this study that should be noted. First, although our hypotheses suggest a direction of influence from alcohol use to dating violence perpetration, our study was not designed to distinguish amongst the various causal mechanisms that may explain covariation between alcohol use and dating violence, which include the causal influence of alcohol use in leading to dating violence, the causal influence of dating violence in leading to alcohol use, and covariance due to common risk factors. In addition, our models assessed the contemporaneous relationships between time-varying alcohol use and violence exposure measures at each grade level. Consequently, we cannot infer causality or temporal ordering between alcohol use and dating violence, nor can we determine whether adolescents were drinking at the time of their involvement in dating violence perpetration.

Second, the current study focused exclusively on one type of dating abuse perpetration (physical) and on one type of substance use (alcohol use). Empirical research

suggests that alcohol use may be associated with other types of dating aggression (e.g., sexual violence; White, McMullin, Swartout, Sechrist, & Gollehon, 2007), and several studies have found that other types of substance use (e.g., marijuana use, hard drug use) are associated with partner violence perpetration (Moore & Stuart, 2005; Moore, et al., 2008). Future research should build on the current study by examining whether exposure to violence contributes to moderate the effects of alcohol and other substance use on physical, psychological and sexual dating violence during adolescence.

Third, our measure of neighborhood violence was limited in that only one item in the scale directly assessed exposure to violent behavior in the neighborhood. The other items assessed perceptions of neighborhood safety, fear, and exposure to the sale of illegal drugs in the neighborhood. These types of items are often included in measures of neighborhood violence (Brandt, Ward, Dawes, & Fisher, 2005; Johnson, et al., 2009); however, because these items do not directly assess violence exposures (e.g., witnessing sexual assault, gang violence), they may not have adequately measured the theoretical construct of interest (Brandt, et al., 2005; Johnson, et al., 2009).

Implications for Prevention

Findings from the current study have several implications for the design and evaluation of prevention programs. The significant main and joint effects of alcohol use and family conflict on dating violence perpetration indicate that early prevention programs that successfully reduce or prevent family conflict and/or heavy alcohol use during adolescence may also reduce or prevent alcohol-related dating violence perpetration. In addition, adolescent dating violence prevention interventions that successfully redress the negative cognitive effects of exposure to violence (e.g.,

acceptance of dating violence, outcome expectancies and conflict resolution skills) may reduce alcohol-related dating violence perpetration. The results of our study further suggest that these prevention strategies would be equally effective in preventing alcohol-related dating violence perpetration by both boys and girls.

We consider the finding that friend involvement in dating violence had a strong and persistent exacerbating effect on the relation between alcohol use and dating violence perpetration to be of particular importance. This finding suggests that abusive dating behaviors may be modeled and socially reinforced by close friends, adding to increasing empirical evidence that suggests that friends and peers play an important role in the development of adolescent romantic relationships (Arriaga & Foshee, 2004; Capaldi, et al., 2001; Connolly & Goldberg, 1999; Foshee, et. al., in press; Kinsfogel & Grych, 2004). Indeed, based on this research, prevention researchers have called on programs to directly address peer influences on dating behavior (Foshee & Reyes, 2009; Kinsfogel & Grych, 2004). For example, Kinsfogel and Grych (2004) posit that prevention strategies that are able to influence social norms (e.g., at the school or peer group level) may provide a form of social control that increase inhibitions against the use of dating aggression. In turn, stronger peer norms against dating abuse may weaken the disinhibiting effect of alcohol intoxication on dating violence perpetration.

Interventions may prevent or mitigate the effects of exposure to friend dating violence on teens' attitudes and expectancies regarding the use of dating aggression by helping teens to recognize the negative consequences of dating violence in their friends' lives and by providing teens with exposure to models of healthy, respectful romantic relationships. Other potentially efficacious strategies for addressing peer influences

proposed by violence prevention researchers include media campaigns that address teen dating violence norms (Manganello, 2008; Odgers & Russell, 2009), and peer-led interventions that promote positive relationship behaviors (Prinstein, Boergers, & Spirito, 2001).

We also note that a closer look at the data from our study indicates that, at each grade, nearly all teens (from 96% to 98%) had at least one friend who reported no involvement in dating violence. Similarly, other studies have found that nearly all teens have at least one friend who is involved in prosocial behaviors such as assisting other teens and involvement in school activities (Prinstein, et al., 2001). These findings indicate that prevention programs should also seek to harness and strengthen the influence of prosocial friends on teens' dating behavior. For example, as confidants, prosocial friends can establish and reinforce standards about what is and is not acceptable behavior (Connolly & Goldberg, 1999). Moreover, because group dating is common, particularly during early adolescence (Feiring, 1996), friends are in the unique position of being able to observe and actively intervene to prevent dating abuse including alcohol-related dating violence (e.g., by helping to arbitrate or defuse dating conflict). Prevention programs should therefore emphasize the positive role that teens' can play in helping to prevent dating abuse among their close friends and peers, and provide training in the best methods to do so.

Finally, we highlight cognitive factors such as norms and expectancies as possible mechanisms through which exposure to violence may contribute to moderate the relationship between alcohol use and dating violence. However, we also note that exposure to family violence has been found to lead to emotional dysregulation, including

difficulties in managing anger (Delsol & Margolin, 2004; Kinsfogel & Grych, 2004). In turn, emotional dysregulation may explain why alcohol use has a stronger effect on dating violence perpetration for teens exposed to family violence. Teens who are emotionally reactive may have a lower threshold for use of aggression because they are less able to control their behavior in response to provocation. As such, the disinhibiting effect of intoxication (which works to lower this threshold even further) would be exacerbated for these individuals as compared to individuals with higher levels of emotional control. If this perspective is correct, it suggests that prevention interventions that seek to reduce alcohol-related dating violence should target skills related to anger management among youth exposed to family violence. Future studies should therefore examine both cognitive and emotional factors as potential explanations for why exposure to violence moderates the relation between alcohol use and dating violence perpetration (i.e., through the testing of mediated moderation models). This information could inform prevention efforts targeted at reducing alcohol-related dating violence perpetration.

Table 7. Means and Standard Deviations for Dating Violence Perpetration by Grade

Semester	Grade	Dating Violence M (SD)
Fall	8	0.20 (0.53)
Spring	8.5	0.25 (0.68)
Fall	9	0.24 (0.60)
Spring	9.5	0.27 (0.69)
Fall	10	0.27 (0.63)
Spring	10.5	0.31 (0.76)
Fall	11	0.27 (0.63)
Fall	12	0.20 (0.55)

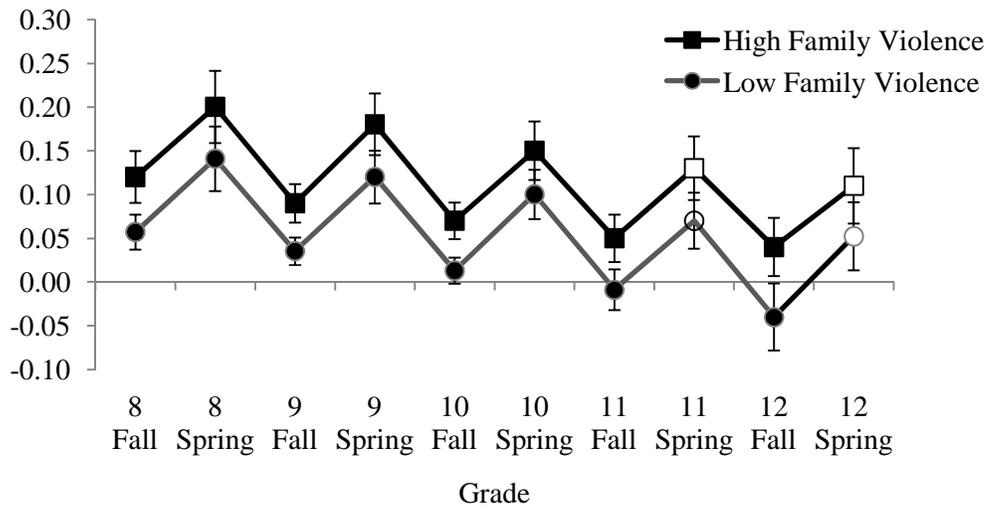
Table 8. Results for Models Examining Measures of Violence Exposure as Moderators of the Effects of Heavy Alcohol Use on Dating Violence across Grades 8 through 12.

Independent Variables	Baseline Model b (SE)	Full Model b (SE)	Reduced Model b (SE)
<i>Main effects</i>			
Semester	0.02 (.02)	0.01 (.02)	0.01 (.02)
Grade	0.03 (.03)	0.03 (.03)	0.03 (.03)
Grade*Grade	-0.01 (.01)	-0.01 (.01)	-0.01 (.01)
Heavy alcohol use	0.18 (.02)***	0.08 (.03)**	0.09 (.03)**
Family violence	0.04 (.01)***	0.03 (.01)*	0.03 (.01)**
Friend dating violence	0.04 (.02)**	0.02 (.02)	0.02 (.02)
Friend peer violence	-0.01 (.01)	-0.02 (.01)	-0.01 (.01)
Neighborhood violence	0.02 (.01)^	0.02 (.01)	0.02 (.01)
<i>Interactions</i>			
Heavy alcohol use*grade	-0.03 (.01)*	-0.02 (.01)^	-0.02 (.01)^
Heavy alcohol use*semester	0.13 (.03)***	0.12 (.04)***	0.12 (.03)***
Family violence* alcohol use	--	0.03 (.01)***	0.03 (.01)***
Friend dating violence* alcohol use	--	0.09 (.02)***	0.09 (.02)***
Friend peer violence* alcohol use	--	0.01 (.01)	--
Neighborhood violence* alcohol use	--	-0.001 (.01)	--

Note: All models specified a random intercept quadratic trajectory for dating violence perpetration with heteroscedastic residual error over time and controlled for the effects of race, sex, parent education and number of friends. Independent predictor variables were all time-varying (level one).

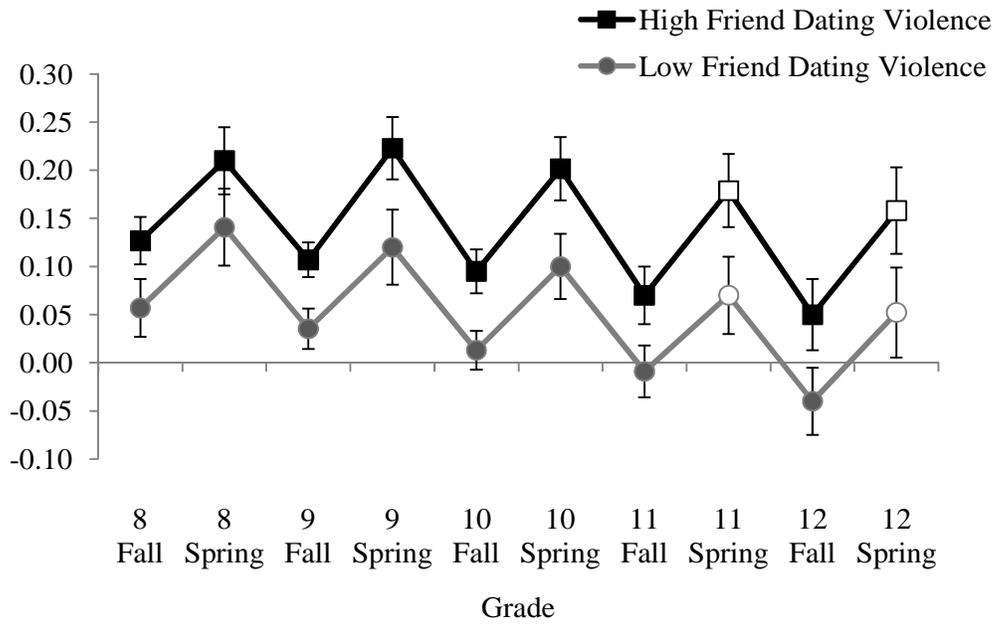
^ p<.10; * p<.05; ** p<.01; *** p<.001

Figure 5. Parameter Estimates and Standard Errors for the Effects of Heavy Alcohol Use on Dating Violence Perpetration at Low and High Levels of Family Violence across Grades 8 through 12.



Note: Family violence was set at -1 std below the mean (low) and +1 std above the mean (high). Effects at grades 11.5 and 12.5 were estimated based on model parameter estimates rather than observed.

Figure 6. Parameter Estimates and Standard Errors for the Effects of Heavy Alcohol Use on Dating Violence Perpetration at Low and High Levels of Friend Involvement in Dating Violence Perpetration across Grades 8 through 12.



Note. Friend dating violence was set at -1 std below the mean (low) and +1 std above the mean (high). Effects at grades 11.5 and 12.5 were estimated based on model parameter estimates rather than observed.

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