

# The Relation Between Childhood Proactive and Reactive Aggression and Substance Use Initiation

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**Abstract** The current study examined whether proactive and reactive aggression were associated with the risk for initiation of substance use from fourth to ninth grade in a sample of 126 aggressive children (66% male). In addition, the study examined whether these functions of aggression increased risk for initiation via peer delinquency and peer rejection. Proactive aggression was marginally significantly directly associated with risk for initiation of alcohol use and indirectly associated with risk for initiation of marijuana and tobacco use through peer delinquency. Reactive aggression was associated with increased risk for initiation of tobacco and marijuana use through a complex chain that included both peer rejection and peer delinquency. However, high levels of reactive aggression that did not lead to peer rejection were negatively associated with risk for initiation of tobacco and marijuana use. Implications for intervention are discussed.

**Keywords** Proactive and reactive aggression · Substance use initiation · Peers

Previous research has examined the relation between childhood proactive and reactive aggression and frequency of substance use (e.g., Connor et al. 2003; Fite et al. 2007). However, no research has examined how these functions of aggression are related to the timing of initiation of substance use. Initiation is defined as the time in which a child/adolescent tries a substance for the first time (Mayhew et al. 2000), and early initiation of substance use (SU) is associated with increased risk for substance abuse and SU related problems (e.g., Hoffman et al. 2006; Kandel and Davies 1992; Kandel and Yamaguchi 1993; Pitkanen et al. 2005). Identifying predictors of early initiation of SU can inform prevention and intervention efforts. Some theory and empirical support suggests distinct correlates of initiation versus escalation of substance use, yet this literature has not considered childhood aggression (e.g., Mayhew et al. 2000). Accordingly, the goal of the current study was to examine the relation between proactive and reactive aggression and the risk for initiation of alcohol, tobacco, and marijuana use from fourth to ninth grade.

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## Proactive and Reactive Aggression

Although related, proactive and reactive aggression represent two distinct subtypes of aggression (Day et al. 1992; Dodge 1991). Proactive aggression represents goal oriented, calculated aggression that is motivated by external reward. An example of proactive aggression is a child punching a child in order to obtain a desired object. Proactive aggression is consistent with social learning

theory, which posits that aggression serves the function of helping one obtain a desired goal (Bandura 1973). Reactive aggression, on the other hand, represents aggressive behavior that occurs in response to others' behavior that is perceived as threatening or intentional. An example of reactive aggression is a child pushing a peer after the peer poked fun at him/her. Reactive aggression may be best explained by the frustration aggression model, which posits that aggression is an angry and hostile reaction to frustration (Berkowitz 1978).

Several studies have shown a different pattern of associations between proactive and reactive aggression, and a variety of variables, including peer relations and long-term outcomes. Whereas proactively aggressive children are typically liked by peers (Dodge and Coie 1987; Poulin and Boivin 2000a; Prinstein and Cillessen 2003) and tend to affiliate with other proactively aggressive children (Poulin and Boivin 2000b), reactively aggressive children are rejected by all peers (e.g., Day et al. 1992; Dodge and Coie 1987; Prinstein and Cillessen 2003). With regard to long-term outcomes, proactive aggression is associated with delinquency and delinquency related violence in adolescence (Brendgen et al. 2001; Vitaro et al. 1998b) and psychopathy in adulthood (e.g., Cornell et al. 1996). In contrast, little is known about the long-term sequelae of reactive aggression. There is some evidence to suggest that reactive aggression is associated with dating violence in adolescence (Brendgen et al. 2001), but other evidence suggests that reactive aggression is protective against adolescent delinquency (e.g., Vitaro et al. 1998b). Thus, more research is needed to understand the long-term outcomes of reactive aggression; as noted preliminary evidence suggests that proactive aggression is associated with more severe behavioral outcomes.

In sum, although related, proactive and reactive subtypes of aggression are distinct and may be best explained by different theories. Furthermore, these subtypes of aggression differentially relate to outcomes such as delinquency and peer relations, which are of interest to the current study, because these outcomes figure prominently in etiological models of adolescent SU. Accordingly, distinguishing between these dimensions of aggression may be useful for better understanding developmental pathways from aggression to SU.

#### Proactive and Reactive Aggression and Substance Use

There is reason to believe that both proactive and reactive aggression may be associated with SU. Proactive aggression may be associated with adolescent SU by way of progression of problem behavior. This pathway is consistent with current developmental models of antisocial behavior that posit that antisocial behavior is a chronic

and persistent display of behavior that begins in childhood and progresses over time (Moffitt 1993; Tolan et al. 1995). Findings suggesting that proactive aggression is related to delinquency in adolescence and psychopathy in adulthood support this pattern of progression. Furthermore, associations with delinquent peers may play a role in the relation between proactive aggression and SU. Proactively aggressive children tend to associate with other proactively aggressive children (Poulin and Boivin 2000b), and association with deviant peers has been repeatedly linked to SU (e.g., Fergusson et al. 2002; Curran et al. 1997). Thus, proactive aggression is expected to be associated with SU.

Although reactive aggression does not appear to follow the same developmental progression as proactive aggression, there are several other pathways by which reactive aggression may be related to SU. First, reactive aggression is an impulsive behavior, and impulsivity has been repeatedly associated with SU (e.g., Acton 2003; Vitaro et al. 1998a). Second, peer rejection might play a role in the relation between reactive aggression and SU. Reactively aggressive individuals are rejected by their peers (e.g., Day et al. 1992; Dodge and Coie 1987; Prinstein and Cillessen 2003) and peer rejection and social isolation in middle childhood and early adolescence (fourth to tenth grade) has been found to be associated with SU (e.g., Dishion et al. 1999; Ennett and Bauman 1993; Fang et al. 2003; Ollendick et al. 1992). However, it should be noted that other research has found that popularity is associated with SU when prevalence rates among children in the school are high (Alexander et al. 2001) or when the perception is that peers value SU (Allen et al. 2005). It appears that both peer rejection and popularity are correlates of substance use. We focus on peer rejection because of the large literature linking it to reactive aggression, and we posited that peer rejection and social isolation may create emotional distress which leads to early initiation of SU to self-medicate for reactively aggressive children.

Alternatively, reactive aggression may be associated with SU initiation through a complex chain that includes peer rejection and peer delinquency. Patterson et al. (1991) suggest that rejected aggressive children are limited in potential peers with whom they can associate because they are likely to be rejected by prosocial peers, and therefore are likely to affiliate with other aggressive children who are also rejected by peers (Dishion et al. 1994). Affiliation with other rejected aggressive children in turn provides an environment that reinforces antisocial behavior, including SU. Reactive aggression leads to peer rejection, and peer rejection has been found to lead to peer delinquency (e.g., Coie et al. 1995; Dishion et al. 1991; Laird et al. 2001), which in turn has been repeatedly linked to SU (e.g., Fergusson et al. 2002; Curran et al. 1997). In sum, both

proactive and reactive aggression are posited to lead to SU, but through different mechanisms.

A few studies have examined the relation between proactive and reactive aggression and SU. Two studies have found that proactive, but not reactive, aggression was associated with SU (Connor et al. 2003; Pulkkinen 1996). In contrast, we found evidence to suggest that both proactive and reactive aggression were associated with increased frequency of SU from eighth to ninth grade, but through different pathways, as proposed above (Fite et al. 2007). More specifically, we found that fifth grade proactive aggression was indirectly associated with increases in frequency of SU through peer delinquency. Reactive aggression was also positively associated with an increase in SU frequency, but through a complex chain. That is, high levels of fifth grade reactive aggression led to high levels of peer rejection, which in turn predicted high levels of peer delinquency and subsequent increases in frequency of SU. However, none of these studies examined how proactive and reactive aggression are associated with the timing of initiation. The current study examined the relation between proactive and reactive aggression and risk for initiation of SU from fourth to ninth grade.

#### The Current Study

In our previous report, we focused on increases in frequency of a composite substance use variable from eighth to ninth grade (Fite et al. 2007). The present study extended our previous research by considering a different outcome. Here we focus on timing of initiation from fourth to ninth grade, and examine timing of alcohol, tobacco, and marijuana use initiation separately. Timing of initiation is important because it is linked to later substance abuse and substance use-related problems. Moreover, epidemiological studies suggest that timing of initiation of alcohol, tobacco, and marijuana use is different (Kandel and Logan 1984; Kandel and Yamaguchi 1993), suggesting the need to look at these outcomes separately. Previous research has found that the initiation of SU typically occurs in the presence of peers (Flay et al. 1998; Mayhew et al. 2000). Accordingly, we examined the role of peer rejection and peer delinquency in the pathways from proactive and reactive aggression to SU initiation.

The current study attempted to characterize pathways to initiation of SU for aggressive children. However, levels of aggression decline during the elementary and middle school years (Coie and Dodge 1998). Moreover, aggressive behavior becomes less instrumental and more hostile in nature (Coie and Dodge 1998), suggesting particularly low rates of proactive aggression throughout this developmental period. Therefore, hypotheses were

examined in a high-risk sample of aggressive youth who are most likely to follow the pathways described above.

## Methods

### Participants

The participants of the current study come from a larger longitudinal study designed to evaluate the effectiveness of the Coping Power intervention program for childhood aggression (Lochman and Wells 2002). Participants were recruited from 17 elementary schools in Durham, NC. Children were initially screened to identify aggressive children. Teachers rated each child on three descriptors (“verbally aggressive”, “physically aggressive”, and “disruptive”) on a scale of one (not at all) to five (very frequently). Using these ratings, the 31% most aggressive children were selected as a pool of potential participants. Of these children’s parents, 65% agreed to participate, resulting in a sample of 245. Participants were then randomly assigned to treatment and control conditions. For the purpose of the current study, we chose to focus on control groups ( $N=126$ ) of the larger study so that findings were not affected by the intervention.

Children were recruited into the study at the end of the fourth grade (mean age=10.4,  $SD=0.51$ ). Of the participants, 66% were male. Of the sample, 79% was African-American, 17% of the sample was Caucasian, and 4% of the sample was comprised of other ethnicities. The current sample’s composition of primarily African American youth is representative of the ethnic make-up found when recruiting an at risk sample within an urban setting. Understanding the proposed processes within this at risk group is important, because it brings cultural utility to the model and permits generalization to urban samples.

Information regarding the family and child behavior was collected from the person identified as the primary caretaker during the past 6 months. Primary caretakers consisted of mostly mothers (90%); however, fathers, grandparents, other relatives, and foster parents were also identified as primary caregivers. According to the Hollingshead index of social status (Hollingshead 1975), 17.74% of the families were unskilled workers, 15.32% were semi-skilled workers, 14.52% were skilled workers, 29.84% were minor professionals, and 22.58% were major professionals, indicating that 50% of the families were middle to upper class.

The study maintained an 87% retention rate. Attrition analyses were conducted in order to examine whether those who completed the study differed from those who did not complete the study on variables at time 1. The only variable

in which study completers differed from non-completers was on levels of proactive aggression ( $t(106)=2.59$ ,  $p=0.01$ ), such that means levels of proactive aggression were higher for completers ( $M=1.84$ ) than non-completers ( $M=1.33$ ).

### Procedure

Active informed consent was obtained from primary caretakers and assent was obtained from children prior to each assessment. Data was collected annually over 6 years. At the end of each school year, interviews were conducted separately with parents and children. Measures were collected from primary caretakers in the home or in the research office, depending on the caregiver's preference. Child reported measures were collected in school, at home, or in the research office. The majority of parent and child interviews (>90%) occurred in the home. At each data collection, caregivers were compensated \$40 and children were compensated \$10 for their participation. In addition, information regarding behavior and social status at school was collected at school from the teachers and classmates.

We wanted to examine early risk for substance use initiation. SU among elementary school aged children is rare (Kaplow et al. 2002; Simons et al. 1996; Spoth et al. 1999) and incidence rates begin to rise in middle school, with a peak around seventh grade (Barman et al. 2004; Chen and Kandel 1995; Colder et al. 2001; Oetting and Beauvais 1990). Therefore, the current study examined risk for initiation from fourth to ninth grade.

The majority of research examining proactive and reactive aggression has used teacher reports of elementary school aged children (e.g., Day et al. 1992; Dodge and Coie 1987). Elementary school teachers have the opportunity to observe children's interactions with peer throughout the school day, and this knowledge is critical because a social context is important for distinguishing proactive and reactive aggression. Likewise, elementary school is an ideal setting in which to collect peer sociometric ratings, because children interact with the same group of peers throughout the day. Accordingly, proactive and reactive aggression and sociometric data were collected in the fifth grade, the year prior to starting middle school where children change classes and teacher and classmates have less intimate knowledge of an individual's aggressive behavior. Finally, a measure of peer delinquency at eighth grade was used in analyses, because peer delinquency was not assessed prior to eighth grade in the current sample.

### Measures

**Substance use** Substance use was assessed using the Center for Substance Abuse Prevention (CSAP) Student Survey at grades 4 to 9. The survey consists of 26 items that were

adapted from the California Student Survey (Pentz et al. 1989). Of interest in the current study were items assessing alcohol, tobacco and marijuana use. Each substance was examined separately because timing of initiation has been found to vary across substances (Kandel and Logan 1984; Kandel and Yamaguchi 1993). Initiation of each substance was examined using a single lifetime substance use item administered at each grade. A sample item is "Have you EVER had a drink of alcohol?" Items were coded as yes (1) or no (0) for analyses.

**Proactive and reactive aggression** Proactive and reactive aggression was assessed at fifth grade using teacher reports of the proactive and reactive aggression scale (Dodge and Coie 1987). The measure consists of six items, three for each scale. The three proactive items are "\_\_\_ threatens or bullies others in order to get his/her own way," "Gets other kids to gang up on somebody they don't like," and "Uses physical force (or threatens to use physical force) in order to dominate other kids." The three reactive item are "When teased or threatened, he/she gets angry easily and strikes back," "Believes other kids are to blame in a fight and feel that they started the trouble," and "When someone hurts him/her (such as bumps into him/her), they assume that the person meant to do it, and then reacts with anger/fighting." Teachers rated how often the child engages in the behavior using a five-point Likert scale: 1 (never) to 5 (almost always). Construct validity of this measure has been demonstrated, with reactive aggression found to be uniquely related to impulsivity and endorsement of aggression in response to peer provocation (i.e., hostile attribution bias) and proactive aggression found to be uniquely associated with the belief that positive consequences will occur as a result of aggressive behavior (i.e., response bias; Dodge et al. 1997). The current measure has also demonstrated criterion validity, with reactive aggression being associated with more social problems and more classroom difficulties than proactive aggression (Waschbusch et al. 1998). The internal consistencies of both these scales were 0.93. Items were averaged to form scale scores for subsequent analysis.

**Perceived peer delinquency** Information on perceived peer delinquency was collected at eighth grade using the Perceived Behavioral Norms questionnaire. The Perceived Behavioral Norms questionnaire is a 6 item self-report scale developed at the University of Kentucky. Consistent with other measures of peer delinquency, children indicate the number of their friends they believe use substances (cigarettes, alcohol, and marijuana) and engage in delinquent behaviors (i.e., shoplifting, vandalism, and physically attacking others) using a five-point scale (0=none to 4=all). Adequate one-year test-retest reliability (0.43–0.60) and construct validity (scores positively associated with child

aggression and substance use) of this measure have been demonstrated (Lochman and Wells 2002). Standardized internal consistency of this measure was 0.82 in the current sample. Items were averaged to form a scale score, which was used for analysis.

**Peer rejection** Peer rejection was assessed using a nomination-based system of classroom sociometrics at fifth grade. Children indicated the three peers they like the most and the three peers they like the least within their classroom. Nominations were standardized within each classroom. Then each individual's "liked least" score was subtracted from their "liked most" score to determine a social preference score (Coie et al. 1982). Scores were then recoded, such that high values indicate high levels of peer rejection. This measure is widely used and has been found to be a good method for discriminating between sociometric groups (Terry and Coie 1991). Furthermore, this measure shows high levels of agreement with other methods used to assess peer status (Terry and Coie 1991).

### Data Analytic Strategy

Survival analysis was used to examine risk for initiation of SU. Age of initiation was defined as the age at which the child first indicated a yes response for lifetime use. If children reported lifetime use at the first assessment, they were considered to have initiated substance use in or prior to fourth grade. In situations in which contradictory information on age of initiation occurred (e.g., responding with a yes response on lifetime use in an earlier year and a no response in later years), the age at which the child first reported use was assumed to be the actual age of initiation. The frequency of contradictory information was less than 7%, suggesting children were consistent in reporting their SU behavior.

Separate models were estimated for each substance (alcohol, tobacco, and marijuana use). Robust Maximum Likelihood estimation with Monte Carlo integration was used (Muthen and Muthen 2004). More specifically, full information maximum likelihood estimation (FIML) was used to accommodate missing data. FIML uses all available data to calculate parameter estimates and does not exclude cases with missing data (Kline 2005). FIML has been found to be less biased and more efficient than other techniques used to handle missing data, such as pairwise and listwise deletion (Arbuckle 1996). Hazard probabilities, the probability that substance use initiation will occur at a particular grade for a particular individual for which initiation has not previously occurred, were estimated. Linear, quadratic, and cubic effects of age were tested. The linear (-5, -4, -3, -2, -1, 0), quadratic (25, 16, 9, 4, 1, 0) and cubic (-125, -64,

-27, -8, -1, 0) contrasts were coded in such a way that the intercept was set at ninth grade. Variances of the intercept and slopes were fixed at 0 in accordance with a traditional survival model.

After establishing the best fitting model for age effects, covariates were added to models. Due to the strong positive relationship between proactive and reactive aggression, it was important to take into account the effect of proactive aggression when examining pathways of reactive aggression and the effects of reactive aggression when examining pathways of proactive aggression, respectively. Accordingly, proactive and reactive aggression were examined simultaneously in each model. Gender and race were included as covariates in all models, as previous research has found gender and race differences in SU and aggression (e.g., Coie and Dodge 1998; Johnson and Hoffman 2000; Wallace et al. 2003; Windle 1990). First, proactive and reactive aggression, gender, and race were added to the models. Second, peer delinquency and peer rejection were added to models. The bias-corrected bootstrap test of indirect effects (MacKinnon et al. 2004) is not available for survival models, and other tests of indirect effects cannot be used to test 3-chain pathway (e.g., the delta method, Sobel 1982). Therefore, we relied on previous simulation studies that suggest that when all chains of an indirect path are significant, the indirect effects are likely significant (MacKinnon et al. 2002).

## Results

### Descriptive Analysis

Correlations, means, and standard deviations (SDs) of predictors are reported in Table 1. Consistent with previous research (e.g., Dodge 1991; Poulin and Boivin 2000a) proactive and reactive aggression were correlated, and mean levels of reactive aggression were higher than mean levels of proactive aggression.<sup>1</sup>

As expected, the prevalence of lifetime SU in the current sample was low in fourth grade (<10% alcohol and tobacco use, and <2% marijuana use). However, by eighth grade prevalence of SU for this high risk sample was 51% for alcohol, 39% for tobacco, and 27% for marijuana use, which is higher than that observed in a nationally representative sample (Monitoring the Future data that overlaps with current data at eighth grade; alcohol use=44%, tobacco use=28%, marijuana use=16%; Johnston et al. 2005). And the prevalence rates of

<sup>1</sup> Descriptive statistics and correlations for each gender are available from the authors.

**Table 1** Correlations, means, and SDs

Variables	1	2	3	4	5	6
Gender	1.0					
Race	0.15	1.0				
Proactive aggression	0.02	0.11	1.0			
Reactive aggression	-0.02	0.15	0.63*	1.0		
Peer rejection	0.19	0.07	0.23*	0.35*	1.0	
Peer delinquency	0.10	0.00	0.20	0.04	0.26*	1.0
Mean	1.34	1.83	1.71	2.71	0.47	1.19
SD	0.48	0.38	0.91	1.20	1.92	0.73

\* $p < .05$ 

the current sample continued to increase, with ninth grade prevalence rates at 56.5% for alcohol, 41.5% for tobacco, and 32% for marijuana use. Higher prevalence rates are attributable to the high-risk nature of the sample.

### Survival Analysis

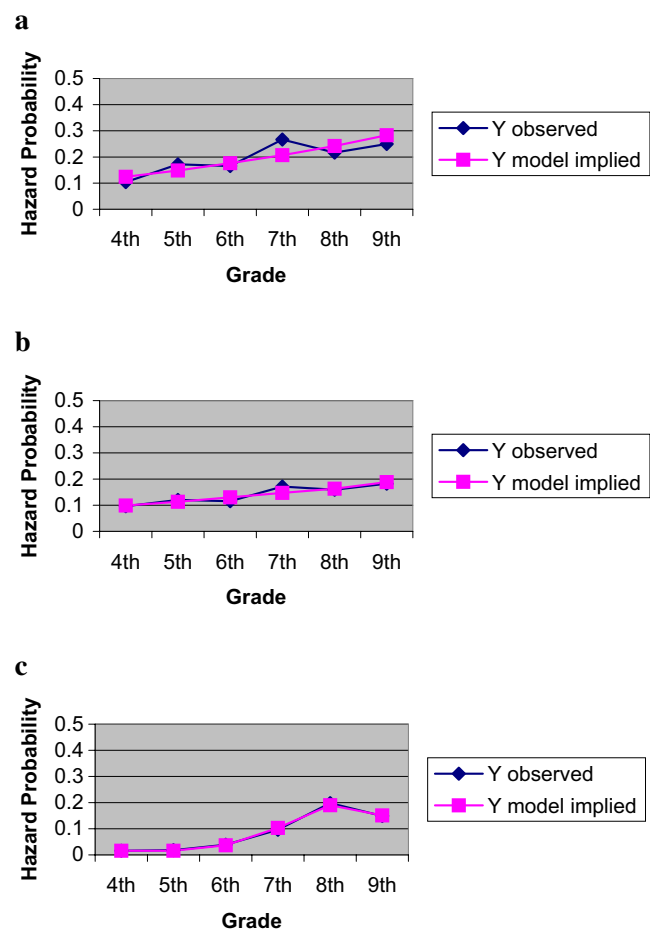
**Alcohol** Initiation of alcohol use hazard probabilities followed a linear trend, such that risk for initiation of alcohol use increased as individuals aged from fourth to ninth grade ( $M=0.20$ ,  $p=0.005$ ). The addition of quadratic ( $\chi^2(1)=1.09$ ,  $p=0.30$ ) and cubic ( $\chi^2(1)=0.02$ ,  $p=0.88$ ) trends did not improve the model fit. Observed and model implied hazard probabilities can be found in Fig. 1a. Covariates of proactive and reactive aggression, race, and gender were added to the model. Proactive aggression was marginally significantly related to the risk of alcohol use initiation at ninth grade ( $B=0.69$ ,  $p=0.09$ ), such that high levels of fifth grade proactive aggression were associated with increased risk for initiation of alcohol use at ninth grade. Race was also a marginally significant predictor of the initiation of alcohol use at ninth grade ( $B=-2.26$ ,  $p=0.07$ ), such that Caucasian youth were more likely to initiate alcohol use than minority youth. Reactive aggression and gender were unrelated to alcohol use initiation at ninth grade, and there were no significant predictors of the linear slope ( $ps > 0.17$ ).

Peer rejection and peer delinquency were then added to the model. Race was the only marginally significant predictor of the linear slope ( $B=-0.54$ ,  $p=0.07$ ) and the only significant predictor of initiation of alcohol use at ninth grade ( $Bs=-2.56$ ,  $p=0.03$ ), such that Caucasian youth were more likely to initiate alcohol use than minority youth. All other variables were unrelated to the risk of alcohol use initiation ( $ps > 0.13$ ).

**Tobacco** Initiation of tobacco use hazard probabilities followed a linear trend, such that risk for the initiation of

tobacco use increased as individuals aged from fourth to ninth grade ( $M=0.15$ ,  $p=0.05$ ). The addition of quadratic ( $\chi^2(1)=0.04$ ,  $p=0.84$ ) and cubic ( $\chi^2(1)=0.01$ ,  $p=0.92$ ) trends did not improve the model fit. Observed and model implied hazard probabilities can be found in Fig. 1b. Proactive and reactive aggression, race, and gender were added to the model. Reactive aggression was negatively associated with risk of ninth grade tobacco use initiation ( $B=-0.70$ ,  $p=0.02$ ), such that high levels of reactive aggression were negatively associated with initiation of tobacco use at ninth grade. Proactive aggression, gender, and race were unrelated to risk of tobacco use initiation at ninth grade, and all variables were unrelated to the linear slope of tobacco use initiation ( $ps > 0.21$ ).

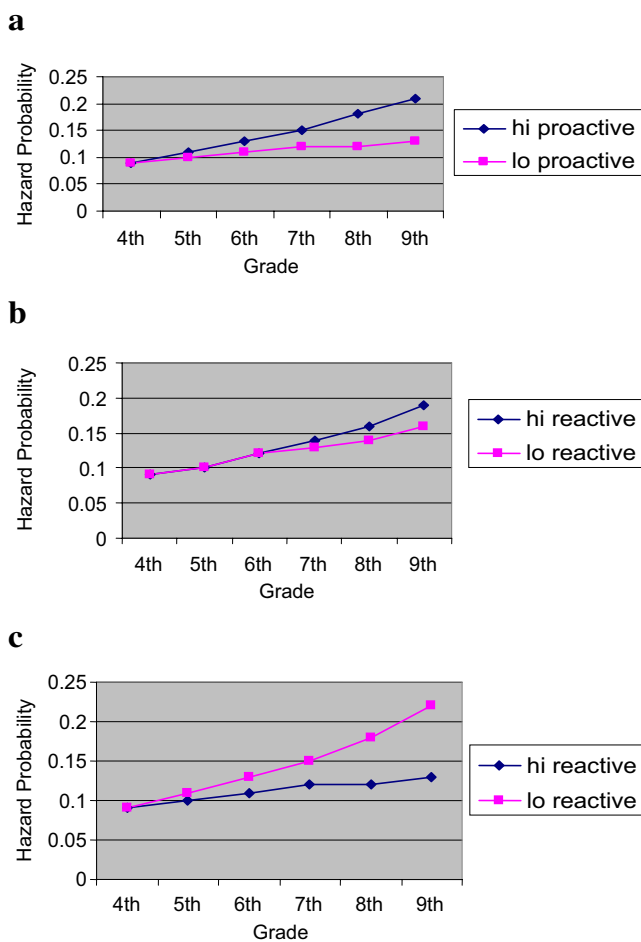
Peer rejection and peer delinquency were then added to the model. Reactive aggression was negatively associated with initiation of tobacco use at ninth grade ( $B=-0.71$ ,  $p=0.04$ ), such that high levels of reactive aggression were negatively associated with the risk of tobacco use initiation at ninth grade. Peer delinquency was positively associated



**Fig. 1** Observed and model implied hazard probabilities. **a** Alcohol, **b** tobacco, and **c** marijuana hazard models

with risk for tobacco initiation at ninth grade ( $B=1.48, p<0.001$ ) and the linear slope of the risk for tobacco use initiation ( $B=0.32, p=0.01$ ). No other variables were directly associated with risk for tobacco use initiation. Proactive aggression was indirectly associated with risk for tobacco use initiation through peer delinquency, such that high levels of proactive aggression were associated with high levels of peer delinquency ( $B=0.21, p=0.04$ ), which in turn was associated with increased risk of initiation of tobacco use. Model implied values were used to plot predicted risk trajectories of initiation of tobacco use at high (+1 SD) and low (−1 SD) levels of proactive aggression through the effect of peer delinquency. As seen in Fig. 2a, high compared to low levels of proactive aggression through peer delinquency were associated with an increase in risk for initiation of tobacco use from fifth to ninth grade. Reactive aggression was also positively associated with risk for tobacco use initiation through a

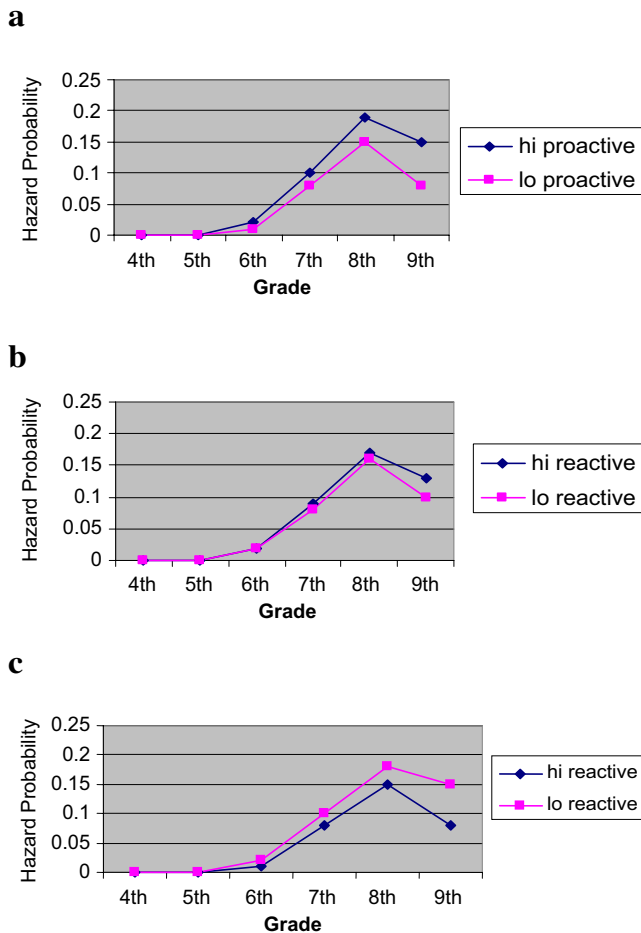
complex chain, such that high levels of reactive aggression were associated with high levels of peer rejection ( $B=0.54, p=0.01$ ), which in turn predicted high levels of peer delinquency ( $B=0.11, p=0.02$ ) and subsequent increases in risk for initiation of tobacco use across grades. Predicted risk trajectories for initiation of tobacco use at high and low levels of reactive aggression through the effect of peer rejection and peer delinquency are plotted in Fig. 2b. High levels of reactive aggression that operated through peer rejection and peer delinquency were associated with increased risk for initiation of tobacco use from seventh to ninth grade. However, reactive aggression was also negatively associated with initiation of tobacco use when it operated only through peer delinquency ( $B=-0.17, p=0.02$ ), as shown in Fig. 2c. That is, high levels of reactive aggression via peer delinquency were associated with decreased risk for initiation of tobacco use from fifth to ninth grade. Overall, these findings suggest that reactive aggression was both positively and negatively associated with risk for tobacco use initiation.



**Fig. 2** Predicted trajectories of tobacco use initiation across levels of **a** proactive aggression through peer delinquency, **b** reactive aggression through peer rejection and peer delinquency, and **c** reactive aggression through peer delinquency

**Marijuana** Initiation of marijuana use hazard probabilities followed a marginally significant cubic pattern (linear  $M=-0.98, p=0.15$ , quadratic  $M=-0.81, p=0.05$ , cubic  $M=-0.10, p=0.07$ ). The addition of a quadratic trend did not improve the model fit ( $\chi^2(1)=2.05, p=0.15$ ), but the addition of a cubic trend produced a marginally significant improvement in the model fit ( $\chi^2(1)=3.40, p=0.06$ ). We chose to retain the cubic trend because it better described the longitudinal pattern of the observed data, as seen in Fig. 1c. Risk for initiation of marijuana use increased slowly until sixth grade, increased rapidly from sixth to eighth grade, then slightly decreased from eighth to ninth grade. Findings suggest that children are most at risk for initiation of marijuana use at eighth grade. Covariates of proactive and reactive aggression, race, and gender were added to the model. Proactive aggression, reactive aggression, gender, and race were unrelated to risk for initiation of marijuana use ( $ps>0.23$ ).

Peer rejection and peer delinquency were added to the model. Peer delinquency was associated with risk of marijuana use initiation at ninth grade ( $B=1.96, p=0.002$ ) and marginally significantly associated with the cubic slope ( $B=0.16, p=0.06$ ), such that high levels of peer delinquency were associated with a strong cubic trend (e.g., a more rapid acceleration of risk for initiation). Proactive aggression was indirectly associated with marijuana use when operating through peer delinquency ( $B=0.21, p=0.05$ ). As seen in Fig. 3a, high levels of proactive aggression as operated through peer delinquency were associated with increased risk for marijuana use initiation from sixth to ninth grade when compared to low levels of proactive aggression. Reactive aggression was positively associated



**Fig. 3** Predicted trajectories of marijuana use initiation across levels of **a** proactive aggression through peer delinquency, **b** reactive aggression through peer rejection and peer delinquency, and **c** reactive aggression through peer delinquency

with marijuana use through a complex chain, such that high levels of reactive aggression were positively associated with peer rejection ( $B=0.53$ ,  $p=0.01$ ), which in turn was positively associated with peer delinquency ( $B=0.10$ ,  $p=0.02$ ) and subsequent risk for initiation of marijuana use. As seen in Fig. 3b, high levels of reactive aggression when operating through peer rejection and peer delinquency were associated with a slightly increased risk for marijuana use initiation from seventh to ninth grade when compared to low levels of reactive aggression. However, reactive aggression was also negatively associated with risk for marijuana use initiation through peer delinquency ( $B=-0.15$ ,  $p=0.04$ ), as shown in Fig. 3c. High levels of reactive aggression when operating through peer delinquency were associated with decreased risk for initiation of marijuana use through peer delinquency from sixth to ninth grade. Findings suggest that reactive aggression was both positively and negatively associated with risk for initiation of marijuana use.

## Discussion

The current study examined the relation between proactive and reactive aggression and timing of initiation of SU from fourth to ninth grade. Proactive aggression was directly associated with risk for initiation of alcohol use and indirectly associated with risk for initiation of marijuana and tobacco use through peer delinquency. However, this direct association was only marginally statistically significant. Reactive aggression was both positively and negatively associated with risk for marijuana and tobacco use initiation. That is, reactive aggression was associated with increased risk for initiation of tobacco and marijuana use through a complex chain that included both peer rejection and peer delinquency. However, high levels of reactive aggression that did not lead to peer rejection were negatively associated with risk for initiation of tobacco and marijuana use. Overall, results are consistent with the pattern of findings associated with increases in frequency of SU (Fite et al. 2007). However, current findings also suggest that the pattern of relations between proactive and reactive aggression and initiation of SU were different for alcohol, marijuana, and tobacco, a pattern of unique relations that has not been previously observed. Findings are reviewed in turn.

### Proactive Aggression and Substance Use Initiation

Childhood proactive aggression was associated with increased risk for earlier initiation of SU in the current study, and other research has found that early initiation of SU is associated with later problem behavior (e.g., Hoffman et al. 2006; Kandel and Davies 1992). These findings are consistent with current developmental models of antisocial behavior, which posit that antisocial behavior, including substance use, is a chronic and persistent display of behavior that begins in childhood and worsens over time (e.g., Moffitt 1993). Moreover, peer delinquency appears to play an important role in this progression, particularly with respect to the initiation of tobacco and marijuana use. That is, high levels of proactive aggression were associated with high levels of peer delinquency, which in turn was associated with increased risk for initiation of tobacco and marijuana use. Current findings taken together with prior research (e.g., Fite et al. 2007; Pulkkinen 1996) suggest that childhood proactive aggression is predictive of both early age of initiation and increases in frequency of SU, and peer delinquency plays an important role.

Interestingly, proactive aggression was directly associated with initiation of alcohol use at ninth grade, but this relation only reached marginal statistical significance. Perhaps proactively aggressive children try alcohol without much peer influence. Yet whether or not these children



continue to use substances, and the degree of their involvement with substances, may depend upon affiliations with delinquent peers. However, more research examining these pathways is necessary to support this conclusion, which remains speculative at this time.

#### Reactive Aggression and Substance Use Initiation

Reactive aggression was positively associated with early age of initiation of tobacco and marijuana use through a complex chain that included both peer rejection and peer delinquency. Findings are consistent with research that has found that rejected aggressive children affiliate with other rejected aggressive children, which provides an environment that is reinforcing of aggression and other antisocial behavior (Dishion et al. 1994; Patterson et al. 1991). In addition, these findings are similar to findings from our previous study that found that reactive aggression was associated with increases in frequency of SU through this complex chain (Fite et al. 2007). Important to note, however, reactive aggression was unrelated to the initiation of alcohol use. Thus, it appears that reactive aggression is associated with tobacco and marijuana, not alcohol, use initiation through this complex chain in early adolescence. Tobacco and marijuana use were less prevalent and this may be indicative of more deviant SU behavior, and thus reactive aggression may be associated with more deviant drug use behavior.

On the other hand, reactive aggression was also found to be directly negatively associated with risk for initiation of tobacco use and indirectly negatively associated with risk for initiation of tobacco and marijuana use through peer delinquency. That is, high levels of reactive aggression that did not lead to peer rejection were associated with low levels of peer delinquency, which in turn were associated with decreased risk for tobacco and marijuana use initiation. These low-risk effects of reactive aggression are also consistent with what we found in our previous study that examined frequency of combined SU (Fite et al. 2007). Previous research suggests that high levels of reactive aggression are associated with hypervigilance of cues that may signal threat or punishment (Dodge 1991). Accordingly, reactive aggression that does not lead to peer rejection may lead to avoidance of delinquent peers and substances for fear of negative consequences. Thus, reactive aggression appears to be both positively and negatively associated with risk for marijuana and tobacco use initiation, and peer rejection plays a key role in whether or not reactive aggression is positively or negatively associated with substance use.

We expected reactive aggression to be positively associated with substance use initiation through peer rejection, because SU can be viewed as a way to cope with emotional

distress associated with peer rejection. However, there was no support for this relation. Peer rejection may not be positively associated with substance use initiation until later in adolescence, when substance use is perceived as a functional behavior that can self-medicate emotional distress. Alternatively, self-medication may not be a primary motive for the initiation of SU, and so peer rejection may not be associated with initiation of SU. It will be important for future studies to examine the association between reactive aggression and substance use in later adolescence before firm conclusions about the role of rejection can be made.

#### Limitations and Conclusions

The current study used a sample of high risk aggressive youth, which may limit the generalizability of findings. However, examining these processes within this at risk group provides important information on etiology that can inform preventive interventions targeting aggressive children. Nonetheless, it will be important for findings to be replicated using a more diverse sample with respect to ethnicity and aggression to establish the generalizability of findings. Furthermore, the current study examined proactive and reactive aggression at fifth grade, and relations may be different if aggression were assessed at earlier or later ages. Future studies should examine the relation between proactive and reactive aggression and substance use at different ages in order to determine the developmental generalizability of findings. Another limitation of the current study is that proactive and reactive aggression and peer rejection were assessed at fifth grade. Thus, one cannot conclude that reactive aggression leads to peer rejection, because peer rejection was also assessed in fifth grade. However, we note that previous longitudinal research has found that aggression leads to peer rejection (e.g., Dodge 1983; Fergusson et al. 1999). Nonetheless, caution should be taken when drawing conclusions regarding the risk pathway from reactive aggression to substance use that was mediated through peer rejection. There is also some evidence suggesting that reliance on children's report of peer behavior can inflate the relation between peer context and problem behavior, because they attribute some of their own behavior to the behavior of their peers (Ennett and Bauman 1993). Future studies should include multiple informants of peer delinquency. In addition, we did not have a measure of peer delinquency prior to eighth grade. Therefore, eighth grade peer delinquency was used to predict the risk of substance use initiation from fourth to ninth grade, which implies that peer delinquency was stable from fourth to ninth grade. It would be useful for future research to assess peer delinquency at each time point that SU is assessed. Finally, the substance use questions were worded as "Have you EVER", which includes use with

parental permission. Pathways to use with and without parental permission may be different, particularly with respect to alcohol use. Therefore, future studies may want to examine whether the proposed pathways are different for alcohol use that occurs with and without parental permission. In addition, it will be important for future research to examine potential moderators of these pathways, particularly the pathways from reactive aggression to substance use. Identifying key moderators (e.g., parenting and temperament) might help determine if/when reactive aggression is a risk factor of substance use initiation.

Despite these limitations, there are important intervention implications of the current study. Early initiation of SU is an important predictor of substance related problems (Kandel and Davies 1992), and findings suggest that both proactive and reactive aggression are risk factors for early SU initiation, but through different pathways. Moreover, pathways from proactive and reactive aggression to SU initiation and frequency of use appear to be similar, with the exception of alcohol use, suggesting that SU initiation and SU escalation prevention and intervention strategies should be similar with regard to the role of peers.

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