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Developmental Pathways Linking Externalizing Symptoms, Internalizing Symptoms, and Academic Competence to Adolescent Substance Use

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Abstract

This study extends previous research investigating the developmental pathways predicting adolescent alcohol and marijuana use by examining the cascading effects of externalizing and internalizing symptoms and academic competence in the prediction of use and level of use of these substances in adolescence. Participants ($N = 191$) were drawn from a longitudinal study of first-born children of low-income mothers. Using data from ages 7, 9, 12, and 16 years, a series of nested two-part (semi-continuous) path models from a developmental cascade modeling framework were compared. Controlling for gender, SES, mother's age at child's birth, and minority status, we found (a) within-domain rank order stability across time, (b) significant cross-domain effects over time, (c) higher externalizing symptoms significantly predicted use of alcohol and marijuana as well as higher levels of use in adolescence, and (d) higher levels of academic competence significantly added to the prediction of use of alcohol.

Keywords

Alcohol use; marijuana use; externalizing symptoms; internalizing symptoms; academic achievement; adolescent substance use

Data on prevalence and age-related patterns of substance use and substance use disorders (Johnston, O'Malley, Bachman, & Schulenberg, 2010), indicate that alcohol use and, to a somewhat lesser extent, marijuana use, are common during adolescence and suggest that a developmental approach to the study of substance use is needed (Masten, Faden, Zucker & Spear, 2009). The examination of adolescent and early adult substance use and substance use disorders from a developmental perspective has recently received attention (Chassin, Hussong, & Beltran, 2009; Haller, Handley, Chassin, & Bountress, 2010; Lynne-Landsman, Bradshaw, & Jalongo, 2010; Rogosch, Oshri, & Cicchetti, 2010; Tarter, 2002;); however, additional research elucidating the transactional nature of salient developmental domains in the prediction of adolescent substance use is warranted (Haller et al., 2010; Masten, Faden, Zucker, & Spear, 2008; Zucker, 2008; Zucker, Donovan, Masten, Mattson, & Moss, 2009).

Developmental models demonstrate that prior to the actual onset of substance use individuals may be situated on developmental pathways that increase (or decrease) the likelihood of adolescent substance use behavior (Jester et al., 2008; King, Iacono, & McGue, 2004; Rogosch et al., 2010; Tarter, 2002; Zucker, Donovan, Masten, Mattson, & Moss,

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2008) and that these pathways may have an effect on not only concurrent adaptation (Best, Manning, Gossop, Gross, & Strang, 2006; Laukkanen, Shemeikka, Viinamäki, Pölkki, & Lehtonen, 2001), but also on adult adaptation and substance use behavior (e.g., Brook, Adams, Balka, & Johnson, 2002; Englund, Egeland, Oliva, & Collins, 2008; Fergusson & Boden, 2008; Guo, Collins, Hill, & Hawkins, 2000; Schulenberg et al., 2005; Wells, Horwood, & Fergusson, 2004; Zucker, 2008; Zucker et al., 2008). One firmly established developmental pathway in the substance use literature is an externalizing symptom pathway (Costello, 2007; Fergusson, Horwood, & Ridder, 2007; Rogosch et al., 2010; Wittchen et al., 2007; Zucker, 2006). Externalizing symptoms in childhood and adolescence have been closely linked with both internalizing symptoms and academic competence (Moilanen, Shaw, & Maxwell, 2010) with each of these factors investigated separately as predictors of substance use (Brook et al., 2002; King et al., 2004; Wittchen et al., 2007). More recently two and, in some cases, all three of these pathways have been examined together in developmental cascade models, although not always in relation to adolescent substance use (Burt & Roisman, 2010; Masten et al., 2005; Moilanen et al., 2010; Rogosch et al., 2010). Research examining the cascading effects of these factors over time, however, is limited. Furthermore, no studies were found examining these three pathways together in one model predicting to adolescent substance use, despite the potential transactional relation between these pathways in the prediction of adolescent substance use behaviors. In the current study we model the developmental and transactional processes of externalizing symptoms, internalizing symptoms, and academic competence longitudinally from age 7 to 16 years in the prediction of both adolescent alcohol and cannabis use in a low-income sample.

Theoretical Approach

We investigate pathways leading to adolescent substance use from an organizational developmental tasks perspective utilizing a cascade modeling framework. This perspective views development as a process whereby individuals go through periods of behavioral reorganization during which they confront important developmental tasks; how individuals negotiate these developmental tasks depends on both previous development as well as current circumstances (Roisman, Masten, Coatsworth, & Tellegen, 2004; Sroufe, 1979; Sroufe, Egeland, Carlson, & Collins 2005). Developmental cascade models frame developmental adaptation as the cumulative effect of within- and cross-domain influence (Masten & Cicchetti, 2010; Masten et al., 2005). Combining the organizational developmental task perspective with a cascade modeling approach suggests a process whereby success or failure within one salient domain of development will likely influence future success or failure both within developmental domains and across other salient domains (Masten, Burt, & Coatsworth, 2006; Masten & Cicchetti, 2010; Sroufe et al., 2005). From this perspective, we postulate that the key to identifying important developmental pathways leading to adolescent substance use behavior is the consideration of salient developmental tasks of childhood that may be central to these early pathways and the identification of important transactional processes between these tasks across development.

Risk Factors for Adolescent Substance Use

Important developmental tasks in childhood include self-control, academic competence, and the development of rule-governed conduct (Masten & Coatsworth, 1998; Zucker et al., 2009). Both internalizing symptoms, such as anxiety and distress, and externalizing symptoms, such as aggression and disruptive behavior, have been conceptualized as varying manifestations of aspects of self-control and behavioral adjustment (Bornstein, Hahn, & Haynes, 2010; Masten & Coatsworth, 1998). Furthermore, externalizing symptoms, internalizing symptoms, and academic factors (e.g., academic failure) have been identified as risk factors for adolescent substance use (Costello, 2007; Hawkins, Catalano, & Miller,

1992), with a growing body of literature suggesting pathways leading from early emotion regulation, aggression, and academic problems to later substance use disorders (e.g., Masten et al., 2009; Zucker, 2006; Zucker et al., 2008).

Externalizing symptoms

A developmental pathway defined by externalizing symptoms leading to adolescent substance use is one of the most replicated cross-sectional and prospective findings in the literature (Costello, 2007). High rates of externalizing symptoms (e.g., aggression, delinquency) in adolescence have been shown to be related contemporaneously to the increased likelihood of alcohol and marijuana use, binge drinking, and frequent intoxication (Best et al., 2006; Fergusson, Horwood, & Swain-Campbell, 2002; Huang, White, Kosterman, Catalano, Hawkins, 2001; Stronski, Ireland, Michaud, Narring, & Resnick, 2000; Swaim, Deffenbacher, & Wayman, 2004; Van Kammen, Loeber, & Stouthamer-Loeber, 1991; Verdurman, Monshouwer, van Dorsselaer, Bogt, & Vollebergh, 2005). Prospectively, hyperactivity, conduct problems, aggressiveness, attention difficulties, and externalizing disorders in childhood have been associated with early onset alcohol use, as well as alcohol and marijuana use, regular marijuana use, heavy alcohol use, frequency of intoxication, persistent alcohol and drug use, and alcohol-related problems in mid- to late adolescence (Fergusson & Lynskey, 1998; Fergusson, Lynskey, & Horwood, 1997; Jester et al., 2008; King et al., 2004; Kumpulainen, 2000; Loeber, Stouthamer-Loeber, & White, 1999; Niemelä et al., 2006; Reboussin, Hubbard, & Ialongo, 2007; Rogosch et al., 2010; Stice, Barrera, & Chassin, 1998; Timmermans, van Lier, & Koot, 2008; Windle, 1993). Researchers examining the effects of externalizing symptoms in childhood on later substance use in cascade models have also found support for an externalizing pathway (Dodge, Malone, Lansford, Miller, Pettit, & Bates, 2009; Lynne-Landsman et al., 2010; Rogosch et al., 2010).

Internalizing symptoms

Similar to externalizing symptoms, researchers have examined internalizing symptoms as a predictor of substance use; this pathway has also been postulated as leading to substance use behaviors (Zucker, 2006). A concurrent association between higher levels of internalizing symptoms (e.g., depression) and alcohol consumption, excessive drinking, and cannabis use in middle adolescence to early adulthood is evident (Best et al., 2006; Fergusson et al., 2002; Koskelainen & Sourander, 2001; McGee, Williams, Poulton, & Moffitt, 2000). However *less* withdrawn behavior has also been associated with more frequent alcohol use among 12 to 16 year olds (Verdurmen et al., 2005). Prospective, longitudinal data yields less consistent associations than those found concurrently. High levels of internalizing symptoms earlier in development have predicted both *greater* and *lesser* involvement with substances later in life (King et al., 2004; Kumpulainen, 2000; Maggs, Patrick, & Feinstein, 2008; Niemelä et al., 2006; Steele, Forehand, Armistead, & Brody, 1995) suggesting that the effects of internalizing symptoms on later substance use behaviors may be more nuanced than that of externalizing symptoms. Maggs et al. (2008), for instance, found that internalizing symptoms in middle childhood and early adolescence predicted lower levels of weekly alcohol consumption at age 16 for males, but not for females, in their British cohort study. However, Pardini, White, and Stouthamer-Loeber (2007) investigating males in the Pittsburgh Youth Study found that higher levels of depression in early adolescence predicted symptoms of alcohol use disorders in early adulthood but only for boys who also had high levels of conduct disorder symptoms; they also found that high levels of anxiety/withdrawal symptoms in adolescence predicted lower levels of alcohol use disorder in early adulthood. Then again, Wittchen et al. (2007) investigating German youth found, after controlling for externalizing disorders, age, and gender, that early adolescents with major depression/dysthymia and panic-anxiety disorders had higher levels of cannabis use ten years later

compared to those adolescents without these disorders. Furthermore, in a developmental cascade model, Rogosch and colleagues (2010) discovered that internalizing symptoms in early adolescence negatively predicted cannabis symptoms in mid-late adolescence after controlling for the effects of externalizing symptoms; they did not, however, find this association earlier in development. Given these, as well as other, complex and nuanced results from longitudinal research, the influence of internalizing symptoms in pathways leading to adolescent substance use is currently unclear; however, recent studies do suggest a potential interactional process between externalizing and internalizing symptoms in the prediction of later substance use.

Academic competence

Researchers have found academic competence to be both a protective and a risk factor for adolescent substance use. In studies examining concurrent associations between academic factors and substance use, academic failure, both in terms of grades and standardized achievement tests, is associated with a higher likelihood of using alcohol in the past month, engaging in heavy drinking, experiencing intoxication, and initiating and using marijuana compared to higher achieving youth (Abdelrahman, Rodriguez, Ryan, French, & Weinbaum, 1998; Clark, Belgrave, & Nasim, 2008; Ellickson, Tucker, Klein, & Saner, 2004; Gutierrez, Molof, & Ungerleider, 1994; Henry, Smith, & Caldwell, 2007; Jeynes, 2002; Laukkanen et al., 2001; McBroom, 1994; O'Malley, Johnston, & Bachman, 1998; Williams et al., 2007; Zufferey et al., 2007). Prospective inquiries, however, reveal that the prediction of adolescent substance use from earlier academic competence is not as straightforward as these studies suggest. For example, in a longitudinal study of inner-city, African American youth, researchers discovered that students with high reading scores and high IQs in first grade were more likely to initiate alcohol and marijuana use earlier in development than their lower-performing peers (Fleming, Kellam, & Brown, 1982). In contrast, Crosnoe and Riegle-Crumb (2007) found that high school students who were taking more advanced mathematics coursework, independent of GPA, were less likely to consume alcohol and binge drink compared to their counterparts, but were more likely to drink and binge drink after completion of high school. Of particular interest are findings from one study (Harty, Thorn, Kalmar, Newcorn, & Halperin, 2004) indicating that the frequency, intensity, and severity of adolescent substance use was predicted from the interaction between middle childhood conduct disorder behavior and standardized achievement test scores in reading and arithmetic; the interaction of conduct disorder with higher reading and arithmetic scores *increased* the probability of later substance use. Haller and colleagues (2010) in a developmental cascade model linking substance use, peer affiliation, and academic achievement found that lower levels of academic achievement at wave 2 ($M = 14$ years) predicted to higher levels of drug use one year later (after controlling for gender, age, and both earlier drug use and substance use promoting peers), but did not find a significant path from academic achievement to binge drinking across the same time points. Similar to the research on internalizing symptoms and substance use, the existing literature regarding the longitudinal effects of academic competence on alcohol and marijuana use is complex. This complexity may be due to a host of factors, including what variables are controlled for, e.g., SES, gender, ethnicity (Bryant, Schulenberg, O'Malley, Bachman, & Johnston, 2003; Ludden & Eccles, 2007), the outcome examined (Hops, Davis, & Lewin, 1999), or different definitions of academic competence (Abdelrahman et al., 1998; Crum, Storr, & Anthony, 2005; Fleming et al., 1982; O'Malley et al., 1998).

Developmental Cascade Models

The transactional relations between externalizing symptoms, internalizing symptoms, and academic competence across time has recently been explored from a developmental cascade perspective; however, none of the studies examining all three constructs explored the

interrelation between these pathways in the prediction of adolescent substance use. All three studies found support for within-construct continuity across the time frames studied (Burt & Roisman, 2010; Masten et al., 2005; Moilanen et al., 2010), however, cross-lag paths, controlling for both within-construct continuity and within-time association, illustrated some variability across the studies.

Masten et al. (2005) studying a low to middle-income sample examined externalizing symptoms, internalizing symptoms, and academic achievement beginning at 8 years (range = 8–12 years) with follow-ups 7 years, 10 years, and 20 years after the first assessment. For the time period covering childhood through adolescence, they observed that externalizing symptoms in childhood (8–12 years) had negative effects on adolescent academic competence (15–19 years), but did not find any cross-lag effects with internalizing symptoms during this time period, nor did they find an effect from academic competence to externalizing symptoms.

Two studies have looked at these three constructs in more detail from childhood to adolescence using developmental cascade modeling. Similar to Masten et al. (2005), Moilanen and colleagues (2010) studying a group of at-risk boys across elementary school age also found a significant negative path from externalizing symptoms to academic competence; externalizing symptoms at 6 and 8 years negatively affected academic competence at 8 and 10 years respectively, but not from ages 10 to 11 years or 11 to 12 years. They also observed a positive effect from externalizing symptoms to internalizing symptoms at both 6 to 8 years and 11 to 12 years, such that higher levels of externalizing symptoms predicted higher levels of internalizing symptoms at the next time period, but did not observe this association in the intervening time periods. Furthermore, Moilanen et al. found significant negative paths from academic competence to internalizing symptoms at 8 to 10 years and 10 to 11 years, and from academic competence to externalizing symptoms at 10 to 11 years and from 11 to 12 years. Their results suggest that externalizing symptoms early in elementary school negatively influence at-risk boys' academic competence, and that this lower level of academic competence then leads to further increases in boys' externalizing symptoms and internalizing symptoms in pre-adolescence. Burt and Roisman (2010) in their examination of participants in the NICHD Study of Early Child Care and Youth Development found a similar result from preschool to third grade; they observed a negative cascade from preschool externalizing symptoms to academic competence in first grade which then lead to higher levels of both externalizing symptoms and internalizing symptoms in third grade. They also found a negative path from externalizing symptoms in fifth grade to academic competence at 15 years; they did not, however, find any cross-lag paths from internalizing symptoms to later academic competence or externalizing symptoms.

Taken together, these studies suggest that early externalizing symptoms set in motion a cascading effect leading to lower levels of academic competence which then leads to increased levels of externalizing behaviors; the cross-lag effects involving internalizing behaviors is less clear, and the influence of possible cascading effects of externalizing behaviors, internalizing behaviors, and academic competence on adolescent substance use has not been previously explored. Continued effort to illuminate the developmental pathways leading to adolescent alcohol and marijuana use will not only advance the field, but also has the potential to contribute to the development of innovative intervention strategies for children at greatest risk of developing later alcohol and marijuana use disorders (Masten et al., 2008).

Current Study

The current study examines the longitudinal impact of externalizing symptoms, internalizing symptoms, and academic competence beginning in childhood and extending through middle adolescence to predict adolescent alcohol and marijuana use in a developmental cascade model. We tested a series of nested models predicting to substance use in adolescence, evaluating within domain stability across time (model 1), cross-lag effects of externalizing symptoms on later academic competence and internalizing symptoms (model 2), cross-lag effects of (a) externalizing symptoms on later academic competence and internalizing behaviors and (b) academic competence on later externalizing and internalizing symptoms (model 3), and a full cross-lag model wherein all variables were predicted to affect later variables across all domains (model 4). We controlled for within time covariance across domains in all models as well as gender, SES, minority status, and mother's age at child's birth. We hypothesized that:

1. Rank-order stability would be observed in externalizing symptoms, internalizing symptoms, and academic competence from age 7 through age 16 years.
2. Cross-lag relations between the domains across time would be observed similar to those found in earlier studies (Burt & Roisman, 2010; Masten et al., 2005; Moilanen et al., 2010) examining externalizing symptoms, internalizing symptoms, and academic competence. Specifically, earlier externalizing symptoms were expected to negatively affect later academic competence and increase later internalizing symptoms, and poor academic competence was expected to increase externalizing and internalizing symptoms over time. Based on previous cascade models, we did not expect to find a cross-lag path from internalizing symptoms to later academic achievement or externalizing symptoms.
3. Consistent with prior research, we expected that higher levels of externalizing symptoms and would be associated with both adolescent alcohol use and marijuana use.
4. Although more tentative, we based our hypothesis regarding the prediction of substance use from internalizing symptoms on results from Rogosch et al. (2010) and Maggs et al. (2008) and expected that higher levels of internalizing symptoms would be related to lower levels of cannabis use and lower levels of alcohol use after controlling for externalizing behaviors and academic competence.
5. Due to the nuanced literature predicting substance use from academic competence, and in consideration of the controls included in our models as well as the inclusion of both externalizing and internalizing symptoms, we tentatively hypothesized that lower levels of academic competence would increase adolescent marijuana use, but would not have an effect on alcohol use.

Method

Participants

Participants ($N = 191$; 105 males, 86 females) were drawn from a longitudinal study of first-born children of mothers who were below the poverty level (see Egeland & Brunnequell, 1979). Women receiving prenatal care through the Minneapolis Health Department between the years 1975 and 1977 were recruited for the study during their third trimester of pregnancy. In the current sample, the mothers' ages at delivery ranged from 12 to 34 ($M = 20.58$; $SD = 3.74$). Sixty-three percent of the mothers were unwed and 39% had not completed high school at the time of their child's birth. Eighty-three percent of mothers were Caucasian, 12% were African American, and 5% were Native American, Hispanic, or Asian.

Sixty-six percent of the adolescents were Caucasian, 12% were African American, 2% were Native American, Hispanic, or Asian, 17% were mixed ethnicity, and 3% had missing data.

The current study included all participants who had any data from ages 7 years through 16 years. Of the 267 original participants, 72% are included in this study. To assess whether the sample used in this study was representative of the original sample, comparisons were made between the current participants and those not included in these analyses ($N = 76$) for demographic variables obtained prenatally or at birth. No significant differences were found for prenatal SES, age of the mothers at the birth of their children, mothers' educational level at the birth of their children, mother's race, or marital status at the children's birth. The children in the retained sample were significantly more likely to have two Caucasian parents ($\chi^2 = 4.56, p < .05$). Additionally, analysis of missing data for the full sample ($N = 267$) was conducted to examine whether missingness was related to the value of the variables under investigation (Schafer & Graham, 2002), only child's minority status was significantly correlated with missingness. Given that we did not have any data from ages 7 to 16 years (the time period of our study) on 76 participants, we dropped those participants from further analyses. Analysis of missing data for the sample of participants with any data from ages 7 to 16 years ($N = 191$) was conducted to determine whether missingness was related to the value of the variables under investigation; missingness was not significantly related to any variables under investigation in the model, including covariates. Descriptive statistics for the measures for participants included in the analyses are reported in Table 1.

Adolescent Substance Use, Age 16

Participants completed a modified version of the Adolescent Health Survey (AdoHS; Blum, Resnick, & Bergeisen, 1989) at age 16. The AdoHS is a self-report questionnaire that assesses risk factors for physical and/or emotional health, including alcohol and marijuana use behavior.

Frequency of alcohol and marijuana use—Adolescents reported frequency of alcohol and marijuana use by answering the following question: "How often do you use the following (without a doctor telling you to)?" Responses were reported on a 6-point scale from "never" (0) to "daily" (5).

Quantity of alcohol use—Adolescents reported on the amount of alcohol they used per occasion by answering the following question: "If you drink beer/wine/hard liquor, generally how much do you drink at one time?" Responses were reported on a 7-point scale from "I don't drink beer/wine/hard liquor" (0) to "6 or more drinks" (6).

For alcohol use, a composite measure of alcohol use at age 16 was created from frequency of alcohol use times quantity of alcohol use. Both alcohol frequency x amount and marijuana frequency, were zero-inflated (50% indicated no use of alcohol; 72% indicated no use of marijuana; see Table 1).

Developmental Predictors

Externalizing and internalizing symptoms—When the participants were 7, 9, and 12 years old, their teachers completed the Teacher's Report Form (TRF; Achenbach & Edelbrock, 1986). The TRF is designed to obtain informants' reports of individual children's problems and adaptive functioning in a standardized format. Teachers rated the items on the behavior checklist on a 3-point scale of 0 = *not true*, 1 = *somewhat or sometimes true*, and 2 = *very true or often true*. Broad-band externalizing and internalizing scales were developed through factor analysis of items (Achenbach & Edelbrock, 1986). The authors report adequate two-week test-retest reliabilities for the TRF subscales and the internalizing and

externalizing scales ranging from .70 to .92, and good convergent and criterion-related validity. The externalizing and internalizing normalized *t* scores were used in the current study.

At age 16, the adolescents completed the Youth Self Report (YSR; Achenbach, 1991). This is a 119 item checklist scored similarly to the TRF but completed by the adolescent in a self-report format. The authors report a seven-day test-retest reliability of .91 for 15–18 year olds. The YSR was used as there is evidence to suggest that other informants may not be fully aware of all of the adolescent's behavior problem symptoms, especially internalizing symptoms (Achenbach, McConaughy, & Howell, 1987; Sourander, Helstelä, & Helenius, 1999; Youngstrom, Loeber, & Stouthamer-Loeber, 2000).

Academic competence—Academic competence at ages 7, 9, 12, and 16 years was assessed in the spring of the year via teacher ratings of the child's overall academic progress compared to typical students in the same grade. Each child's progress was rated by their teachers at 7, 9, and 12 years on a 5-point scale ranging from very poor to outstanding. At age 16, each child's progress was rated by their English teachers on a 7-point scale ranging from very low to excellent. Given that our participants attended numerous schools, this measure facilitated an equivalent assessment of academic progress across various grading systems used within different schools and across grade levels.

Covariates

Gender—Males were coded 1 and females were coded 2.

Household socioeconomic status (SES) Prenatal—When the mother's were in their third trimester of pregnancy, household SES was assessed based on the mean of *z*-scores from three sources: household Socioeconomic Index (SEI), mother's level of education in years, and household income. The SEI assesses occupational status given levels of income and education and is sensitive to differences among middle to low SES groups. A revised version of the Duncan SEI (Duncan, 1961; Stevens & Featherman, 1981) was used to determine the occupation receiving the highest SEI score in the household. Participants' mothers reported on their educational level and household income. The *z*-score mean for the three sources was then transformed into *t*-scores; low scores represent lower levels of SES.

Mother's age at child's birth—The age of the mothers in years at the time of their child's birth was obtained from hospital records.

Child's minority status—The race/ethnicity of each child was obtained from clinic/hospital records. Race/ethnicity was then dummy coded as white/non-minority (1; 65.6%) vs. non-white/minority (2; 30.7%). The remainder of the sample (3.6%) was missing data on this variable.

Data Analysis Plan

We developed and tested four proposed path analysis models using MPlus version 6.1 (Muthén & Muthén, 1998–2010). Since both alcohol frequency x amount and marijuana frequency were zero-inflated, we conducted two-part (semi-continuous) models with an MLR (maximum likelihood with robust standard errors) estimator and an integration algorithm. The two-part model is appropriate when the variable has a floor effect, such as a large amount of zeros in the outcome data, and analyzes outcome variables as both a binary and a continuous variable (Muthén & Muthén, 1998–2010). Analyzing the data in this way allowed us to test predictors of the probability of use vs. non-use and the level of use for

those who used. Four nested models were tested separately for both alcohol and marijuana use (see Table 2).

The first model (within-domain model) tested paths within the same construct predicting to each of the outcome variables; this model examines whether paths from early measures of each specific construct to later measures of the same construct predict to later substance use, and, as such, examines within-domain stability across time. All of the other models included these same within-domain paths. In addition, all the models examined included within-time cross-sectional construct correlations. We tested three additional models to further explore possible across time linkages between these constructs. The second model (externalizing cascades model) added cross-domain paths from externalizing symptoms to later internalizing symptoms and academic competence. This model tests the hypothesis that externalizing symptoms affect later internalizing symptoms and later academic competence. The third model (academic cascades model) added cross-domain paths from academic competence to later internalizing and externalizing symptoms. This model examines whether paths from academic competence to later externalizing and internalizing symptoms are evident in addition to paths from externalizing symptoms to later academic competence and internalizing symptoms. The fourth model (full cascade model) added the remaining cross-domain paths from internalizing symptoms to later externalizing symptoms and academic competence. This model tested whether there was a cascading effect from all three measures at age 7 to 9 to 12 to 16 years across domains and tests the theoretical assumption that the predictor variables influence each other across time. In addition, all models tested the effects of 16 year externalizing symptoms, internalizing symptoms, and academic competence on 16 year substance use outcomes.

All paths in all of the models included gender, prenatal SES, mother's age at child's birth, and child's minority status as co-variables. Models for both alcohol use and marijuana use at 16 years were tested separately. To compare each of the models we used chi-square difference testing based on loglikelihood values and scaling correction factors (Muthén & Muthén, 1998–2010).

Missing data—All participants who had any data from ages 7 to 16 years were included in analyses ($N = 191$). Amount of missing data was low, ranging from 0% to 13.7% with a mean of 6.3% over all variables and all time points. Given that there was a very low rate of missing data and based on our analyses of missing data indicating that children's minority status was the only variable from the full sample associated with missingness (and no data from the current sample were associated with missingness), data were determined to be missing at random (Schafer & Graham, 2002) given our control variables. Full information maximum likelihood estimation (FIML) was used to allow analysis of the sample using MPlus (Muthén & Muthén, 1998–2010). FIML generates unbiased parameter estimates when data are missing at random (Graham, Cumsille, & Elek-Fisk, 2003; McDonald & Ho, 2002).

Results

Correlations

Zero-order correlations are reported in Table 3. Higher level of alcohol use was significantly associated ($p < .05$) with lower SES, non-minority status (both parents white), higher levels of externalizing at 7, 9, and 16 years, and higher levels of academic competence at 7 years. Higher level of marijuana use was significantly associated ($p < .05$) with higher levels of externalizing behavior at 7, 9, 12, and 16 years. Within-domain correlations indicated stability across time, and cross-lagged correlations were also evident.

Cascade Analysis

Table 4 shows the relative fit and the model comparisons using chi-square difference testing with robust estimation (Muthén & Muthén, 1998–2010) for the four cascade models for both alcohol and marijuana use. Model comparisons indicate that: (a) Model 1 (within-domain model) was not significantly different than Model 2 (externalizing cascade model: cross-domain paths from externalizing symptoms only) for either the alcohol models ($\Delta\chi^2(6) = 10.265$) or the marijuana models ($\Delta\chi^2(6) = 10.336$); (b) Model 3 (academic cascade model: cross-domain paths from externalizing symptoms and academic competence) was not significantly different than Model 2 for either the alcohol models ($\Delta\chi^2(6) = 10.193$) or the marijuana models ($\Delta\chi^2(6) = 10.416$); and (c) Model 4 (full cascade model) showed a significant increase in model fit from Model 3 for both the alcohol models ($\Delta\chi^2(6) = 12.597$; $p < .05$) and the marijuana models ($\Delta\chi^2(6) = 12.654$; $p < .05$). Given these results, Model 4 was determined to be the best fitting model.

Unstandardized and standardized parameter estimates as well as standard errors and confidence intervals for the full cascade models (Model 4) for alcohol and marijuana are reported in Tables 5 and 6 respectively. Figures 1 and 2 show the standardized path coefficients for significant paths for alcohol use and marijuana use respectively for the full cascade model. Omitted from the figures are paths not significant at $p < .05$ and significant paths from the covariates.

As hypothesized, externalizing symptoms, internalizing symptoms, and academic competence demonstrated within-domain stability across the entire time span under investigation (see Tables 5 and 6 and Figures 1 and 2). Significant within-time associations between all of the domains were also evident at 7, 9, and 12 years and between internalizing symptoms and externalizing symptoms at 16 years; although not significant at $p < .05$, within-time associations between academic competence and internalizing and externalizing symptoms were in the expected direction.

Statistically significant cross-domain paths estimated in the full cascade models are presented in Figures 1 and 2, and all estimated cross-domain paths are shown in Tables 5 and 6. Several significant cross-domain paths were observed from ages 7 to 12 years. Similar to findings from earlier research examining cascade models (Burt & Roisman, 2010; Moilanen et al., 2010), higher levels of academic competence at 9 years significantly predicted to lower levels of externalizing ($\beta = -.15$, $p < .05$) and internalizing symptoms ($\beta = -.20$, $p < .05$) at 12 years. Contrary to our expectations and previous work (Burt & Roisman, 2010; Masten et al., 2005; Moilanen et al., 2010), however, externalizing symptoms did not significantly predict to later academic competence or internalizing symptoms. Also diverging from our hypotheses, but similar to results found by Rogosch et al. (2010), a path was observed from internalizing symptoms at 7 years to externalizing symptoms at 9 years ($\beta = -.22$, $p < .01$) such that higher levels of internalizing symptoms lead to lower levels of externalizing symptoms. Internalizing symptoms at 9 years was also negatively related to academic competence at 12 years ($\beta = -.20$, $p < .05$). No significant cross-lag relations were observed from 12 years to 16 years.

Although our hypothesis regarding the prediction of marijuana and alcohol use from externalizing symptoms was supported, our other hypotheses regarding the prediction of substance use were not supported. As hypothesized, higher levels of externalizing symptoms added significantly to the prediction of both use vs. non-use and level of alcohol and marijuana use. Higher levels of externalizing symptoms at 16 years increased the odds of alcohol use [OR = 1.087] and the odds of marijuana use [OR = 1.187]; so that, for every one unit increase in externalizing symptoms, the odds of alcohol use increased by a factor of 1.087 and the odds of marijuana use increased by a factor of 1.187. In addition, contrary to

our expectations, the odds of alcohol use also increased with higher levels of academic competence [OR = 1.256]. Neither internalizing symptoms nor any of the control variables significantly predicted use vs. non-use of alcohol or marijuana. For those who used alcohol and marijuana, higher levels of externalizing symptoms ($\beta = .51, p < .001$ for alcohol; $\beta = .38, p < .001$ for marijuana) and lower levels of SES ($\beta = -.29, p < .05$ for alcohol; $\beta = -.48, p < .05$ for marijuana) significantly predicted higher levels of use, but neither internalizing symptoms nor academic competence added significantly to the prediction of level of use for either alcohol or marijuana.

Follow-up Gender Analysis

As a follow-up to our main analyses, we also conducted multiple group analyses to test for gender invariance across the full cascade models. Paths were constrained to be equal within each gender group and then cross-domain paths and paths from variables predicting to substance use were allowed to be freely estimated. A nested comparison of these two models did not show any significant difference for either the alcohol models ($\Delta\chi^2(30) = 24.802$) or the marijuana models ($\Delta\chi^2(30) = 34.684$), suggesting that the cross-domain paths and the paths predicting to substance use did not substantially differ by gender.

Discussion

In the current study we examined the developmental and transactional processes of externalizing symptoms, internalizing symptoms, and academic competence longitudinally from 7 to 16 years in the prediction of both adolescent alcohol and marijuana use, controlling for gender, prenatal SES, mother's age at child's birth, and minority status in a low-income sample. Although researchers have recently begun to examine the cascading effects between externalizing and internalizing symptoms and academic competence across childhood and into adolescence (Burt & Roisman, 2010; Masten et al., 2005; Moilanen et al., 2010), these studies are relatively rare, and the interrelation between these pathways in the prediction of adolescent substance use has not previously been explored. Four nested two-part (semi-continuous) path models were compared examining potential developmental cascading effects predicting to adolescent substance use. For both alcohol and marijuana use, the best fitting model was a full cascade model wherein earlier measures predicted to later measures both within and across domains. Rank-order stability of externalizing symptoms, internalizing symptoms, and academic competence from 7 through 16 years was demonstrated in the current study, consistent with previous studies examining these variables in cascade models (Burt & Roisman, 2010; Lynne-Landsman et al., 2010; Moilanen et al., 2010; Rogosch et al., 2010). Furthermore, and partially consistent with past research (Burt & Roisman, 2010; Masten et al., 2005; Moilanen et al., 2010) we observed cross-lag relations from (a) internalizing symptoms at 7 years negatively predicting to externalizing symptoms at 9 years, (b) internalizing symptoms at 9 years negatively predicting to academic competence at 12 years, and (c) academic competence at 9 years negatively predicting to both externalizing and internalizing symptoms at 12 years. We also found that higher levels of externalizing symptoms increased the odds of using alcohol and marijuana and predicted higher levels of use for both substances. Contrary to our hypotheses, however, higher levels of academic competence also increased the odds of using alcohol, but did not have an influence on level of alcohol use or marijuana use. Additionally, our hypothesis that internalizing symptoms would be associated with lower levels of substance use was not supported.

Our results supporting the hypothesis of rank order stability across development in externalizing symptoms, internalizing symptoms, and academic competence has also been found in a number of studies examining some or all of these constructs from a cascade perspective (Burt & Roisman, 2010; Masten et al., 2005; Moilanen, 2010; Rogosch et al.,

2010). Results indicating the stability of externalizing and internalizing symptoms and academic competence across time suggest that the emergence of high levels of externalizing and internalizing symptoms as well as academic failure early in development will likely portend the later occurrence of these problems into adolescence, and that interventions aimed at curtailing these difficulties may be more likely be effective earlier in development.

Our study also provides both supportive and contradictory evidence for specific cross-domain pathways across development. It has been suggested (Burt & Rosman, 2010; Masten et al., 2005) that a transactional relation occurs between externalizing symptoms and academic competence/failure, such that early externalizing symptoms lead to academic failure which then further increases externalizing symptoms and so forth. Although we did find support for a pathway leading from academic failure to higher levels of externalizing symptoms in middle childhood, contrary to more recent cascade modeling studies (e.g., Burt & Roisman, 2010; Masten et al., 2005; Moilanen et al., 2010), we did not find a cascading effect from early externalizing symptoms to later academic competence or later internalizing symptoms. Rogosch et al. (2010), although not examining academic competence, also did not find a pathway from externalizing symptoms to later internalizing symptoms in their study examining the role of maltreatment in situating individuals on maladaptive developmental pathways leading to cascading influences ultimately predicting to marijuana use in adolescence. Again, similar to the Rogosch study and opposite our hypothesis, we did find that early internalizing symptoms at 7 years decreased the likelihood of higher levels of externalizing symptoms at 9 years; we also found that higher levels of internalizing symptoms at 9 years predicted lower levels of academic competence at 12 years. Taken together, results examining cross-domain paths in our low-income sample indicate there are developmental transactional processes occurring prior to adolescence between externalizing symptoms, internalizing symptoms, and academic competence such that internalizing symptoms decrease both externalizing symptoms and academic competence, and academic failure increases both internalizing and externalizing symptoms.

Partial support was also found for our hypotheses regarding the predictors of adolescent substance use. In particular, support was found for our prediction of a positive relation between externalizing symptoms and both alcohol and marijuana use. We observed that externalizing symptoms early in development provides a basis for the continuation of externalizing symptoms across childhood and into adolescence, thereby increasing the probability of both alcohol and marijuana use by mid-adolescence. In addition to predicting any use of substances, externalizing symptoms also predicted higher levels of alcohol and marijuana use. These results are consistent with a well substantiated finding in the extant literature (Best et al., 2006; Fergusson & Lynskey, 1998; Fergusson et al., 1997; Huang et al., 2001; Jester et al., 2008; Niemelä et al., 2006; King et al., 2004; Loeber et al., 1999; Stice et al., 1998; Swaim et al., 2004; Verdurman et al., 2005; Windle, 1993; Zucker, 2008). Our hypotheses regarding academic competence and internalizing symptoms were not supported, however. Instead, we found no evidence of a direct effect from internalizing symptoms to substance use, and, the only effect found for academic competence was in opposition to our expectations. We hypothesized that academic failure would increase adolescents' use of marijuana but would not have effect on alcohol use; instead, we found that academic competence increased the probability of any alcohol use, but did not have an effect on either level of alcohol use or marijuana use.

Although at first glance it appears that the positive prediction of alcohol use from a history of academic competence contradicts much of past research findings (Abdelrahman et al., 1998; Crosnoe, 2006; Crosnoe & Riegle-Crumb, 2007; Ellickson et al., 2004; Henry et al., 2007; Jeynes, 2002; Laukkanen et al., 2001; Williams et al., 2007), alcohol use, in particular experimental use (e.g., infrequent and/or low-level use), is statistically, and arguably

developmentally normative in adolescence (Johnston et al., 2010; Newcomb & Bentler, 1988). Furthermore, past literature suggests that developmentally competent adolescents are likely to engage in experimental substance use (e.g., Baumrind, 1991; Masten et al., 2008). The lack of a direct effect from academic competence to any use of marijuana is more than likely due to the low level of use in our sample and the strong effect from externalizing symptoms. Our finding that academic competence predicted any use of alcohol but not level of use suggests that for our low-income sample, those adolescents who were academically competent were also more likely to experiment with alcohol compared to those who were doing poorly in school, and that academic failure did not lead to either use of marijuana or level of alcohol or marijuana use at age 16. Fleming et al. (1982) also found somewhat similar results in their inner-city, African American sample; first graders who were doing better academically were more likely to initiate substance use earlier in development compared to their less academically inclined peers.

Limitations and Conclusions

The longitudinal, prospective nature of our study allowed us to obtain frequent, comprehensive assessments of our participants. However, as with any study of this nature, the sample size is relatively limited; the study should, therefore, be replicated with larger samples. The small sample size may have precluded us from finding any gender differences, and, given the possibility that gender may have an effect on the type of behaviors examined in this study it is important for larger studies to further explore the differential effects of gender in their research. An additional limitation of our study is that 66% of our sample was Caucasian. Given that research indicates that there are different substance use rates as a function of ethnic group status (Johnston et al., 2010), it is important to continue to explore developmental pathways as they relate to adolescent substance use among more ethnically diverse samples. Furthermore, we would caution against over generalizing the results of our study to other populations as the current study utilized a low-income sample. Despite the truncated sample, we did observe that adolescents born into the lowest levels of SES within our low-income sample were more likely to have engage in higher levels of alcohol and marijuana use, even after controlling for other covariates (gender, minority status, mother's age at child's birth) externalizing and internalizing symptoms, and academic competence. Given that past research has reported inconsistent associations between SES and adolescent alcohol and marijuana use (Hanson & Chen, 2007), it is important to continue to explore the potential effects of SES on substance use in adolescence.

Despite these limitations, our research extends previous work examining both substance use and developmental cascades, and, given our controls, provides a rigorous test of the developmental pathways of externalizing symptoms, internalizing symptoms, and academic competence from 7 to 16 years leading to the prediction of adolescent alcohol and marijuana use in our low-income sample. Our study provides evidence that at least as early as age 7 individuals are situated on developmental pathways that increase or decrease the likelihood of adolescent substance use behavior. It is especially important to note that children in our sample who were more successful in school at 9 years were less likely to show internalizing or externalizing symptoms at 12 years. These results suggest that a potential intervention strategy to decrease children's internalizing and externalizing symptoms, and ultimately decrease adolescent substance use behaviors, is to provide academic support aimed at increasing school success at least as early as third grade. Given our findings regarding rank-order stability in these measures of competence in salient developmental tasks and the existence of developmental pathways leading to adolescent substance use beginning as early as first grade, it is imperative that programs aimed at substance use prevention and intervention begin early in development.

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References

- Abdelrahman AI, Rodriguez G, Ryan JA, French JF, Weinbaum D. The epidemiology of substance use among middle school students: The impact of school, familial, community and individual risk factors. *Journal of Child & Adolescent Substance Abuse*. 1998; 8(1):55–75.10.1300/J029v08n01
- Achenbach, TM. Manual for the youth self-report and 1991 profile. Burlington, VT: University of Vermont, Department of Psychiatry; 1991.
- Achenbach, TM.; Edelbrock, C. Manual for the teacher's report form and teacher version of the child behavior profile. Burlington, VT: University of Vermont, Department of Psychiatry; 1986.
- Achenbach TM, McConaughy SH, Howell CT. Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychological Bulletin*. 1987; 101(2):213–232.10.1037/0033-2909.101.2.213 [PubMed: 3562706]
- Baumrind D. The influence of parenting styles on adolescent competence and substance use. *Journal of Early Adolescence*. 1991; 11:56–95.10.1177/0272431691110004
- Best D, Manning V, Gossop M, Gross S, Strang J. Excessive drinking and other problem behaviours among 14–16 year old schoolchildren. *Addictive Behaviors*. 2006; 31(8):1424–1435.10.1016/j.addbeh.2005.12.002 [PubMed: 16442742]
- Blum, RW.; Resnick, MD.; Bergeisen, LG. The state of adolescent health in Minnesota. Minneapolis, MN: University of Minnesota Adolescent Health Program; 1989.
- Bornstein MH, Hahn C, Haynes OM. Social competence, externalizing, and internalizing behavioral adjustment from early childhood through early adolescence: Developmental cascades. *Development and Psychopathology*. 2010; 22(4):717–735.10.1017/S0954579410000416 [PubMed: 20883577]
- Brook JS, Adams RE, Balka EB, Johnson E. Early adolescent marijuana use: Risks for the transition to young adulthood. *Psychological Medicine: A Journal of Research in Psychiatry and the Allied Sciences*. 2002; 32(1):79–91.10.1017/S0033291701004809
- Bryant AL, Schulenberg JE, O'Malley PM, Bachman JG, Johnston LD. How academic achievement, attitudes, and behaviors relate to the course of substance use during adolescence: A 6-year, multiwave national longitudinal study. *Journal of Research on Adolescence*. 2003; 13(3):361–397.10.1111/1532-7795.1303005
- Burt KB, Roisman GI. Competence and psychopathology: Cascade effects in the NICHD study of Early Care and Youth Development. *Development and Psychopathology*. 2010; 22:557–567.10.1017/S0954579410000271 [PubMed: 20576178]
- Chassin, L.; Hussong, A.; Beltran, I. Adolescent substance use. In: Lerner, RM.; Steinberg, L., editors. *Handbook of adolescent psychology*. 1. Vol. 3. Hoboken, NJ: Wiley; 2009. p. 723-763. Individual bases of adolescent development
- Clark TT, Belgrave FZ, Masim A. Risk and protective factors for substance use among urban African American adolescents considered high-risk. *Journal of Ethnicity in Substance Abuse*. 2008; 7(3): 292–303.10.1080/15332640802313296 [PubMed: 19042811]
- Costello EJ. Psychiatric predictors of adolescent and young adult drug use and abuse: What have we learned? *Drug and Alcohol Dependence*. 2007; 88S:S97–S99.10.1016/j.drugalcdep.2006.12.027 [PubMed: 17276625]
- Crosnoe R. The connection between academic failure and adolescent drinking in secondary school. *Sociology of Education*. 2006; 79:44–60.10.1177/003804070607900103 [PubMed: 20216913]
- Crosnoe R, Riegle-Crumb C. A life course model of education and alcohol use. *Journal of Health and Social Behavior*. 2007; 48:267–282.10.1177/002214650704800305 [PubMed: 17982868]
- Crum RM, Storr CL, Anthony JC. Are educational aspirations associated with the risk of alcohol use and alcohol use-related problems among adolescents? *Substance use & Misuse*. 2005; 40:151–169.10.1081/JA-200047558 [PubMed: 15770882]

- Dodge KA, Malone PS, Lansford JE, Miller S, Pettit GS, Bates JE. A dynamic cascade model of the development of substance-use onset. *Monographs of the Society for Research in Child Development*. 2009; 294(3):1–134.
- Duncan, O. A socioeconomic index for all occupations. In: Reiss, AJ., Jr, editor. *Occupations and Social Status*. New York: Free Press; 1961. p. 109-138.
- Egeland B, Brunnequell D. An at-risk approach to the study of child abuse: Some preliminary findings. *Journal of the American Academy of Child Psychiatry*. 1979; 18:219–235. [PubMed: 447956]
- Ellickson PL, Tucker JS, Klein DJ, Saner H. Antecedents and outcomes of marijuana use initiation during adolescence. *Preventive Medicine: An International Journal Devoted to Practice and Theory*. 2004; 39(5):976–984.10.1016/j.ypmed.2004.04.013
- Englund MM, Egeland B, Oliva EM, Collins WA. Childhood and adolescent predictors of heavy drinking and alcohol use disorders in early adulthood: A longitudinal developmental analysis. *Addiction*. 2008; 103(Suppl1):23–35.10.1111/j.1360-0443.2008.02174.x [PubMed: 18426538]
- Fergusson DM, Boden JM. Cannabis use and later life outcomes. *Addiction*. 2008; 103(6):969–76.10.1111/j.1360-0443.2008.02221.x [PubMed: 18482420]
- Fergusson DM, Horwood LJ, Ridder EM. Conduct and attentional problems in childhood and adolescence and later substance use, abuse, and dependence: Results of a 25-year longitudinal study. *Drug and Alcohol Dependence*. 2007; 88:S14–S26.10.1016/j.drugalcdep.2006.12.011 [PubMed: 17292565]
- Fergusson DM, Horwood LJ, Swain-Campbell N. Cannabis use and psychosocial adjustment in adolescence and young adulthood. *Addiction*. 2002; 97(9):1123–1135.10.1046/j.1360-0443.2002.00103.x [PubMed: 12199828]
- Fergusson DM, Lynskey MT. Conduct problems in childhood and psychosocial outcomes in young adulthood: A prospective study. *Journal of Emotional and Behavioral Disorders*. 1998; 6(1):2–18.10.1177/106342669800600101
- Fergusson DM, Lynskey MT, Horwood LJ. Attentional difficulties in middle childhood and psychosocial outcomes in young adulthood. *Journal of Child Psychology and Psychiatry*. 1997; 38(6):633–644.10.1111/j.1469-7610.1997.tb01690.x [PubMed: 9315973]
- Fleming JP, Kellam SG, Brown CH. Early predictors of age at first use of alcohol, marijuana, and cigarettes. *Drug and Alcohol Dependence*. 1982; 9(4):285–303.10.1016/0376-8716(82)90068-0 [PubMed: 6982159]
- Graham, JW.; Cumsille, PE.; Elek-Fisk, E. Methods for handling missing data. In: Schinka, JA.; Velicer, WF., editors. *Handbook of psychology: Research methods in psychology*. Vol. 2. Hoboken, NJ: Wiley; 2003. p. 87-114.
- Guo J, Collins LM, Hill KG, Hawkins JD. Developmental pathways to alcohol abuse and dependence in young adulthood. *Journal of Studies on Alcohol*. 2000; 61:799–808. [PubMed: 11188485]
- Gutierrez SE, Molof M, Ungerleider S. Relationship of “risk” factors to teen substance use: A comparison of abstainers, infrequent users, and frequent users. *International Journal of the Addictions*. 1994; 29(12):1559–1579. [PubMed: 7836019]
- Haller M, Handley E, Chassin L, Bountress K. Developmental cascades: Linking adolescent substance use, affiliation with substance use promoting peers, and academic achievement to adult substance use disorders. *Development and Psychopathology*. 2010; 22:899–916.10.1017/S0954579410000532 [PubMed: 20883589]
- Harty SC, Thorn NK, Kalmar JH, Newcorn JH, Halperin J. The effect of childhood conduct disorder and cognitive functioning on adolescent substance use. *CNS Spectrums*. 2004; 9(9):661–666. [PubMed: 15337863]
- Hawkins JD, Catalano RF, Miller JY. Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin*. 1992; 112(1):64–105.10.1037/0033-2909.112.1.64 [PubMed: 1529040]
- Henry KL, Smith EA, Caldwell LL. Deterioration of academic achievement and marijuana use onset among rural adolescents. *Health Education Research*. 2007; 22(3):372–384.10.1093/her/cyl083 [PubMed: 16968870]

- Hanson MD, Chen E. Socioeconomic status and health behaviors in adolescence: A review of the literature. *Journal of Behavioral Medicine*. 2007; 30:263–285.10.1007/s10865-007-9098-3 [PubMed: 17514418]
- Hops H, Davis B, Lewin LM. The development of alcohol and other substance use: A gender study of family and peer context. *Journal of Studies of Alcohol*. 1999; 13:22–31.
- Huang B, White HR, Kosterman R, Catalano RF, Hawkins JD. Developmental associations between alcohol and interpersonal aggression during adolescence. *Journal of Research in Crime and Delinquency*. 2001; 38(1):64–83.10.1177/0022427801038001004
- Jester JM, Nigg JT, Buu A, Puttler LI, Glass JM, Heitzeg MM, Zucker RA. Trajectories of childhood aggression and inattention/hyperactivity: Differential effects on substance abuse in adolescence. *American Academy of Child and Adolescent Psychiatry*. 2008; 47(10):1158–1165.10.1097/CHI.0b013e3181825a4e
- Jeynes WH. The relationship between the consumption of various drugs by adolescents and their academic achievement. *American Journal of Drug and Alcohol Abuse*. 2002; 28(1):15–35.10.1081/ADA-120001279 [PubMed: 11853131]
- Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Secondary school students (NIH Publication No 10-7584). Vol. I. Bethesda, MD: National Institute on Drug Abuse; 2010. Monitoring the Future national survey results on drug use, 1975–2009.
- King SM, Iacono WG, McGue M. Childhood externalizing and internalizing psychopathology in the prediction of early substance use. *Addiction*. 2004; 99(12):1548–1559.10.1111/j.1360-0443.2004.00893.x [PubMed: 15585046]
- Koskelainen M, Sourander A. Self-reported alcohol use and behavioural problems among Finnish adolescents. *Psychiatria Fennica*. 2001; 32:57–66.
- Kumpulainen K. Psychiatric symptoms and deviance in early adolescence predict heavy alcohol use 3 years later. *Addiction*. 2000; 95(12):1847–1857.10.1046/j.1360-0443.2000.9512184713.x [PubMed: 11177499]
- Laukkanen ER, Shemeikka SL, Vinamäki HT, Pölkki PL, Lehtonen JO. Heavy drinking is associated with more severe psychosocial dysfunction among girls than boys in Finland. *Journal of Adolescent Health*. 2001; 28:270–277.10.1016/S1054-139X(00)00183-X [PubMed: 11287244]
- Loeber R, Stouthamer-Loeber M, White HR. Developmental aspects of delinquency and internalizing problems and their association with persistent juvenile substance use between ages 7 and 18. *Journal of Clinical Child Psychology*. 1999; 28(3):322–332.10.127/S15374424jccp280304 [PubMed: 10446681]
- Ludden AB, Eccles JS. Psychosocial, motivational, and contextual profiles of youth reporting different patterns of substance use during adolescence. *Journal of Research on Adolescence*. 2007; 17(1):51–88.10.1111/j.1532-7795.2007.00512.x
- Lynne-Landsman SD, Bradshaw CP, Ialongo NS. Testing a developmental cascade model of adolescent substance use trajectories and young adult adjustment. *Development and Psychopathology*. 2010; 22:933–948.10.1017/S095479410000556 [PubMed: 20883591]
- Maggs JL, Patrick ME, Feinstein L. Childhood and adolescent predictors of alcohol use and problems in adolescence and adulthood in the National Child Development Study. *Addiction*. 2008; 103(Suppl1):7–22.10.1111/j.1360-0443.2008.02173.x [PubMed: 18426537]
- Masten, AS.; Burt, KB.; Coatsworth, JD. Competence and psychopathology in development. In: Cicchetti, D.; Cohen, DJ., editors. *Developmental psychopathology*. 2. Vol. 3. Hoboken, NJ: Wiley; 2006. p. 696-783.
- Masten AS, Cicchetti D. Developmental cascades. *Development and Psychopathology*. 2010; 22:491–495.10.1017/S0954579410000222 [PubMed: 20576173]
- Masten AS, Coatsworth JD. The development of competence in favorable and unfavorable environments: Lessons from research on successful children. *American Psychologist*. 1998; 53(2):205–220.10.1037/0003-066X.53.2.205 [PubMed: 9491748]
- Masten AS, Faden VB, Zucker RA, Spear LP. Underage drinking: A developmental framework. *Pediatrics*. 2008; 121(suppl 4):S235–S251.10.1542/peds.2007-2243A [PubMed: 18381492]
- Masten AS, Faden VB, Zucker RA, Spear LP. A developmental perspective on underage alcohol use. *Alcohol Research & Health*. 2009; 32(1):3–15.

- Masten AS, Roisman GI, Long JD, Burt KB, Obradović J, Riley JR, Tellegen A. Developmental cascades: Linking academic achievement and externalizing and internalizing symptoms over 20 years. *Developmental Psychology*. 2005; 41(5):733–746.10.1037/0012-1649.41.5.733 [PubMed: 16173871]
- McBroom JR. Correlates of alcohol and marijuana use among junior high school students: Family, peers, school problems, and psychosocial concerns. *Youth and Society*. 1994; 26(1):54–68.10.1177/0044118X94026001003
- McDonald RP, Ho MR. Principles and practice in reporting structural equation analyses. *Psychological Methods*. 2002; 7:64–82.10.1037/1082-989X.7.1.64 [PubMed: 11928891]
- McGee R, Williams S, Poulton R, Moffitt T. A longitudinal study of cannabis use and mental health from adolescence to early adulthood. *Addiction*. 2000; 95(4):491–503.10.1046/j.1360-0443.2000.9544912.x [PubMed: 10829326]
- Moilanen KL, Shaw DS, Maxwell KL. Developmental cascades: Externalizing, internalizing, and academic competence from middle childhood to early adolescence. *Development and Psychopathology*. 2010; 22:635–653.10.1017/S095479410000337 [PubMed: 20576184]
- Muthén, L.K.; Muthén, B.O. *Mplus user's guide*. 6. Los Angeles, CA: Muthén & Muthén; 1998–2010.
- Newcomb, M.; Bentler, P. *Consequences of adolescent drug use: Impact on the lives of young adults*. Newbury Park: Sage; 1988.
- Niemelä S, Sourander A, Poikolainen K, Helenius H, Sillanmäki L, Parkkola K, ...Moilanen I. Childhood predictors of drunkenness in late adolescence among males: A 10-year-population-based follow-up study. *Addiction*. 2006; 101(4):512–521.10.1111/j.1360-0443.2006.01381.x [PubMed: 16548931]
- O'Malley PM, Johnston LD, Bachman JG. Alcohol use among adolescents. *Alcohol Health and Research World*. 1998; 22(2):85–93. [PubMed: 15706782]
- Pardini D, White HR, Stouthamer-Loeber M. Early adolescent psychopathology as a predictor of alcohol use disorders by young adults. *Drug and Alcohol Dependence*. 2007; 88:S38–S49.10.1016/j.drugalcdep.2006.12.014 [PubMed: 17257781]
- Reboussin BA, Hubbard S, Ialongo NS. Marijuana use patterns among African-American middle-school students: A longitudinal latent class regression analysis. *Drug and Alcohol Dependence*. 2007; 90(1):12–24.10.1016/j.drugalcdep.2007.02.006 [PubMed: 17379455]
- Rogosch RA, Oshri A, Cicchetti A. From child maltreatment to adolescent cannabis abuse and dependence: A developmental cascade model. *Development and Psychopathology*. 2010; 22:883–897.10.1017/S0954579410000520 [PubMed: 20883588]
- Roisman GI, Masten AS, Coatsworth JD, Tellegen A. Salient and emerging developmental tasks in the transition to adulthood. *Child Development*. 2004; 75(1):123–133.10.1111/j.1467-8624.2004.00658.x [PubMed: 15015679]
- Schulenberg JE, Merline AC, Johnston LD, O'Malley PM, Bachman JG, Laetz VB. Trajectories of marijuana use during the transition to adulthood: The big picture based on national panel data. *Journal of Drug Issues*. 2005; 35(2):255–280. [PubMed: 16534532]
- Shafer J, Graham J. Missing data: Our view of the state of the art. *Psychological Methods*. 2002; 7:147–177.10.1037/1082-989X.7.2.147 [PubMed: 12090408]
- Sourander A, Helstelä L, Helenius H. Parent-adolescent agreement on emotional and behavioral problems. *Social Psychiatry and Psychiatric Epidemiology*. 1999; 34(12):657–663.10.1007/s001270050189 [PubMed: 10703276]
- Sroufe LA. The coherence of individual development: Early care, attachment, and subsequent developmental issues. *American Psychologist*. 1979; 34(10):834–841.10.1037/0003-066X.34.10.834
- Sroufe, L.A.; Egeland, B.; Carlson, E.A.; Collins, W.A. *The development of the person: The Minnesota study of risk and adaptation from birth to adulthood*. New York: Guilford; 2005.
- Steele RG, Forehand R, Armistead L, Brody G. Predicting alcohol and drug use in early adulthood: The role of internalizing and externalizing behavior problems in early adolescence. *American Journal of Orthopsychiatry*. 1995; 65(3):380–388.10.1037/h0079694 [PubMed: 7485423]
- Stevens G, Featherman DL. A revised socioeconomic index of occupational status. *Social Science Research*. 1981; 10:364–395.

- Stice E, Barrera M Jr, Chassin L. Prospective differential prediction of adolescent alcohol use and problem use: Examining the mechanisms of effect. *Journal of Abnormal Psychology*. 1998; 107(4):616–628.10.1037/0021-843X.107.4.616 [PubMed: 9830249]
- Stronski SM, Ireland M, Michaud P, Narring F, Resnick MD. Protective correlates of stages in adolescent substance use: A Swiss national study. *Journal of Adolescent Health*. 2000; 26(6):420–427.10.1016/S1054-139X(99)00057-9 [PubMed: 10822184]
- Swaim RD, Deffenbacher JL, Wayman JC. Concurrent and prospective effects of multi-dimensional aggression and anger on adolescent alcohol use. *Aggressive Behavior*. 2004; 30(5):356–372.10.1002/ab.20090
- Tarter RE. Etiology of adolescent substance abuse: A developmental perspective. *American Journal on Addictions*. 2002; 11:171–191.10.1080/1055049029000879 [PubMed: 12202010]
- Timmermans M, van Lier PAC, Koot HM. Which forms of child/adolescent externalizing behaviors account for late adolescent risky sexual behavior and substance use? *Journal of Child Psychology and Psychiatry*. 2008; 49(4):386–394.10.1111/j.1469-7610.2007.01842.x [PubMed: 17979959]
- Van Kammen WB, Loeber R, Stouthamer-Loeber M. Substance use and its relationship to conduct problems and delinquency in young boys. *Journal of Youth and Adolescence*. 1991; 20(4):399–413.10.1007/BF01537182
- Verdurmen J, Monshouwer K, van Dorsselaer S, Bogt T, Vollebergh W. Alcohol use and mental health in adolescents: Interactions with age and gender-Findings from the Dutch 2001 Health Behaviour in school-aged children survey. *Journal of Studies on Alcohol*. 2005; 66:605–609. [PubMed: 16329458]
- Wells JE, Horwood LJ, Fergusson DM. Drinking patterns in mid-adolescence and psychosocial outcomes in late adolescence and early adulthood. *Addiction*. 2004; 99(12):1529–1541.10.1111/j.1360-0443.2004.00918.x
- Williams JH, Davis LE, Johnson SD, Williams TR, Saunders JA, Nebbitt VE. Substance use and academic performance among African American high school students. *Social Work Research*. 2007; 31(3):151–161.
- Windle M. A retrospective measure of childhood behavior problems and its use in predicting adolescent problem behaviors. *Journal of Studies on Alcohol*. 1993; 54:422–431. [PubMed: 8341044]
- Wittchen H, Fröhlich C, Behrendt S, Günther A, Rehm J, Zimmermann P, Perkonig A. Cannabis use and cannabis use disorders and their relationship to mental disorders: A 10-year prospective-longitudinal community study in adolescents. *Drug and Alcohol Dependence*. 2007; 88:S60–S70.10.1016/j.drugalcdep.2006.12.013 [PubMed: 17257779]
- Youngstrom E, Loeber R, Stouthamer-Loeber M. Patterns and correlates of agreement between parent, teacher, and male adolescent ratings of externalizing and internalizing problems. *Journal of Consulting and Clinical Psychology*. 2000; 68(6):1038–1050.10.1037/0022-006X.68.6.1038 [PubMed: 11142538]
- Zucker, RA. Alcohol use and the alcohol use disorders: A developmental-biopsychosocial systems formulation covering the lifecourse. In: Cicchetti, D.; Cohen, DJ., editors. *Developmental psychopathology*. 2. Vol. 3. Hoboken, NJ: Wiley; 2006. p. 620–656. Risk, disorder, and adaption
- Zucker RA. Anticipating problem alcohol use developmentally from childhood into middle adulthood: What have we learned? *Addiction*. 2008; 103(Suppl 1):100–108.10.1111/j.1360-0443.2008.02179.x [PubMed: 18426543]
- Zucker RA, Donovan JE, Masten AS, Mattson ME, Moss HB. Early developmental processes and the continuity of risk for underage drinking and problem drinking. *Pediatrics*. 2008; 21(Suppl 4):S252–S272.10.1542/peds.2007-2243B [PubMed: 18381493]
- Zucker RA, Donovan JE, Masten AS, Mattson ME, Moss HB. Developmental processes and mechanisms: Ages 0–10. *Alcohol Research & Health*. 2009; 32:16–29.
- Zufferey A, Michaud P, Jeannin A, Berchtold A, Chossis I, van Melle G, Suris JC. Cumulative risk factors for adolescent alcohol misuse and its perceived consequences among 16 to 20 year old adolescents in Switzerland. *Preventive Medicine*. 2007; 45:233–239.10.1016/j.ypmed.2007.04.015 [PubMed: 17573102]

Figure 1. Standardized path coefficients for tested paths of full cascade two part (semi-continuous) path model predicting alcohol use at age 16.
 Note: R^2 values are in parentheses. Int = internalizing symptoms; Ac Comp = academic competence; Ext = externalizing symptoms.
 * $p < .05$; ** $p < .01$, *** $p < .001$

Figure 2.

Standardized path coefficients for tested paths of full cascade two part (semi-continuous) path model predicting cannabis use at age 16.

Note: R^2 values are in parentheses. Int = internalizing symptoms; Ac Comp = academic competence; Ext = externalizing symptoms.

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

Table 1

Study variable descriptive statistics

Wave	Variable	N	M (SD)	Range	Skewness	Kurtosis
Age 7	Externalizing symptoms	188	55.44 (10.00)	39.00—86.00	.560	.110
	Internalizing symptoms	188	52.38 (10.51)	36.00—79.00	.277	-.403
	Academic Competence	168	2.98 (1.05)	1.00—5.00	.004	-.682
Age 9	Externalizing symptoms	185	55.89 (10.72)	39.00—82.00	.323	-.309
	Internalizing symptoms	185	54.61 (10.41)	36.00—83.00	.109	-.629
Age 12	Academic Competence	170	2.91 (1.00)	1.00—5.00	.046	-.711
	Externalizing symptoms	184	55.22 (9.63)	40.00—83.00	.104	-.498
	Internalizing symptoms	184	55.20 (8.96)	38.00—84.00	.226	.520
Age 16	Academic Competence	170	2.89 (1.08)	1.00—6.00	.185	-.487
	Externalizing symptoms	169	57.72 (9.67)	27.00—83.00	-.019	.510
	Internalizing symptoms	169	52.08 (9.42)	32.00—88.00	.671	1.146
	Academic Competence	165	3.85 (1.75)	1.00—7.00	-.156	-1.025
	Frequency Cannabis Use	171	.60 (1.21)	0.00—5.00	2.256	4.516
				No use = 124		
				Any use = 47		
	Frequency Alcohol Use	169	1.28 (1.24)	0.00—5.00	.615	-.494
	Amount Alcohol Use	169	1.45 (1.79)	0.00—5.00	.878	-.717
	Freq. X Amt. Alcohol Use	170	3.64 (5.47)	0.00—25.00	1.642	2.027
				No use = 85		
				Any use = 85		
Co-variables	Gender	191		Males = 105		
				Females = 86		
	SES (Prenatal)	190	50.33 (9.78)	31.92—105.52	1.633	6.047
	Age of Mother (Child's Birth)	191	20.58 (3.74)	12.00—34.00	.967	1.162
	Baby Minority Status	184		White = 126		
				Non-White = 58		

Table 2

Hierarchically nested cascade path models.

Age 7–9 Paths	Age 9–12 Paths	Age 12–16 Paths	Paths to Outcomes
Model 1: Within Domain Model (Included in all subsequent models)			
Ext7 → Ext9	Ext9 → Ext12	Ext12 → Ext16	Ext 16 → SU16
Int7 → Int9	Int9 → Int12	Int12 → Int16	Int16 → SU16
Acad7 → Acad9	Acad9 → Acad12	Acad12 → Acad16	Acad16 → SU16
Model 2: Externalizing Cascades (total of 6 cross-domain paths)			
Ext 7 → Int9	Ext9 → Int12	Ext12 → Int16	
Ext 7 → Acad9	Ext9 → Acad9	Ext12 → Acad16	
Model 3: Academic Cascades (total of 12 cross-domain paths)			
Ext 7 → Int9	Ext9 → Int12	Ext12 → Int16	
Ext 7 → Acad9	Ext9 → Acad9	Ext12 → Acad16	
Acad7 → Ext9	Acad9 → Ext12	Acad12 → Ext16	
Acad7 → Int9	Acad9 → Int12	Acad12 → Int16	
Model 4: Full Cascade Model (total of 18 cross-domain paths)			
Ext7 → Int9	Ext9 → Int12	Ext12 → Int16	
Ext7 → Acad9	Ext9 → Acad12	Ext12 → Acad16	
Acad7 → Ext9	Acad9 → Ext12	Acad12 → Ext16	
Acad7 → Int9	Acad9 → Int12	Acad12 → Int16	
Int7 → Ext9	Int9 → Ext12	Int12 → Ext16	
Int7 → Acad9	Int9 → Acad12	Int12 → Acad16	

Note: Int = internalizing symptoms; Ext = externalizing symptoms; Acad = academic competence

Table 3

Zero-Order Correlations for Variables under Investigation

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Gender	--																
2. SES	-.12	--															
3. Mother's Age	.00	.44**	--														
4. Child	-.04	-.10	-.09	--													
Minority Status																	
5. Ext 7 yrs	-.05	-.10	-.09	.19**	--												
6. Ext 9 yrs	-.05	-.11	-.04	.25***	.52***	--											
7. Ext 12 yrs	-.10	-.16*	-.08	.18*	.53***	.51***	--										
8. Ext 16 yrs	.07	-.18*	-.17*	-.07	.32***	.20**	.29***	--									
9. Int 7 yrs	-.13	.05	.05	.06	.55***	.12	.17*	.07	--								
10. Int 9 yrs	-.04	-.16*	-.02	.15*	.21**	.37***	.21**	.05	.27***	--							
11. Int 12 yrs	-.03	-.10	-.02	.03	.23**	.15*	.45**	.21**	.29***	.36***	--						
12. Int 16 yrs	.19*	.01	-.04	-.05	.03	-.08	-.04	.44***	.05	.10	.20**	--					
13. Acad 7 yrs	.13	.09	.15*	-.08	-.21**	-.04	-.16*	.02	-.25***	-.14	-.17*	-.09	--				
14. Acad 9 yrs	.13	.18*	.17*	-.29***	-.19*	-.26***	-.29***	-.01	-.08	-.32***	-.28***	.01	.62***	--			
15. Acad 12 yrs	.31***	.21**	.19*	-.17*	-.21**	-.23**	-.35***	-.05	-.11	-.30***	-.30***	.01	.41***	.58***	--		
16. Acad 16 yrs	.22**	.23**	.14	-.09	-.04	-.05	-.21**	-.15	.04	-.07	-.23**	-.11	.37***	.38***	.42***	--	
17. Alc. Freq. x Amt	.10	-.16*	-.09	-.17*	.16*	.16*	.05	.47***	-.08	.02	-.05	.13	.16*	.14	.15	.11	--
18. Marij. Freq. x Amt	.01	-.13	-.11	-.04	.20*	.25***	.29***	.46***	-.01	.10	.14	.09	.01	-.05	-.06	-.10	.60***

Note: Ext = externalizing symptoms; Int = internalizing symptoms; Acad = academic competence; Alc. Freq. x Amt = alcohol frequency times amount; Marij. Freq. = marijuana frequency

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

Table 4

Comparison statistics for competing nested models.

Model	df	Loglikelihood Value	Scaling Correction Factor	χ^2 Difference Test (TRd)	AIC	BIC
Alcohol Use at 16						
Model 1: Within-domain	119	-7725.937	1.037		15689.87	16076.89
Model 2: Externalizing Cascades	125	-7720.507	1.038	10.265 (6) (2 vs. 1)	15691.01	16097.55
Model 3: Academic Cascades	131	-7715.548	1.035	10.193 (6) (3 vs. 2)	15693.10	16119.14
Model 4: Full Cascade	137	-7709.602	1.031	12.597 (6)* (4 vs. 3)	15693.20	16138.77
Marijuana Use at 16						
Model 1: Within-domain	119	-7635.328	1.039		15508.66	15895.68
Model 2: Externalizing Cascades	125	-7629.910	1.040	10.336 (6) (2 vs. 1)	15509.82	15916.35
Model 3: Academic Cascades	131	-7624.947	1.036	10.416 (6) (3 vs. 2)	15511.89	15937.94
Model 4: Full Cascade	137	-7618.968	1.032	12.654 (6)* (4 vs. 3)	15511.94	15957.50

Note: df = degrees of freedom; AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion

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

Table 5

Unstandardized and Standardized Parameter Estimates and Unstandardized Confidence Intervals for Full Cascade Model for Alcohol (Standard Errors in Parentheses; N = 191)

Parameter Estimates	Unstandardized	Standardized	Est./S.E.	Unstandardized 95% C.I.
SES ↔ Mother's Age	15.98 (2.63) ***	.44	6.09	[11.66, 20.30]
SES ↔ Child's Minority Status	-.47 (.33)	-.11	-1.46	[-1.01, .06]
Ext7 ↔ Int7	56.37 (8.72) ***	.56	6.47	[42.03, 70.72]
Ext7 ↔ Acad7	-2.25 (.75) ***	-.22	-3.00	[-3.48, -1.01]
Int7 ↔ Acad7	-3.09 (.81) ***	-.28	-3.82	[-4.42, -1.76]
Ext9 ↔ Int9	30.19 (6.63) ***	.36	4.55	[19.27, 41.10]
Ext9 ↔ Acad9	-1.57 (.55) **	-.24	-2.86	[-2.47, -.67]
Int9 ↔ Acad9	-1.97 (.51) ***	-.27	-3.89	[-2.80, -1.14]
Ext12 ↔ Int12	28.49 (5.39) ***	.44	5.29	[19.63, 37.35]
Ext12 ↔ Acad12	-1.37 (.53) *	-.21	-2.58	[-2.24, -.49]
Int12 ↔ Acad12	-1.13 (.51) *	-.17	-2.23	[-1.96, -.30]
Ext16 ↔ Int16	36.90 (7.03) ***	.47	5.25	[25.34, 48.47]
Ext16 ↔ Acad16	-1.28 (.96)	-.09	-1.34	[-2.86, .29]
Int16 ↔ Acad16	-1.84 (.98)	-.13	-1.87	[-3.46, -.22]
Gender → Ext7	-.91 (1.43)	-.05	-.64	[-3.27, 1.44]
SES → Ext7	-.07 (.09)	-.07	-.84	[-.21, .07]
Mother's Age → Ext7	-.11 (.23)	-.04	-.48	[-.49, .27]
Child's Minority Status → Ext7	3.91 (1.60) *	.18	2.44	[1.27, 6.54]
Gender → Int7	-2.59 (1.51)	-.12	-1.72	[-5.06, -.11]
SES → Int7	.02 (.08)	.02	.21	[-.11, .14]
Mother's Age → Int7	.14 (.21)	.05	.68	[-.20, .48]
Child's Minority Status → Int7	1.24 (1.69)	.06	.74	[-1.53, 4.02]
Gender → Acad7	.20 (.15)	.09	1.30	[-.05, .45]
SES → Acad7	.01 (.01)	.10	1.50	[-.00, .02]
Mother's Age → Acad7	.02 (.02)	.08	1.08	[-.01, .06]
Child's Minority Status → Acad7	-.12 (.17)	-.05	-.74	[-.40, .15]
Gender → Ext9	-1.19 (1.28)	-.06	-.93	[-3.30, .91]
SES → Ext9	-.07 (.10)	-.06	-.70	[-.23, .09]
Mother's Age → Ext9	.16 (.19)	.06	.82	[-.16, .47]
Child's Minority Status → Ext9	3.23 (1.54) *	.14	2.10	[.70, 5.77]
Ext7 → Ext9	.66 (.08) ***	.61	8.62	[.53, .78]
Int7 → Ext9	-.22 (.08) **	-.22	-2.87	[-.35, -.10]
Acad7 → Ext9	.13 (.62)	.01	.21	[-.90, 1.16]
Gender → Int9	-.44 (1.48)	-.02	-.30	[-2.88, 2.00]
SES → Int9	-.19 (.07) **	-.18	-2.60	[-.31, -.07]
Mother's Age → Int9	.20 (.19)	.07	1.08	[-.11, .51]

Parameter Estimates	Unstandardized	Standardized	Est./S.E.	Unstandardized 95% C.I.
Child's Minority Status → Int9	2.38 (1.63)	.11	1.46	[−.30, 5.07]
Int7 → Int9	.21 (.08)**	.21	2.60	[.08, .34]
Ext7 → Int9	.05 (.08)	.04	.57	[−.09, .18]
Acad7 → Int9	−.96 (.81)	−.10	−1.19	[−2.28, .37]
Gender → Acad9	.15 (.11)	.08	1.35	[−.03, .34]
SES → Acad9	.01 (.01)	.11	1.67	[.00, .02]
Mother's Age → Acad9	.000 (.02)	.00	.02	[−.03, .03]
Child's Minority Status → Acad9	−.39 (.13)**	−.18	−3.07	[−.60, −.18]
Acad7 → Acad9	.55 (.06)***	.59	9.77	[.46, .64]
Ext.7 → Acad9	−.00 (.01)	−.04	−.51	[−.02, .01]
Int7 → Acad9	.01 (.01)	.10	1.49	[.00, .02]
Gender → Ext12	−1.21 (1.21)	−.06	−1.00	[−3.19, .77]
SES → Ext12	−.10 (.07)	−.10	−1.40	[−.22, .02]
Mother's Age → Ext12	.02 (.19)	.01	.11	[−.29, .33]
Child's Minority Status → Ext12	.41 (1.39)	.02	.29	[−1.88, 2.69]
Ext9 → Ext12	.41 (.07)***	.46	6.31	[.30, .52]
Int9 → Ext12	−.02 (.06)	−.02	−.32	[−.11, .08]
Acad9 → Ext12	−1.46 (.61)*	−.15	−2.42	[−2.46, −.47]
Gender → Int12	.12 (1.20)	.01	.10	[−1.85, 2.1]
SES → Int12	−.03 (.07)	−.04	−.48	[−.14, .08]
Mother's Age → Int12	.05 (.16)	.02	.35	[−.20, .31]
Child's Minority Status → Int12	−1.23 (1.54)	−.06	−.80	[−3.77, 1.31]
Int9 → Int12	.26 (.07)***	.30	3.83	[.15, .38]
Ext9 → Int12	.00 (.06)	.00	.05	[−.10, .11]
Acad9 → Int12	−1.80 (.66)**	−.20	−2.74	[−2.89, −.72]
Gender → Acad12	.51 (.12)***	.24	4.29	[.32, .71]
SES → Acad12	.01 (.01)*	.13	2.48	[.00, .02]
Mother's Age → Acad12	.00 (.02)	.01	.13	[−.03, .04]
Child's Minority Status → Acad12	.06 (.16)	.03	.36	[−.20, .32]
Acad9 → Acad12	.54 (.08)***	.50	6.71	[.40, .67]
Ext9 → Acad12	−.00 (.01)	−.02	−.37	[−.01, .01]
Int9 → Acad12	−.01(.01)*	−.14	−2.06	[−.03, .00]
Gender → Ext16	1.37 (1.55)	.07	.88	[−1.19, 3.93]
SES → Ext16	−.09 (.08)	−.10	−1.15	[−.23, .04]
Mother's Age → Ext16	−.33 (.19)	−.13	−1.74	[−.64, −.02]
Child's Minority Status → Ext16	−2.89 (1.57)	−.14	−1.84	[−5.47, −.30]
Ext12 → Ext16	.29 (.08)***	.29	3.81	[.17, .42]
Int12 → Ext16	.08 (.10)	.08	.86	[−.08, .24]
Acad12 → Ext16	.66 (.70)	.07	.94	[−.50, 1.81]
Gender → Int16	3.70 (1.39)**	.20	2.66	[1.41, 5.98]

Parameter Estimates	Unstandardized	Standardized	Est./S.E.	Unstandardized 95% C.I.
SES → Int16	.06 (.08)	.06	.68	[−.08, .20]
Mother's Age → Int16	−.17 (.20)	−.07	−.85	[−.51, .16]
Child's Minority Status → Int16	−.67 (1.54)	−.03	−.43	[−3.20, 1.87]
Int12 → Int16	.28 (.10)**	.27	2.83	[.12, .44]
Ext12 → Int16	−.13 (.09)	−.13	−1.49	[−.28, .01]
Acad12 → Int16	−.22 (.70)	−.03	−.32	[−1.37, .92]
Gender → Acad16	.40 (.27)	.11	1.51	[−.04, .84]
SES → Acad16	.03 (.01)**	.17	2.93	[.01, .05]
Mother's Age → Acad16	.01 (.03)	.02	.23	[−.05, .06]
Child's Minority Status → Acad16	.04 (.26)	.01	.16	[−.39, .47]
Acad12 → Acad16	.53 (.14)***	.33	3.86	[.31, .76]
Ext12 → Acad16	−.01 (.01)	−.04	−.57	[−.03, .01]
Int12 → Acad16	−.01 (.02)	−.06	−.77	[−.04, .01]
Part 1: Alcohol Model (Full Cascade) No Use vs. Use				
Gender	.28 (.37)	.07	.77	[−.32, .89]
SES	−.03 (.02)	−.15	−1.65	[−.06, .00]
Mother's Age	.07 (.05)	.12	1.27	[−.02, .15]
Child's Minority Status	−.52 (.39)	−.12	−1.35	[−1.16, .12]
Ext16	.08 (.02)***	.39	4.05	[.05, .12]
Int16	.01 (.02)	.02	.27	[−.03, .04]
Acad16	.23 (.10)*	.19	2.19	[.06, .40]
Part 2: Alcohol Model (Full Cascade) If Use, Level of Use				
Gender	−.08 (.18)	−.04	−.45	[−.37, .21]
SES	−.03 (.01)*	−.29	−2.41	[−.05, −.01]
Mother's Age	−.02 (.03)	−.06	−.55	[−.06, .03]
Child's Minority Status	−.25 (.23)	−.12	−1.10	[−.63, .13]
Ext16	.05 (.01)***	.51	5.99	[.04, .07]
Int16	−.01 (.010)	−.15	−1.64	[−.03, .00]
Acad16	.09 (.06)	.16	1.68	[.00, .18]

Note: CI = confidence interval; Ext = externalizing symptoms; Int = internalizing symptoms; Acad = academic competence

*
 $p < .05$,

**
 $p < .01$,

***
 $p < .001$

Table 6

Unstandardized and Standardized Parameter Estimates and Unstandardized Confidence Intervals for Full Cascade Model for Marijuana (Standard Errors in Parentheses; N = 191)

Parameter Estimates	Unstandardized	Standardized	Est./S.E.	Unstandardized 95% C.I.
SES ↔ Mother's Age	15.99 (2.63) ***	.44	6.09	[11.67, 20.31]
SES ↔ Child's Minority Status	-.47 (.33)	-.10	-1.44	[-1.01, .07]
Ext7 ↔ Int7	56.39 (8.72) ***	.56	6.46	[42.04, 70.74]
Ext7 ↔ Acad7	-2.25 (.75) ***	-.22	-3.00	[-3.48, -1.02]
Int7 ↔ Acad7	-3.09 (.81) ***	-.28	-3.82	[-4.42, -1.76]
Ext9 ↔ Int9	30.03 (6.63) ***	.36	4.53	[19.14, 40.93]
Ext9 ↔ Acad9	-1.55 (.55) **	-.23	-2.84	[-2.45, -.66]
Int9 ↔ Acad9	-1.96 (.51) ***	-.27	-3.88	[-2.79, -1.13]
Ext12 ↔ Int12	28.51 (5.39) ***	.44	5.29	[19.65, 37.38]
Ext12 ↔ Acad12	-1.37 (.53) *	-.21	-2.58	[-2.25, -.50]
Int12 ↔ Acad12	-1.13 (.51) *	-.17	-2.23	[-1.96, -.30]
Ext16 ↔ Int16	36.94 (7.09) ***	.47	5.21	[25.29, 48.60]
Ext16 ↔ Acad16	-1.30 (.96)	-.10	-1.35	[-2.88, .28]
Int16 ↔ Acad16	-1.77 (.99)	-.13	-1.79	[-3.40, -.14]
Gender → Ext7	-.92 (1.43)	-.05	-.64	[-3.27, 1.44]
SES → Ext7	-.07 (.09)	-.07	-.81	[-.21, .07]
Mother's Age → Ext7	-.11 (.23)	-.04	-.50	[-.49, .26]
Child's Minority Status → Ext7	3.87 (1.60) *	.18	2.41	[1.23, 6.51]
Gender → Int7	-2.59 (1.51)	-.12	-1.72	[-5.07, -.12]
SES → Int7	.01 (.08)	.01	.18	[-.11, .14]
Mother's Age → Int7	.14 (.21)	.05	.69	[-.20, .48]
Child's Minority Status → Int7	1.22 (1.68)	.05	.73	[-1.55, 3.98]
Gender → Acad7	.20 (.15)	.09	1.30	[-.05, .45]
SES → Acad7	.01 (.01)	.10	1.50	[-.00, .02]
Mother's Age → Acad7	.02 (.02)	.08	1.07	[-.01, .06]
Child's Minority Status → Acad7	-.12 (.17)	-.05	-.74	[-.40, .15]
Gender → Ext9	-1.20 (1.28)	-.06	-.94	[-3.30, .90]
SES → Ext9	-.07 (.10)	-.06	-.74	[-.23, .09]
Mother's Age → Ext9	.16 (.19)	.06	.85	[-.15, .48]
Child's Minority Status → Ext9	3.32 (1.52) *	.14	2.18	[.82, 5.82]
Ext7 → Ext9	.66 (.08) ***	.61	8.62	[.53, .78]
Int7 → Ext9	-.22 (.08) **	-.22	-2.88	[-.35, -.10]
Acad7 → Ext9	.13 (.62)	.01	.22	[-.90, 1.16]
Gender → Int9	-.45 (1.48)	-.02	-.31	[-2.89, 1.99]
SES → Int9	-.19 (.07) **	-.18	-2.61	[-.31, -.07]
Mother's Age → Int9	.20 (.19)	.07	1.09	[-.10, .51]

Parameter Estimates	Unstandardized	Standardized	Est./S.E.	Unstandardized 95% C.I.
Child's Minority Status → Int9	2.44 (1.63)	.11	1.50	[−.23, 5.11]
Int7 → Int9	.21 (.08) **	.21	2.60	[.08, .34]
Ext7 → Int9	.05 (.08)	.04	.58	[−.09, .18]
Acad7 → Int9	−.96 (.81)	−.10	−1.89	[−2.28, .37]
Gender → Acad9	.16 (.11)	.08	1.65	[−.03, .34]
SES → Acad9	.01 (.01)	.11	1.71	[.00, .02]
Mother's Age → Acad9	.000 (.02)	.00	.01	[−.03, .03]
Child's Minority Status → Acad9	−.39 (.13) **	−.18	−3.11	[−.60, −.19]
Acad7 → Acad9	.55 (.06) ***	.58	9.76	[.46, .64]
Ext.7 → Acad9	−.00 (.01)	−.04	−.51	[−.02, .01]
Int7 → Acad9	.01 (.01)	.10	1.50	[.00, .02]
Gender → Ext12	−1.20 (1.21)	−.06	−1.00	[−3.19, .78]
SES → Ext12	−.10 (.07)	−.10	−1.38	[−.22, .02]
Mother's Age → Ext12	.02 (.19)	.01	.08	[−.29, .32]
Child's Minority Status → Ext12	.35 (1.38)	.02	.25	[−1.93, 2.62]
Ext9 → Ext12	.41 (.07) ***	.46	6.32	[.31, .52]
Int9 → Ext12	−.02 (.06)	−.02	−.31	[−.11, .08]
Acad9 → Ext12	−1.47 (.61) *	−.15	−2.42	[−2.47, −.47]
Gender → Int12	.14 (1.20)	.01	.11	[−1.84, 2.1]
SES → Int12	−.03 (.07)	−.03	−.44	[−.14, .08]
Mother's Age → Int12	.05 (.16)	.02	.32	[−.21, .31]
Child's Minority Status → Int12	−1.28 (1.54)	−.07	−.83	[−3.82, 1.26]
Int9 → Int12	.26 (.07) ***	.30	3.83	[.15, .38]
Ext9 → Int12	.00 (.06)	.01	.07	[−.10, .11]
Acad9 → Int12	−1.80 (.66) **	−.20	−2.74	[−2.90, −.72]
Gender → Acad12	.51 (.12) ***	.24	4.29	[.32, .71]
SES → Acad12	.01 (.01) *	.13	2.46	[.01, .02]
Mother's Age → Acad12	.00 (.02)	.01	.14	[−.03, .04]
Child's Minority Status → Acad12	.06 (.16)	.03	.39	[−.20, .32]
Acad9 → Acad12	.54 (.08) ***	.50	6.72	[.41, .67]
Ext9 → Acad12	−.00 (.01)	−.02	−.39	[−.01, .01]
Int9 → Acad12	−.01 (.01) *	−.14	−2.07	[−.03, .00]
Gender → Ext16	1.43 (1.56)	.07	.92	[−1.13, 3.99]
SES → Ext16	−.10 (.08)	−.10	−1.18	[−.23, .04]
Mother's Age → Ext16	−.34 (.20)	−.13	−1.72	[−.66, −.02]
Child's Minority Status → Ext16	−3.09 (1.56) *	−.15	−1.98	[−5.66, −.52]
Ext12 → Ext16	.29 (.08) ***	.29	3.86	[.17, .42]
Int12 → Ext16	.08 (.10)	.07	.79	[−.08, .23]
Acad12 → Ext16	.66 (.71)	.07	.94	[−.50, 1.83]

Parameter Estimates	Unstandardized	Standardized	Est./S.E.	Unstandardized 95% C.I.
Gender → Int16	3.72 (1.38) **	.20	2.69	[1.45, 6.00]
SES → Int16	.06 (.08)	.06	.68	[−.08, .20]
Mother's Age → Int16	−.16 (.20)	−.07	−.81	[−.50, .17]
Child's Minority Status → Int16	−.76 (1.52)	−.04	−.50	[−3.26, 1.74]
Int12 → Int16	.28 (.10) **	.26	2.77	[.11, .44]
Ext12 → Int16	−.13 (.09)	−.13	−1.47	[−.27, .02]
Acad12 → Int16	−.21 (.69)	−.03	−.31	[−1.35, .93]
Gender → Acad16	.40 (.27)	.11	1.48	[−.05, .84]
SES → Acad16	.03 (.01) **	.17	2.98	[.01, .05]
Mother's Age → Acad16	.01 (.03)	.01	.19	[−.05, .06]
Child's Minority Status → Acad16	.04 (.26)	.01	.15	[−.39, .47]
Acad12 → Acad16	.54 (.14) ***	.33	3.86	[.31, .76]
Ext12 → Acad16	−.01 (.01)	−.05	−.61	[−.03, .01]
Int12 → Acad16	−.01 (.02)	−.06	−.71	[−.04, .01]
Part 1: Marijuana Model (Full Cascade) No Use vs. Use				
Gender	−.03 (.45)	−.01	−.06	[−.77, .71]
SES	.01 (.02)	.02	.22	[−.04, .05]
Mother's Age	−.02 (.06)	−.03	−.34	[−.12, .08]
Child's Minority Status	−.09 (.45)	−.02	−.21	[−.84, .65]
Ext16	.17 (.03) ***	.68	5.51	[.12, .22]
Int16	−.03 (.02)	−.09	−1.17	[−.06, .01]
Acad16	−.09 (.14)	−.06	−.61	[−.32, .15]
Part 2: Marijuana Model (Full Cascade) If Use, Level of Use				
Gender	.07 (.17)	.05	.43	[−.20, .34]
SES	−.03 (.01) *	−.48	−2.24	[−.06, −.01]
Mother's Age	.05 (.03)	.27	1.48	[−.01, .10]
Child's Minority Status	−.02 (.17)	−.02	−.14	[−.31, .26]
Ext16	.03 (.01) *	.37	2.15	[.01, .04]
Int16	−.02 (.01)	−.22	−1.41	[−.03, .00]
Acad16	.01 (.04)	−.06	.20	[−.05, .07]

Note: CI = confidence interval; Ext = externalizing symptoms; Int = internalizing symptoms; Acad = academic competence

*
 $p < .05$,

**
 $p < .01$,

***
 $p < .001$