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The Relation of Change in Hostility and Sociability During Childhood to Substance Use in Mid Adolescence

Sarah E. Hampson,
Oregon Research Institute, Eugene, Oregon

Elizabeth Tildesley,
Oregon Research Institute, Eugene, Oregon

Judy A. Andrews,
Oregon Research Institute, Eugene, Oregon

Koen Luyckx, and
Catholic University Leuven, Leuven, Belgium

Daniel K. Mroczek
Purdue University

Abstract

In a cohort-sequential longitudinal study (N = 1,075), we related change in children's hostility and sociability assessed from 1st-8th grade to their use of cigarettes, alcohol, and marijuana assessed from 9th-12th grade. Children who were more hostile at 1st grade, and had higher rates of growth of hostility, used more of all three substances at 9th grade, and those with higher initial levels of hostility increased their use of cigarettes and marijuana from 9th to 12th grade. Children who were more sociable at 1st grade used more alcohol at 9th grade. These findings demonstrate the significance of individual differences in the development of personality traits for the prediction of later substance use and have implications for prevention.

Keywords

trait change; adolescent substance use; hostility; sociability

Adolescents experiment with substances, most commonly alcohol, cigarettes, and marijuana. Over high school, life-time prevalence for these substances increases such that by 12th grade, the majority of adolescents (71.9%) have tried alcohol, approximately one half (44.7%) have tried cigarettes, and only somewhat fewer (42.6%) have tried marijuana (Johnston, O'Malley, Bachman, & Schulenberg, 2009). For some, experimentation will lead to regular use or abuse with damaging consequences for their later health and well-being (Newcomb & Bentler, 1988). Therefore, these levels of adolescent substance use are a cause for concern and call for the development of substance-use prevention programs based on etiological research.

Please address all correspondence to Sarah E. Hampson, Ph.D., Oregon Research Institute, 1715 Franklin Boulevard, Eugene, OR 97403. Phone (541) 484-2123; Fax: (541) 484-1108. sarah@ori.org.

Etiological theories view the development of substance use as a person-environment process that unfolds over time involving the integration of cognitive, social, biological, and personality factors (e.g., Lerner, 2002; Stattin & Magnusson, 1996). Cognitive factors include intention and willingness to try substances, social images of substance users, and beliefs about the prevalence of peers' substance use. These beliefs develop prior to actual substance use and increase its likelihood (Andrews, Hampson, Barckley, Gerrard, & Gibbons, 2008; Gibbons, Gerard, Blanton, & Russell, 1998; Kandel, 1996). Social factors include negative peer influence, parental, school, and neighborhood factors (Andrews & Hops, in press; Ary, Duncan, Duncan, & Hops, 1999; Brook, Whiteman, Nomura, Gordon, & Cohen, 1988; Dishion, 1990; Eccles, Lord, & Buchanan, 1996). At the biological level, early pubertal maturation is a risk factor for substance use, partially through its relationship with increased stress and affiliation with older peers (Tschann et al., 1994; Westling, Andrews, Hampson, & Peterson, 2008).

Compared to such cognitive, social, and biological factors, childhood personality traits have received less attention but are potentially of particular importance. Personality variables are usually included in models of substance use as distal factors that have direct and indirect effects on the development of substance use (e.g., Jessor & Jessor, 1977). Personality traits affect how children experience, interpret, and respond to developmental tasks including ones that have implications for substance use, such as relationship formation and school engagement (Caspi, Roberts, & Shiner, 2005). Traits develop simultaneously with cognitive, social, and biological factors that affect susceptibility to substance use, and they both influence these factors and are influenced by them (Roberts, Wood, & Caspi, 2008). Hence, individual differences in trait development are expected to predict subsequent substance use. In the present study, we focused on the development of hostility and sociability from childhood to early adolescence (1^{st} through 8^{th} grade), and we related individual differences in the development of these traits to growth in smoking, alcohol, and marijuana use in high school (9^{th} through 12^{th} grade).

Childhood Traits of Hostility and Sociability as Predictors of Substance Use

Early temperament forms the basis for later personality traits. Temperament dimensions include positive emotionality, negative emotionality, impulsivity, and effortful control (e.g., Ahadi & Rothbart, 1994; Caspi, 1998). The childhood traits of hostility and sociability may be viewed as transitions between temperament and aspects of the Big Five personality dimensions in adulthood (Caspi et al., 2005). Hostility reflects negative emotionality and poor anger regulation, and relates primarily to Big Five low agreeableness, unconscientiousness, and emotional instability. Sociability reflects positive emotionality and approach temperament, and relates primarily to Big Five extraversion. Both traits have been associated with substance use in adolescents and young adults (Shedler & Block, 1990).

There are strong parallels between hostility and sociability and the behavior patterns of aggression and social withdrawal studied by developmental researchers. Social withdrawal describes the absence of sociability (Rubin, Coplan, & Bowker, 2009), and aggression is a behavioral expression of hostility (Pepler & Rubin, 1991). Teachers' ratings of these internalizing and externalizing behaviors are used to categorize children as having or not having conduct disorders that can be predictive of and comorbid with substance use (Pepler & Rubin, 1991; Rubin et al., 2009; Serbin, Moskowitz, Schwartzman, & Ledingham, 1991). Withdrawal predicts loneliness, depression, and anxiety (Prior, Smart, Sanson, & Oberklaid, 2000; Rubin, Chen, McDougall, Bowker, & McKinnon, 1995), whereas aggression predicts adolescent bullying and delinquency (Moffitt, 1993; Pepler et al., 2006).

The trait approach taken in the present study views these observable behavior patterns as indicators of underlying personality traits that all children possess to varying degrees

(Shiner, 1998). Supporting the trait approach, latent constructs indicated by teacher ratings of elementary and middle school children on behavioral measures predicted later teacher ratings on dimensions of the Big Five personality dimensions when these same children were in high school (Hampson, Andrews, Barckley, & Peterson, 2007a). Behavior ratings of sociability, popularity, social withdrawal, and activity formed a unidimensional sociability construct that correlated primarily with Big Five extraversion. Ratings of negative influence, overt, and covert aggression formed a unidimensional hostility construct that correlated with Big Five emotional instability, disagreeableness, and unconscientiousness.

Of primary interest to the present study, hostility and sociability have been related to various forms of adolescent substance use. Hostility and related traits such as rebelliousness, anger, and negative affect, have been related to adolescent substance use defined as a combination of one or more substances (Wills, DuHamel, & Vaccaro, 1995). These traits also predict use of specific substances such as cigarette (Burt, Dinh, Peterson, & Sarason, 2000; Forgays, Forgays, Wrzesniewski, & Bonaiuto, 1993; Hampson, Andrews, & Barckley, 2007b; Tyas & Pederson, 1998; Weiss et al., 2005) and alcohol use (Block, Block, & Keyes, 1988; Boyle et al., 1993; Brook, Whiteman, Gordon, & Cohen, 1986; Hampson, Andrews, Barckley, & Severson, 2006; Kellam, Brown, & Fleming, 1982). Such studies indicate that the base level of childhood hostility is a risk factor for substance use. However, it remains to be determined whether increasing levels of hostility over childhood are also a risk factor.

Findings for sociability have been less consistent. Whereas some studies report an association between higher levels of sociability and higher levels of substance use (e.g., Brook et al., 1988; Chassin et al., 1993; Jessor & Jessor, 1977), others have found that less sociability, social competence, or social orientation is related to more substance use (e.g., Tarter, 1988; Tarter, Sambrano, & Dunn, 2002; Wills, Vaccaro, & McNamara, 1994). In these studies, substance use has often been evaluated as a combination of alcohol, tobacco, and marijuana, so it has not been possible to determine whether the association with sociability varies by substance. In our research, we have found that higher levels of sociability predicted intentions to use alcohol (Hampson et al., 2006) but did not predict intentions to smoke cigarettes (Hampson et al., 2007b). Alcohol use is more prevalent and begins earlier than cigarette use, so sociable children may see it as less deviant and as a more acceptable activity than using other substances. It appears that the base level of childhood sociability can serve as a risk factor for some forms of adolescent substance use. It remains to be determined whether changes in sociability over time also put a child at risk for certain kinds of substance use.

The Development of Childhood Hostility and Sociability as Predictors of the Development of Substance Use

Models of the influence of personality traits on substance use have treated childhood traits as stable dispositions. However, what is known about the development of personality traits prior to early adolescence suggests this assumption may not be warranted. Roberts and DelVecchio (2000) meta-analyzed studies assessing differential stability of temperament and personality from birth to age 70+. Rank-order correlations showed a steady increase with age, and were lowest during infancy, middle childhood (age 6-12), and adolescence (age 12-18), suggesting that childhood and adolescence are periods of greatest personality instability. In contrast, a meta-analysis of personality maturation evaluated by mean-level change by Roberts, Walton, and Viechtbauer (2006) suggested that ages 10-20 is a period of relative stability (mean trait levels neither increase nor decrease over time). Reconciling the conclusions from these meta-analyses points to childhood and early adolescence as a period when traits are in flux. There appears to be individual change in trait level over time (resulting in relatively low rank-order stability) in the absence of a consistent maturational trend (resulting in apparently stable mean levels over time).

Individual differences in the rate at which traits develop over time are novel and theoretically interesting for the prediction of substance use. Traits increase or decrease over time through interactions with the environment involving mechanisms such as niche selection, evocation, manipulation, and accumulation (Roberts et al., 2008). Children tend to gravitate to environments compatible with their traits, such as groups composed of others with similar traits, and to leave ones that are incompatible (Caspi et al., 2005; Donohew et al., 1999; Roberts & Robins, 2004). Alternatively, through manipulation, children will shape their environments to increase person/environment fit. For example, children who display hostile behaviors will evoke hostility in others, confirming the child's developing aggressive and distrustful tendencies. A sociable child may create opportunities to interact with others and so become more popular, and see themselves as more sociable. Through accumulation of selected, evoked, and manipulated trait-related experiences, trait tendencies are strengthened or weakened resulting in children becoming, for example, more hostile or more sociable over time. By these processes, we hypothesize that increasing hostility over childhood will increase the likelihood of exposure to and involvement with well-established social and cognitive risk factors for substance use such as negative peer influence, conflictual parent/child relationships, school disengagement, positive social images of substance users, and beliefs that peers are using substances. In contrast, increasing sociability over childhood may increase the likelihood of exposure to factors that develop social investment and protect against deviancy, such as positive peer influence and school engagement (Lodi-Smith & Roberts, 2007). However, as indicated by the inconsistencies in past research, in some contexts (e.g., when combined with high sensation seeking) or for some substances (e.g., ones more commonly used such as alcohol), sociability may result in greater substance use (Wills et al., 1994).

To fully describe change and individual differences in the rate of change over time, at least three data points are required. Multiple assessments allow for the use of Latent Growth Modeling (LGM; Muthén, 1991), which is a technique for studying change over time in a latent construct. It is an extension of structural equation modeling that estimates the mean trajectory for the group as a whole and the variance in individual trajectories. In LGM, a latent growth construct is represented by two parameters: the intercept (initial level) and slope (change over time). The means of the intercept and slope represent the mean trajectory for the sample, and the variances of the intercept and slope represent individual differences in that trajectory. If there is little or no maturational change at the group level, then the mean of the slope will not differ significantly from zero indicating no overall pattern of trait increase or decrease over time for the sample as a whole (i.e., no mean-level change). However, the variance associated with the slope can be significant even when the mean of the slope is not, indicating meaningful individual differences in the rate of trait growth (i.e., low rank-order stability). For prediction purposes, the variance of the intercept and/or slope must be significant. Further advantages of growth modeling with three time points include the evaluation of linear versus quadratic change and, with four time points, the evaluation of cubic change. Growth modeling also allows an estimation of the relation between the intercept and slope of latent constructs (Fraley & Roberts, 2005; Raudenbush & Bryk, 2002; Singer & Willett, 2003).

Studies that have used growth parameters of personality traits to predict outcomes are rare. In an example from research predicting mortality, Mroczek and Spiro (2003, 2007) modeled the growth-curve parameters (i.e., intercept and slope) of neuroticism and extraversion for participants in the Normative Aging Study. The parameters for neuroticism, which was assessed on up to six occasions over a 12-year period, were used to predict survival time in this older, male sample. Men with the combination of higher initial levels and greater increases in neuroticism over time were more likely to die sooner than men without that combination. This study demonstrated the value of individual differences in rate of trait

change, assessed by parameters of trait trajectories, as predictors of a consequential outcome. However, to our knowledge, there have been no comparable studies of trait change in childhood and early adolescence in which individual differences in trait maturation have been used as predictors of substance use.

The Present Study

The present study was conducted on a community sample of children participating in an ongoing longitudinal, cohort sequential study of the predictors of substance use, the Oregon Youth Substance Use Project (OYSUP). The annual teacher assessments of hostility and sociability through elementary and middle school enabled the use of LGM to evaluate individual differences in the development of these childhood traits. Growth parameters in these traits were used to predict the use of alcohol, tobacco, and marijuana assessed annually over high school and modeled as latent growth constructs. Because adolescent substance use typically increases over time, it is more appropriate and informative to model it as a latent growth construct than to study it at a single time point (Singer & Willett, 2003). Relatively higher levels and faster rates of growth indicate more problematic substance use, and the identification of predictors of problematic substance use by adolescents is particularly valuable for early prevention interventions. Alcohol, tobacco, and marijuana were modeled separately to allow for differences in predictors among substances.

We expected that hostility would be related to later use of all three substances. It was predicted that those children with higher levels of hostility, and greater increases in hostility over time, would be more likely to be using substances at higher levels, and have greater increases in their substance use over time, during high school. Previous findings for sociability indicated that a clear pattern of results was less likely. Children with higher levels of sociability, and greater increases in sociability over time, may be less likely to be using substances at higher levels and have less increase in their substance use over time, during high school. However, given previous inconsistent findings for sociability, we anticipated that its relation to substance use may differ across substances. Because of somewhat higher rates of illicit substance use among male adolescents (Johnston et al., 2009), and gender difference in our previous findings for the association of hostility to alcohol and cigarettes use (Hampson et al., 2006; Hampson et al., 2007b), differences between boys and girls were examined in all the models.

Method

Design

The OYSUP used a cohort sequential design in which five grade cohorts (1st through 5th grade at the first assessment) were assessed annually over four years (T1-T4), until they were in 4th through 8th grade. The fifth assessment (T5) took place two years after T4 when participants were in 6th through 10th grades. Thereafter, assessments have occurred annually and are ongoing. This design serves as a proxy for a true longitudinal design where a single cohort is assessed multiple times. As shown in Figure 1, by collapsing across cohorts, the cohort sequential design enabled us to study trajectories of hostility and sociability from 1st to 8th grade, assessed on eight occasions, and to relate these trajectories to substance-use trajectories from 9th through 12th grade assessed on four occasions.

Cohort differences were examined using one-way analyses of variance followed by post hoc (Scheffé test) comparisons (Cohort 1 = 1st graders at T1, Cohort 2 = 2nd graders at T1, Cohort 3 = 3rd graders at T1, Cohort 4 = 4th graders at T1, Cohort 5 = 5th graders at T1). We examined differences in hostility and sociability as a function of cohort at each grade separately for boys and girls. Cohort differences in hostility were found for boys at both

Grade 5, F (3, 404) = 3.86, $p < .01$, and Grade 8, F (3, 338) = 5.80, $p < .001$. Post hoc comparisons showed that at Grade 5, Cohort 3 boys had significantly higher hostility than Cohort 2 boys, Cohen's $d = .52$, and at Grade 8, Cohort 2 boys were significantly less hostile than either Cohort 1, Cohen's $d = .55$ or Cohort 3 boys, Cohen's $d = .52$. Cohort differences for hostility were also found for girls at Grade 8, $F (3, 369) = 3.67$, $p < .05$. Cohort 3 girls were more hostile than Cohort 5 girls, Cohen's $d = .46$. There were no significant cohort effects in sociability for either boys or girls. We also examined cohort effects for use of cigarettes, alcohol, and marijuana at 9th through 12th grade by gender and found only one effect: At Grade 12 for boys, F (1,177) = 4.43, $p < .05$, Cohort 5 boys reported significantly more cigarette use than Cohort 4 boys, Cohen's $d = .31$. Because there were only a few small to medium differences between cohorts, participants were collapsed across cohorts for the analyses.

Participants

The OYSUP initially recruited 1,075 children from 15 elementary schools within one school district in Western Oregon. An average of 215 students in each of 1st through 5th grade participated at T1 (50.3% female). The mean age of the sample at T1 was 9.0 years (SD = 1.45) across cohorts. The sample at T1 was 86% Caucasian, 7% Hispanic, 1% Afro-American, and 2% each of Asian/Pacific Islander, American Indian or Alaskan native, and other or mixed race/ethnicity. Approximately 7% of mothers and 11% of fathers had not obtained a high school diploma, and 71% of mothers and 66% of fathers had some form of post-high school education. The schools were located in a predominantly working class community; 40% of the sample was eligible for a free or reduced lunch, an indicator of low family income. At T1, participants were representative of children in the school district in terms of race/ethnicity and participation in the free or reduced lunch program, but the 3rd and 5th grade cohorts had slightly higher achievement test scores on reading and math (Andrews, Tildesley, Hops, Duncan, & Severson, 2003). The highest level of attrition (10%) was observed between the fourth and fifth assessments. The main reasons for attrition were parents withholding consent for future participation and inability to locate participants for follow-up.

The sample used in these analyses consisted of 1,074 children (540 girls and 534 boys, 99% of the entire sample) who participated in at least one assessment. The proportion who participated in all eight assessments was 78.1%; in seven, 8.3%; in six, 2.4%; in five, 1.2%; in four, 4.8%; in three, .8%; in two, 1.6%; and, in one, 2.7%.

Of the children who participated in two assessments including T1, 138 (13%) did not participate in the T8 assessment. In comparing children who participated at T1 and T8 with children who did not participate at T8, significantly more boys in the oldest cohort (Cohort 5) did not participate at T8 compared with boys in the other cohorts, $X^2(4, N = 532) = 10.57$, $p < .05$. There were no differences for girls by cohort for those who participated at both T1 and T8 and those who did not. For hostility, boys' hostility at T1 was significantly higher for those who did not participate at T8 than for those who did, regardless of cohort. There were no differences in sociability as a function of attrition for either boys or girls. For substance use, we found no attrition effects by cohort for boys or girls between those who participated at T5 and T8 and those who did not participate at T8. However, boys' substance use was higher at T5 for those who did not participate at T8 compared with those who did: cigarettes, $t(450) = 4.43$, $p < .001$; alcohol, $t(452) = 2.93$, $p < .01$; marijuana, $t(451) = 3.50$, $df = 451$, $p < .01$. Girls' use of cigarettes, $t(460) = 3.58$, $p < .001$, and marijuana, $t(464) = 2.51$, $p < .05$, was higher at T5 for those who did not participate at T8 compared to those who did.

Overall, these attrition effects are typical for longitudinal studies of substance use, with older participants, males, and substance users more likely to drop out (Andrews, Hops, &

Duncan, 1997; Andrews, Hops, Tildesley, & Li, 2002; Kandel, 1984; Newcomb & Bentler, 1988). Importantly, participants were similar to non-participants in terms of grade, gender, race/ethnicity, and proportion who received a free or reduced lunch.

Measures and Procedures

Hostility and sociability—Teachers rated their students towards the end of the school year on items drawn from behavioral observation scales including the Walker-McConnell Test of Children's Social Skills (Walker & McConnell, 1995), the Harter Social Acceptance subscale of the Perceived Competence Scale for Children (Harter, 1985), the Teacher Report Form (Achenbach, 1991), and the relational aggression, overt aggression, and pro-social subscales of the Children's Social Behavior Scale Teacher Form (Crick, 1996). Teacher's ratings of students' behavior were collected until the student was in the 8th grade. In 1st through 7th grade, core teachers (i.e., ones who spent the most time with their students) were asked for ratings. Most students had only one core teacher. Where they had two (e.g., because of job-sharing), the mean of their ratings was used unless one teacher said they did not know the child “at all well,” in which case only the ratings from the other teacher were used. In 8th grade, students did not have core teachers so, to increase reliability, two different teachers who taught academic subjects were asked for ratings. As with the younger grades, the mean of their ratings was used unless one of the teachers said they did not know the child at all well, in which case only the other teacher's ratings were used. For 1st through 7th grades, mean teacher ratings were used infrequently (ranging from one in 1st grade to 40 in 5th grade). In 8th grade, mean ratings were used in 584 (75%) of cases.

A detailed description of scale development was provided by Hampson et al. (2007a). In an exploratory factor analysis, a two-factor solution produced independent and interpretable factors that accounted for 52% of the variance. The highest loading, univocal marker items were selected for each factor to maximize their orthogonality. The ten indicators for hostility were six items from the Crick relational aggression scale (gossips, isolates, excludes, rejects, threatens other children, tells lies), three items from the Crick overt aggression scales (bullies, hits, fights), and one OYSUP item assessing how often the student exerted a negative influence on friends. The eight indicators for sociability were three items from the Walker-McConnell scale (maintaining conversation, initiating conversation, and extending play or conversation), three items from the Achenbach withdrawn scale (withdrawn, prefers to be alone, and underactive), one item from the Harter scale assessing number of friends, and one OYSUP item assessing popularity. Coefficient alphas for the ten-item hostility scale assessed for each of the eight grade groups ranged from .89-.92 for boys and .88-.92 for girls, and for the eight-item sociability scale ranged from .93-.96 for boys and from .92-.95 for girls.

Substance use—Students completed paper and pencil self-report surveys at school or, if they had moved out of the school district, at Oregon Research Institute or via a phone interview. Participants indicated their level of use of each of cigarettes, alcohol, and marijuana during the past 12 months, 0 = “Never,” to 5 = “Some each day.”

Statistical Approach

We used cohort sequential latent growth modeling (LGM; Muthén, 1991) to test models relating the growth of hostility and sociability across the 1st through 8th grade to growth in cigarettes, alcohol and marijuana use across the 9th through 12th grade. All models were analyzed with Mplus Version 5.1 (Muthén & Muthén, 1998/2008) with the maximum likelihood method, using the EM algorithm for missing data (Dempster, Laird, & Rubin, 1977).

Initially, we tested separate growth models for hostility and sociability to determine the growth model that best represented the change in each latent construct over the eight grades (e.g. linear vs. quadratic). Within each growth model, the intercept and slope (latent constructs) were based on eight indicators: the assessment of the variable at each of eight grades (1^{st}-8^{th}). To test a linear model, factor loadings of the intercept on all indicators were set to 1 and factor loadings of the slope on the eight indicators were set sequentially to 0, 1, 2, 3, 4, 5, 6, and 7. To test a quadratic model, the loadings of the intercept on all indicators were set to 1 and the loadings of the slope were set to equal the square of each of the linear loadings (e.g., 0, 1, 4, 9, etc.). Correlations between the intercepts and slopes of the latent constructs were included in all models if significant. The residuals of variables at the same or adjacent time points were allowed to be correlated if indicated by modification indices. Using similar procedures, we tested the fit of separate growth models for each substance across 9^{th} – 12^{th} grades using the factor loadings for the intercepts and slopes described in the linear model above. For all these initial growth models, the inclusion of the quadratic model did not significantly improve the fit. LGM provides mean initial levels (intercepts) and mean rates of change (slopes) based on the growth trajectories for all participants, and the variances for these means that indicate the extent to which there are individual differences in growth. Significant variances, but not necessarily significant means, are required when using intercepts and slopes as predictors or the criterion.

In the next step, we used a parallel process model with the LGMs for both hostility and sociability across elementary and middle school (i.e., 1^{st} 8^{th} grades) predicting use of each substance across the high school years (i.e., 9^{th}-12^{th} grades). The model included structural paths from the intercepts and slopes of hostility and sociability to the intercepts and slopes of the respective substance. Separate models were evaluated for cigarettes, alcohol, and marijuana.

We examined gender differences in model parameters using multiple-group analysis. Within this analysis, all paths were fixed to be equal across gender and then sequentially freed in a stepwise manner according to the modification indices to test for gender differences. If a structural path was significant ($p < .05$) for either gender, it was included in the final model.

Three criteria were used to assess goodness of fit of the models (Duncan, Duncan, & Strycker, 2006). The χ^2 test compares the predicted and actual models: small (i.e., non-significant) values indicate goodness of fit. However, the χ^2 test is more likely to be significant when samples are large, so additional criteria were also considered: a comparative fit index (CFI) of at least .95, and a root mean square error of approximation (RMSEA) of below .08 (Kline, 2006).

Results

Latent Growth Constructs for Each Trait and Each Substance

The observed mean levels of hostility and sociability at each grade are shown separately for boys and girls across 1^{st} to 8^{th} grade in Table 1. The observed mean levels of cigarette, alcohol, and marijuana use in the past 12 months are shown separately for boys and girls across 9^{th} to 12^{th} grades in Table 2. Fit indices for the latent growth models for each construct are provided in Table 3, and the means and variances for the intercepts and slopes of each construct separately for boys and girls are shown in Table 4.

Hostility—A linear growth model fitted the data well and there were no significant gender differences in the overall growth model. The mean of the intercept was significant, indicating it differed significantly from zero, but the mean of the slope was not, indicating no maturational trend to increase or decrease in hostility across the first eight grades for the

sample as a whole. However, the variances of the intercept and slope were significant, indicating individual variability in both initial level and change in hostility across grades. Inspection of the distribution of the individual slopes indicated that 46% were negative (i.e., declined over time, slopes < 0), 2% showed no change (i.e., slopes = 0), and 52% were positive (i.e., increased over time, slopes > 0). There was a negative correlation between the intercept and slope, indicating that children with lower levels of hostility at 1st grade increased in hostility as they grew older, and it was the same for boys and girls, r = -.57, $p < .001$.

Sociability—The linear model for sociability fit the data well, and the overall model did not differ significantly between genders. The mean and variance of the intercept (initial level) were significant, and the mean varied by gender, with boys rated as less sociable than girls at 1st grade (see Table 4). The mean and variance of the slope were significant, with sociability showing modest decreases over time for both boys and girls. Inspection of the distribution of the individual slopes indicated that 85% were negative (i.e., slopes < 0), 1% showed no change (i.e., slope = 0), and 14% were positive (i.e., slopes > 0). The negative correlation between the intercept and the slope was significant and did not differ by gender, indicating that children with higher sociability at 1st grade decreased their sociability more rapidly across grades, r = -.44, $p < .001$.

Cigarettes—The linear model for cigarette use fit the data well, and the overall model did not differ significantly between genders. The means and variances of the intercept and slope were all significant. There was one gender difference: the variance of the intercept was significantly greater for girls than boys (see Table 4). The correlation between the intercept and the slope was not significant and did not vary by gender, indicating that the initial level of cigarette use in the 9th grade was not related to change in use across grades, r = -.07, *ns*. There was one significant correlation for both boys and girls between the residuals for 10th and 11th grade cigarette use that was retained in the final model, r = .46, $p < .001$.

Alcohol—The linear model for alcohol use fit the data well, and the overall model did not differ significantly between genders. The means and the variances of the intercept and slope were significant and there was only one gender difference: Girls reported slightly higher initial levels of alcohol use than did boys at 9th grade (see Table 4). The correlation between the intercept and the slope was not significant and did not differ by gender, indicating that children's level of alcohol use in the 9th grade was not significantly related to change in use across grades, r_{is} = -.01, *ns*. The significant residual correlation for boys between alcohol use at 10th and 11th grades was retained in the final model, r =.35, $p < .001$.

Marijuana—The linear model for marijuana use also fit the data well, and the overall model did not differ significantly between genders. The means and variances of the intercept and slope were significant and did not differ by gender. The negative correlation between the intercept and the slope was significantly smaller for boys (r = -.20, $p < .05$) than girls (r = -.38, $p < .001$) indicating that girls with lower marijuana use in the 9th grade increased their use at a faster rate across grades than did boys. There also was one significant correlation for girls between the residuals for marijuana use at 10th and 11th grades that was retained in the final model, r =.49, p < .001.

We used multiple sample analysis to examine cohort differences in the means and variances of the intercept and slope within each of the above univariate growth models. Since not all cohorts were assessed at each grade, separate analyses were conducted to examine change across specific grades. We examined cohort differences in the growth parameters of hostility and sociability by comparing cohorts 1 and 2 across 2nd-8th grades, cohorts 1 through 3 across 3rd-8th grades, cohorts 1 through 4 across 4th-8th grades, and all five cohorts were

compared across 5th-8th grades. For hostility, we found the residual for 8th grade was significantly different for cohort 4 compared to all other cohorts. In addition, the variation in the slope of hostility for cohort 3 as compared to other cohorts across 5th-8th grades was significantly greater. For sociability, for cohort 1 at 5th grade, the error variance was significantly greater compared to the other four cohorts at 5th grade.

Since cigarette, alcohol and marijuana use were measured across 9th-12th grades, we compared cohorts 2 through 4 for differences in growth parameters across 9th-10th grades, cohorts 3 and 4 across 9th-11th grades, and cohorts 4 and 5 for 11th -12th grades. We found no significant differences as a function of cohort. Minimal differences as a function of cohort provided further support for the use of cohort sequential analyses.

Predicting Substance Use from Latent Growth Constructs of Hostility and Sociability

The next models evaluated our hypotheses about the prospective associations between childhood hostility and sociability, assessed during elementary and middle school, and later substance use assessed during high school. Higher initial level and greater growth of childhood hostility was expected to increase the likelihood of higher initial level and growth of all three substances. Effects for sociability were less confidently predicted, but protective effects for higher childhood sociability were a possibility. These hypotheses were tested in separate models for each substance that estimated paths from the intercept and the slope of hostility and sociability to the intercept and slope of the use of the substance.

The results for each model are shown in Figures 2 – 4. In these figures, and the text, standardized path coefficients representing significant simple regressions are reported. The significance of these path coefficients is evaluated by the critical ratio of the parameter estimate divided by the standard error, which gives the *z* statistic that is evaluated against the normal distribution (i.e., it must exceed +/− 1.96 to be significant). Where gender differences were significant, the coefficients for both genders are reported (coefficients for girls are in parenthesis). Only significant structural paths are shown. For the sake of simplicity, the modest but significant correlations among the intercepts and slopes of hostility and sociability are not shown in the figures, but they are reported here (there were no gender differences). The intercept of hostility correlated negatively with the intercept of sociability (r = -.21, $p < .001$) and positively with the slope of sociability (r = .23, $p < .01$). The remaining correlations between the slope of hostility and the intercept and slope of sociability were not significant and were fixed to zero. These correlations were the same across all three final models. Residuals for sociability and hostility at grade 5 were significantly correlated for both boys and girls ($r = -.21$, $p < .001$). For boys, residuals for sociability and hostility at 2nd grade ($r = -.30$, $p < .01$) and 4th grade ($r = -.30$, $p < .001$) were correlated. For girls, the residuals for hostility at 4th and 5th grades were significantly correlated ($r = .25$, $p < .001$). These residual correlations (not shown in the figures) were the same for all three final models predicting substance use.

Cigarettes—The model for cigarette use is shown in Figure 2. This model fit the data well, X^2 (352, N = 1,074) = 493.72, $p < .001$; CFI = .97; RMSEA = .027; 90% *CI* = .021, .033. The intercept of hostility predicted the intercept of cigarette use, and the effect was significantly stronger for girls (.42, $p < .001$) than boys (.39; $p < .001$). The hostility intercept predicted the slope (.40, $p < .001$) of cigarette use for both boys and girls. Thus, as hypothesized, children with higher initial levels of hostility (particularly girls) were smoking more at 9th grade and were more likely to increase their cigarette use during high school. Growth (slope) in hostility across elementary and middle school predicted the intercept of cigarette use at 9th grade for both boys and girls (.48, p < .001). That is, as hypothesized, children who became increasingly hostile during elementary and middle school were

smoking more by 9th grade. However, contrary to our hypothesis, the slope of hostility did not predict the slope of cigarette use during high school for either boys or girls. There were no significant effects of childhood sociability on adolescent cigarette use.

Alcohol—The model for alcohol use is shown in Figure 3, and demonstrated an adequate fit, X^2 (353, N = 1074) = 444.87, p <.001; CFI = .98; RMSEA = .022; 90% *CI* = .015, .028. In partial support of our hypotheses, the intercept of hostility predicted the intercept but not the slope of alcohol use for both boys and girls, and this association was significantly stronger for girls (.58, p < .001) than boys (.40, p < .001). That is, children, particularly girls, who were more hostile at 1st grade, were drinking more alcohol by 9th grade, but they were not more likely to increase their alcohol use during high school. The slope of hostility also predicted the intercept (.47, p < .001) but not the slope of alcohol use for boys and girls. That is, children who became more hostile during elementary and middle school had higher levels of alcohol use by 9th grade but did not increase their alcohol use from 9th to 12th grades.

One significant association for sociability was observed. For both boys and girls, the intercept of sociability predicted the intercept of alcohol use indicating that children who were more sociable at 1st grade were more likely to have higher levels of alcohol use by 9th grade (.20, p < .001).

Marijuana—The fit of this model, shown in Figure 4, was adequate, X^2 (353, N = 1074) = 486.47, p < .001; CFI = .97, RMSEA = .027; 90% *CI* = .020, .032. This model provided the most support for the hypothesized effects of level and growth of hostility. The intercept of hostility predicted both the intercept and the slope of marijuana use for both boys and girls. The association between the intercept of hostility and the intercept of marijuana use was higher for girls (.41, p < .001) than for boys (.31, p < .001), whereas the association between the intercept of hostility and the slope of marijuana use was higher for boys (.44, p < .001) than for girls (.26, p < .01). These findings indicated that children, particularly girls, who were more hostile at 1st grade, were using more marijuana by 9th grade, and that children, particularly boys, who were more hostile in 1st grade increased their marijuana use significantly more during high school. The slope of hostility predicted the intercept of marijuana use for both boys and girls (.47, p <.001) but did not predict the slope of marijuana use. That is, children's increasing hostility over elementary and middle school was associated with higher levels of marijuana use by 9th grade, but did not predict growth in marijuana use during high school. Sociability was not associated with marijuana use.

Discussion

This study extends prior research on the influence of personality on the development of substance use by relating growth of hostility and sociability in elementary school to growth of subsequent substance use in high school. By modeling trait predictors and substance use outcomes as latent growth constructs, it was possible to relate individual differences in the level and rate of growth of latent traits to individual differences in the level and rate of growth of subsequent smoking, alcohol, and marijuana. Consistent with our initial hypothesis, childhood hostility emerged as a more consistent predictor across all three substances than sociability, demonstrating the significance of the development of this particular trait for the etiology of substance use.

Growth of Adolescent Substance Use and Childhood Traits

Using LGM, developmental trends in levels and growth of substance use across the high school years were described, and differences between boys and girls examined. The levels of

use of cigarettes and marijuana did not differ between boys and girls, but girls used more alcohol than boys. Consistent with national trends, use of cigarettes, alcohol, and marijuana increased linearly across the four high-school years for both boys and girls (Johnston et al., 2008). The correlations between the level and slope of substance use indicated that for marijuana, those who started off at relatively low levels of use in 9th grade had more rapid rates of increase over the four years, and this was particularly true for girls. No such relation was observed for cigarettes and alcohol, suggesting no comparable catch-up process for these substances in high school, possibly because initiation of cigarettes and alcohol use occurs at an earlier age than marijuana (Andrews et al., 2003; Johnston et al., 2008).

Our findings add to what little is known about the development of personality traits over the elementary school years. There was no maturational trend to either increase or decrease in hostility, which is consistent with the conclusion of a prior meta-analysis that trait means show stability over time for this age range (Roberts et al., 2006). However, sociability showed a slight but significant decline. This finding is consistent with the modest reduction in childhood extraversion, assessed by mothers, observed by Lamb, Chuang, Wessels, Broberg, and Hwang (2002) over five assessments from age 2 to 15 years. The decline in sociability observed here, assessed predominantly by items referring to participation in social interaction, may reflect a maturational trend to develop social restraint during elementary and middle school, or it may reflect the decreasing opportunity for teachers to observer children's social interactions as classwork becomes more individual and there is less playtime.

There was significant variation in the level and the slope of both hostility and sociability. Variation in trait level confirmed that there were individual differences in the extent to which these children were hostile and sociable. Variation in slope was the more interesting and novel finding. It demonstrated that there were individual differences in trait change during childhood even when, as was the case for hostility, there was no evidence for a maturational trend. Individual differences in rate of change provide a new way of examining the influence of a personality trait on subsequent outcomes and here we showed that this variance predicted later substance use.

Hostility as a Predictor of Substance Use

Consistent with our initial hypothesis, childhood hostility emerged as an important predictor of later substance use. Higher initial levels of childhood hostility predicted higher levels of substance use in 9th grade for cigarettes, alcohol, and marijuana. Children with higher initial levels of hostility were also more likely to increase their use of cigarettes and marijuana during high school. Furthermore, increasing hostility over childhood predicted higher levels of use of all three substances in 9th grade. The findings for individual differences in rate of change for hostility are of particular interest. Increasing hostility across elementary and middle school emerged as a novel risk factor for greater substance use in high school.

Given that there was no maturational trend for children to increase in hostility, why some children become increasing hostile, and why this confers greater risk for later substance use, become important questions. Previous studies of the etiology of substance use point to possible explanatory mechanisms. Children's beliefs about substances, which include social images of substance users, subjective norms, and intentions and willingness to use, indicate cognitive susceptibility for later substance use (e.g., Andrews et al., 2008; Choi, Gilpin, Farkas, & Pierce, 2001; Gritz et al., 2003). There is evidence that more hostile children are more likely to develop greater cognitive susceptibility to substance use. For example, more hostile children in OYSUP were more likely to intend to use cigarettes and alcohol when older, and the effects of boys' hostility on intentions to smoke, and of both boys' and girls' hostility on intentions to drink alcohol, were mediated by subjective norms (Hampson et al.,

2006; Hampson et al., 2007b). Subjective norms were operationalized as children's beliefs about the extent to which their friends and other kids in their neighborhood used the substance in question, and more hostile children believed that more of their peers were using substances.

The role of these peer-based norms as mediators of hostility suggests a peer-influence process, which is another well-established etiological factor in adolescent substance use (Andrews & Hops, in press). Hostile children may be more likely to join deviant peer groups and thus be at greater risk of substance use (Dishion, 1990; Hawkins, Catalano, & Miller, 1992; Patterson, Reid, & Dishion, 1992). For example, children from alcoholic families who were more impulsive and low in agreeableness (i.e., hostile), were more likely to become involved with deviant peers and at risk for substance dependence (Chassin, Flora, & King, 2004), and high sensation-seeking adolescents associated with deviant peers who were also higher sensation seekers (Donohew et al., 1999). Through the mechanism of niche selection, hostile children may seek out a deviant peer group composed of similar others, and then socialization within that group may contribute to the further development of their hostility by mechanisms such as evocation, manipulation, and accumulation, leading to the development of cognitive susceptibility (e.g., intentions, willingness) and eventual substance use (Roberts et al., 2008).

Sociability as a Predictor of Substance Use

As expected, sociability demonstrated a less consistent pattern of associations with substance use than hostility. The relatively few associations between childhood sociability and adolescent substance use may indicate that sociable children enjoy some degree of protection, benefitting from more prosocial early peer influences (Bukowski, Brendgen, & Vitaro, 2007). However, being more sociable in childhood did not predict less adolescent substance use. Childhood sociability was unrelated to adolescent cigarette or marijuana use but, contrary to our hypothesis, higher levels predicted initial levels of alcohol use in high school, suggesting sociable children may develop beliefs that alcohol use is prevalent and acceptable and hence are more susceptible to using alcohol in adolescence. Sociable children are likely to be more popular, and popularity has been associated with adolescent alcohol use, suggesting the importance of peer influence (Hops, Davis, & Lewin, 1999; Pearson et al., 2006). Trait mechanisms such as niche selection may result in sociable children seeking out environments (e.g., team sports) that support the development of cognitive susceptibility (e.g., willingness and intentions) for later use of alcohol (Eccles & Barber, 1999).

Of interest was the absence of any effects of negative growth in sociability (sociability showed a slight maturational trend to decline). Although there was significant variance in growth, individual differences in change in sociability did not predict later substance use. Past developmental research on the conduct disorder of social withdrawal suggests that children who are less social and who become increasing less social, would be more likely to use substances in adolescence (Rubin et al., 2009). Our findings do not support this prediction. Instead, this study supported the position that higher levels of sociability can be a risk factor for substance use (Brook et al., 1988; Chassin et al., 1993; Jessor & Jessor, 1977), and underscored the importance of examining different substances separately.

Strengths and Limitations

Although latent growth of traits has been studied in young and old adults (Mroczek & Spiro, 2007; Vaidya, Gray, Haig, Mroczek, & Watson, 2008), to our knowledge no study has examined trait growth from early childhood to adolescence using LGM. Prior studies have used parameters of latent trait growth to predict a single outcome such as mortality (Mroczek & Spiro, 2007), or have used traits measured on only one occasion to predict an

outcome modeled as a latent growth construct, such as growth in academic achievement (Hart, Atkins, & Matsuba, 2008). Here, to address novel substantive questions, we related growth of personality traits to growth of substance use.

In addition to multiple assessments, another strength of this study was the use of teacher ratings of personality. Teachers are more informed raters than parents because they can judge a child relative to his or her peers, and can be more objective. Ratings were made by unique teachers at each assessment, which reduced the risk of biases from repeated assessments by the same teacher. The same raters across assessments (teachers, parents, or the self) may be biased towards perceiving greater personality stability over time. In addition, stability can be confounded with method bias (e.g., using the same portions of the scale in their ratings). Ratings from unique teachers across across multiple assessments showed more trait instability in childhood than has been reported hitherto.

This study has a number of limitations. As a non-experimental study, causal relations between childhood personality traits and later substance use cannot be inferred, although the prospective nature of this design makes a causal account more plausible. The OYSUP sample is almost exclusively White (European American), thus restricting the generalizability of the present findings. This study only examined whether childhood trait change was related to later substance use and did not test potential mechanisms to account for these associations, although some potential mechanisms were outlined. Personality traits are one of many risk factors for substance use and the effects of these other factors were not studied here. In previous papers, we showed that personality traits may influence cognitions regarding substance use which in turn influence intentions and use (Hampson et al., 2006, 2007b). Other etiological factors not studied here, including ones related so socioeconomic status such as parenting styles, may also influence both the development of personality traits and substance use. Moreover, this paper did not distinguish between increasing substance use and problematic use, such as binge drinking. It is possible that differentiating between qualitatively different levels of use would yield yet more interesting associations with early childhood personality. For example, sociability may predict experimental but not problematic substance use, whereas hostility may be more strongly associated with problematic use.

Conclusions

The present findings demonstrate that individual differences in the growth of childhood personality traits, in addition to the individual differences in the level of these traits, can predict subsequent substance use. In particular, increasing hostility over childhood as well as higher levels of early hostility, were identified as risk factors for later use of the most prevalent forms of high school substance use. This knowledge could be used to inform interventions to prevent the development of adolescent substance use. Although it remains for future research to investigate the processes by which developing traits influence later behavior, an implication of this study is that intervening to alter the developmental course of potentially harmful traits could result in prevention of later problem behavior.

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References

Achenbach, TM. Manual for the Child Behavior Checklist/4-18 and 1991 Profile. Burlington, VT: University of Vermont, Department of Psychiatry; 1991.

Achenbach, TM. Manual for the Teacher's Report Form and 1991 Profile. Burlington, VT: University of Vermont Department of Psychiatry; 1991.

Ahadi, S.; Rothbart, MK. Temperament, development and the Big Five. In: Halverson, C., Jr; Kohnstamm, D.; Martin, R., editors. Development of the structure of temperament and personality from infancy to adulthood. Hillsdale, NJ: Erlbaum; 1994. p. 189-208.

Andrews JA, Hampson SE, Barckley M, Gerrard M, Gibbons FX. The effect of early cognitions on cigarette and alcohol use in adolescence. Psychology of Addictive Behaviors 2008;22:96–106. [PubMed: 18298235]

Andrews, JA.; Hops, H. The influence of peers on substance use. In: Scheier, LM., editor. Handbook of Drug Use Etiology. American Psychological Association; in press

Andrews JA, Hops H, Duncan SC. Adolescent modeling of parent substance use: The moderating effect of the relationship with the parent. Journal of Family Psychology 1997;11:259–270.

Andrews JA, Hops H, Tildesley E, Li F. The influence of peers on young adult substance use. Health Psychology 2002;21:349–357. [PubMed: 12090677]

Andrews JA, Tildesley E, Hops H, Duncan SC, Severson H. Elementary school age children's future intentions and use of substances. Journal of Clinical Child and Adolescent Psychology 2003;32:556–567. [PubMed: 14710464]

Ary DV, Duncan TE, Duncan SC, Hops H. Adolescent problem behavior: The influence of parents and peers. Behavior Research and Therapy 1999;37:217–230.

Block J, Block JE, Keyes S. Longitudinally foretelling drug usage in adolescence: Early childhood personality and environmental precursors. Child Development 1988;59:336–355. [PubMed: 3359859]

Boyle MH, Offord DR, Racine YA, Fleming JE, Szatmari P, Links P. Predicting substance use in early adolescence based on parent and teacher assessments of childhood psychiatric disorder: Results from the Ontario Child Health Study follow-up. Journal of Child Psychology and Psychiatry 1993;34:535–544. [PubMed: 8509493]

Brook J, Whiteman M, Gordon A, Cohen P. Some models and mechanisms for explaining the impact of maternal and adolescent characteristics on adolescent stage of drug use. Developmental Psychology 1986;22(4):460–467.

Brook JS, Whiteman M, Nomura C, Gordon AS, Cohen P. Personality, family, and ecological influences on adolescent drug use: A developmental analysis. Journal of Chemical Dependency Treatment 1988;1(2):123–161.

Bukowski, WM.; Brendgen, M.; Vitaro, F. Peers and socialization: Effects on externalizing and internalizing problems. In: Grusec, JE.; Hastings, PD., editors. Handbook of socialization: Theory and research. New York: Guilford Press; 2007. p. 355-381.

Burt RD, Dinh KT, Peterson AV Jr, Sarason IG. Predicting adolescent smoking: A prospective study of personality variables. Preventive Medicine 2000;30:115–125. [PubMed: 10656839]

Caspi, A. Personality development across the life course. In: Eisenberg, N., editor. Handbook of child development. New York: Wiley; 1998. p. 311-388.

Caspi A, Roberts BW, Shiner R. Personality development. Annual Review of Psychology 2005;56:453–484.

Chassin L, Flora D, King K. Trajectories of Alcohol and Drug Use and Dependence From Adolescence to Adulthood: The Effects of Familial Alcoholism and Personality. Journal of Abnormal Psychology 2004 November;113(4):483–498. [PubMed: 15535782]

Chassin L, Pillow DR, Curran PJ, Molina Brooke SG, Barrera M Jr. Relation of parental alcoholism to early adolescent substance use: A test of three mediating mechanisms. Journal of Abnormal Psychology 1993;102:3–19. [PubMed: 8436697]

Choi WS, Gilpin EA, Farkas AJ, Pierce JP. Determining the probability of future smoking among adolescents. Addiction 2001;96:313–323. [PubMed: 11182877]

Crick NR. The role of overt aggression, relational aggression, and prosocial behavior in the prediction of children's future social adjustment. Child Development 1996;67:2317–2327. [PubMed: 9022243]

Dempster AP, Laird NM, Rubin DB. Maximum likelihood from incomplete data via the EM algorithm. Journal of the Royal Statistical Society, B 1977;39:1–38.

Dishion, TJ. The peer context of troublesome child and adolescent behavior. In: Leone, PE., editor. Understanding troubled and troubling youth. Beverly Hills, CA: Sage Publications; 1990. p. 128-153.

Donohew RL, Hoyle RH, Clayton RR, Skinner WF, Colon SE, Rice RE. Sensation seeking and drug use by adolescents and their friends: Models for marijuana and alcohol. Journal of Studies in Alcohol 1999;60:622–631.

Duncan, TE.; Duncan, SC.; Strycker, LA. An introduction to latent variable growth curve modeling. 2nd. Mahwah, NJ: Erlbaum; 2006.

Eccles J, Barber B. Student council, volunteering, basketball, or marching band: What kind of extracurricular involvement matters? Journal of Adolescent Research 1999;14:10–43.

Eccles, J.; Lord, S.; Buchanan, C. School transitions in early adolescence: What are we doing to our young people?. In: Graber, JA.; Brooks-Gunn, J.; Petersen, AC., editors. Transitions through adolescence: Interpersonal domains and context. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.; 1996. p. 251-284.

Forgays DG, Forgays DK, Wrzesniewski K, Bonaiuto P. Personality dimensions and cigarette smoking behavior in Polish and US adolescents. Psychology and Health 1993;8:257–268.

Fraley CR, Roberts BW. Patterns of continuity: A dynamic model for conceptualizing the stability of individual differences in psychological constructs across the life course. Psychological Review 2005;112:60–74. [PubMed: 15631588]

Gibbons FX, Gerrard M, Blanton H, Russell DW. Reasoned action and social reaction: Willingness and intention as independent predictors of health risk. Journal of Personality and Social Psychology 1998;74:1164–1181. [PubMed: 9599437]

Gritz ER, Prokhorov AV, Hudmon KS, Mullin Jones M, Rosenblum C, Chang CC, Chamberlain RM, Taylor WC, Johnston D, de Moor C. Predictors of susceptibility to smoking and ever smoking: A longitudinal study in a triethnic sample of adolescents. Nicotine and Tobacco Research 2003;5:493–506. [PubMed: 12959787]

Hampson SE, Andrews JA, Barckley M. Predictors of development of elementary-school children's intentions to smoke cigarettes: Prototypes, subjective norms, and hostility. Nicotine and Tobacco Control 2007b;9:751–760.

Hampson SE, Andrews JA, Barckley M, Peterson M. Trait stability and continuity in childhood: Relating sociability and hostility to the Five-Factor Model. Journal of Research in Personality 2007a;41:507–523. [PubMed: 18488082]

Hampson SE, Andrews JA, Barckley M, Severson HH. Personality predictors of the development of elementary-school children's intentions to drink alcohol: The mediating effects of attitudes and subjective norms. Psychology of Addictive Behaviors 2006;20:288–297. [PubMed: 16938066]

Hart D, Atkins R, Matsuba MK. The association of neighborhood poverty with personality change in childhood. Journal of Personality and Social Psychology 2008;94:1048–1061. [PubMed: 18505317]

Harter, S. Manual for the Self Perception Profile for Children. University of Denver; 1985.

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;112:64–105. [PubMed: 1529040]

Hops H, Davis B, Lewin L. The development of alcohol and other substance use: A gender study of family and peer context. Journal of Studies on Alcohol, Supplement 1999;13:22–31. [PubMed: 10225485]

Jessor, R.; Jessor, SL. Problem behavior and psychosocial development: A longitudinal study of youth. New York, NY: Academic Press; 1977.

Johnston, LD.; O'Malley, PM.; Bachman, JG.; Schulenberg, JE. Monitoring the Future: National results on adolescent drug use: Overview of key findings, 2008. Bethesda, MD: National Institute on Drug Abuse; 2009. NIH Publication No 09-7401

Kandel DB. Marijuana users in young adulthood. Archives of General Psychiatry 1984;41:200–209. [PubMed: 6607718]

Kandel D. The parental and peer contexts of adolescent deviance: An algebra of interpersonal influences. Journal of Drug Issues 1996 March;26(2):289–315.

Kellam SG, Brown CH, Fleming JP. Social adaptation to first grade and teenage drug, alcohol and cigarette use. Journal of School Health 1982;52:301–306. [PubMed: 6919707]

Kline, RB. Principles and practice of structural equation modeling. 2nd. New York: Guilford Press; 2006.

Lamb ME, Chuang SS, Wessels H, Broberg AG, Hwang CP. Emergence and construct validation of the Big Five factors in early childhood: A longitudinal analysis of their ontogeny in Sweden. Child Development 2002;73:1517–1524. [PubMed: 12361316]

Lerner, RM. Concepts and theories of human development. 3rd. Mahwah, NJ: Erlbaum; 2002.

Lodi-Smith J, Roberts B. Social Investment and Personality: A Meta-Analysis of the Relationship of Personality Traits to Investment in Work, Family, Religion, and Volunteerism. Personality and Social Psychology Review 2007;11:1–19.

Moffitt TE. Life-course-persistent and adolescence-limited antisocial behavior: A developmental taxonomy. Psychological Review 1993;100:674–701. [PubMed: 8255953]

Mroczek DK, Spiro A III. Personality change influences mortality in older men. Psychological Science 2007;18:371–376. [PubMed: 17576273]

Mroczek DK, Spiro A III. Modeling intraindividual change in personality traits: Findings from the Normative Aging Study. Journal of Gerontology: Psychological Sciences 2003;58B:P153–P165.

Muthén, BO. Analysis of longitudinal data sets using latent variable models with varying parameters. In: Collins, LM.; Horn, JM., editors. Best methods for the analysis of change: Recent advances, unanswered questions, future directions. Washington, DC: American Psychological Association; 1991. p. 1-17.

Muthén, LK.; Muthén, BO. Mplus user's guide. Los Angeles, CA: Muthén & Muthén; 1998/2008.

Newcomb, M.; Bentler, P. Consequences of adolescent drug use Impact on the lives of young adults. Newbury Park, CA: Sage; 1988.

Patterson, GR.; Reid, JB.; Dishion, TJ. A social interactional approach: IV Antisocial boys. Eugene, OR: Castalia Publishing Company; 1992.

Pearson M, Sweeting H, West P, Young R, Gordon J, Turner K. Adolescent substance use in different social and peer contexts: A social network analysis. Drugs: Education, Prevention and Policy 2006;13:519–536.

Pepler DJ, Craig WM, Connolly JA, Yuile A, McMaster L, Jiang D. A developmental perspective on bullying. Aggressive Behavior 2006;32:376–384.

Pepler, D.; Rubin, K. The development and treatment of childhood aggression. Hillsdale, NJ England: Lawrence Erlbaum Associates, Inc.; 1991.

Prior M, Smart D, Sanson A, Oberklaid F. Does shy-inhibited temperament in childhood lead to anxiety problems in adolescence? Journal of the American Academy of Child and Adolescenct Psychiatry 2000;39:461–468.

Raudenbush, SW.; Bryk, AS. Hierarchical linear models: Applications and data analysis methods. 2nd. London: Sage; 2002.

Roberts BW, DelVecchio WF. The rank-order consistency of personality traits from childhood to old age: A quantitative review of longitudinal studies. Psychological Bulletin 2000;126:3–25. [PubMed: 10668348]

Roberts BW, Robins RW. A longitudinal study of person-environment fit and personality development. Journal of Personality 2004;72:89–110. [PubMed: 14686885]

Roberts BW, Walton KE, Viechtbauer W. Patterns of mean-level change in personality traits across the life course: A meta-analysis of longitudinal studies. Psychological Bulletin 2006;132:1–25. [PubMed: 16435954]

Roberts, BW.; Wood, D.; Caspi, A. Personality development. In: John, OP.; Robins, RW.; Pervin, LA., editors. Handbook of personality: Theory and research. 3rd. New York, NY: Guilford; 2008. p. 375-398.

Rubin KH, Chen X, McDougall P, Bowker A, McKinnon J. The Waterloo Longitudinal Project: Predicting adolescent internalizing and externalizing problems from early and mid-childhood. Development and Psychopathology 1995;7:751–764.

Rubin KH, Coplan RJ, Bowker JC. Social withdrawal in childhood. Annual Review of Psychology 2009;60:141–171.

Serbin, L.; Moskowitz, D.; Schwartzman, A.; Ledingham, J. Aggressive, withdrawn, and aggressive/withdrawn children in adolescence: Into the next generation. In: Pepler, DJ.; Rubin, KH., editors. The development and treatment of childhood aggression. Hillsdale, NJ: Erlbaum; 1991. p. 55-70.

Shedler J, Block J. Adolescent drug use and psychological health: A longitudinal inquiry. American Psychologist 1990;45:612–630. [PubMed: 2350080]

Shiner R. How shall we speak of children's personalities in middle childhood? A preliminary taxonomy. Psychological Bulletin 1998;124:308–332. [PubMed: 9849111]

Singer, JD.; Willett, JB. Applied longitudinal data analysis: Modeling change and event occurrence. New York: Oxford University Press; 2003.

Stattin, H.; Magnusson, D. Pubertal maturation in female development. Hillsdale, NJ: Erlbaum; 1990.

Tarter RE. Are their inherited behavioral traits that predispose to substance abuse? Journal of Consulting and Clinical Psychology 1988;56:189–196. [PubMed: 3286703]

Tarter RE, Sambrano S, Dunn MD. Predictor variables by developmental stages: A Center for Substance Abuse Prevention multisite study. Psychology of Addictive Behaviors 2002;16:S3–S10. [PubMed: 12502273]

Tschann J, Adler N, Irwin C, Millstein S, Turner R, Kegeles S. Initiation of substance use in early adolescence: The roles of pubertal timing and emotional distress. Health Psychology 1994 July; 13:326–333. [PubMed: 7957011]

Tyas S, Pederson L. Psychosocial factors related to adolescent smoking: A critical review of the literature. Tobacco Control 1998;7:409–420. [PubMed: 10093176]

Vaidya JG, Gray EK, Haig JR, Mroczek DK, Watson D. Differential stability and individual growth trajectories of Big Five and affective traits during young adulthood. Journal of Personality 2008;76:267–304. [PubMed: 18331279]

Walker, HM.; McConnell, SR. Walker-McConnell Scale of Social Competence and School Adjustment. San Diego, CA: Singular Publishing Group; 1995.

Weiss JW, Mouttapa M, Chou CP, Nezami E, Anderson Johnson C, Palmer PH, Cen S, Gallaher P, Ritt-Olson A, Azen S, Unger JB. Hostility, depressive symptoms, and smoking in early adolescence. Journal of Adolescence 2005;28:49–62. [PubMed: 15683634]

Westling E, Andrews JA, Hampson SE, Peterson M. Pubertal timing and substance use: The effects of gender, parental monitoring and deviant peers. Journal of Adolescent Health 2008;42:555–563. [PubMed: 18486864]

Wills TA, DuHamel K, Vaccaro D. Activity and mood temperament as predictors of adolescent substance use: Test of a self-regulation mediational model. Journal of Personality and Social Psychology 1995;68:901–916. [PubMed: 7776186]

Wills TA, Vaccaro D, McNamara G. Novelty seeking, risk taking, and related constructs as predictors of adolescent substance use: An application of Cloninger's theory. Journal of Substance Abuse 1994;6:1–20. [PubMed: 8081104]

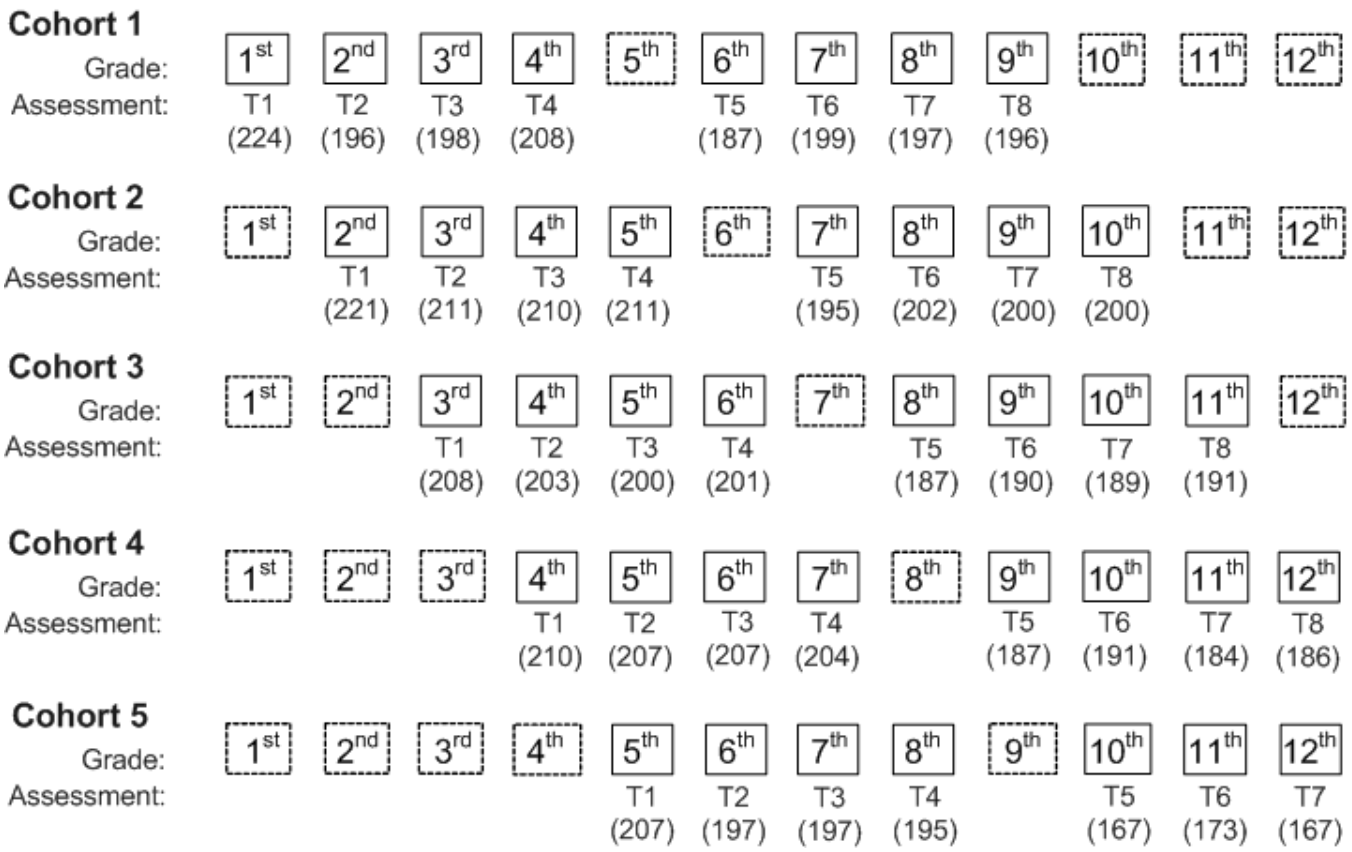

Figure 1.

The cohort sequential design of the Oregon Youth Substance Use Project demonstrating how collapsing across cohorts yielded a longitudinal study of 1^{st} – 12^{th} grade.

NOTE: Boxes with broken outlines indicate that there was no assessment for that cohort at that grade. Due to a delay in funding, there was a gap of two years between T4 and T5 resulting in one missing grade assessment for each cohort. The number of participants at each time of assessment (T) is show in parentheses.

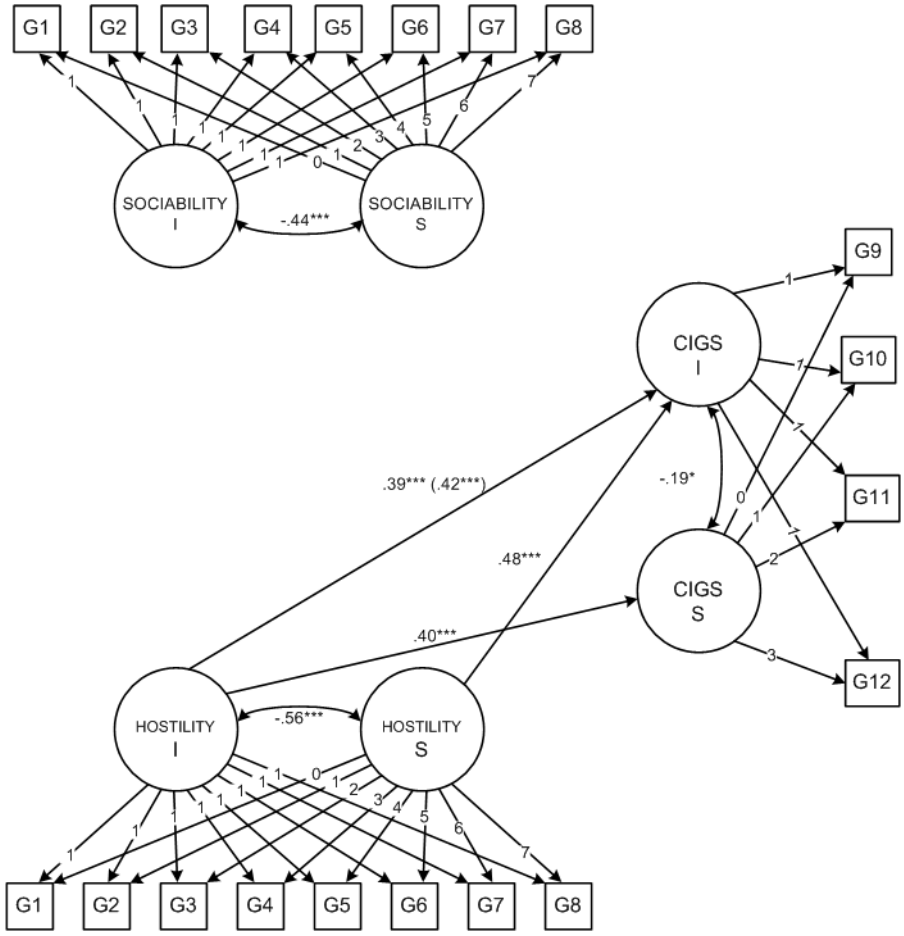

Figure 2.

Hostility and sociability in elementary and middle school predicting cigarette use in high school.

NOTE: Hostility and sociability were measured at seven assessments (T1 – T7) and cigarette use was measured at four assessments (T5-T8). Therefore, using cohort-sequential analyses, sociability and hostility factors are represented by 8 grades in elementary and middle school (1^{st}-8^{th}) and cigarette use is represented by 4 grades in high school (9^{th}-12^{th}). Only significant standardized structural paths are shown. Where there were significant gender differences, estimates are shown separately for boys and girls (girls are in parentheses). Several residual correlations and correlations among the intercepts and slopes of hostility and sociability were estimated, but are not shown. I = intercept, S = slope.

* p = <. 05. ** p = < .01. *** p = < .001.

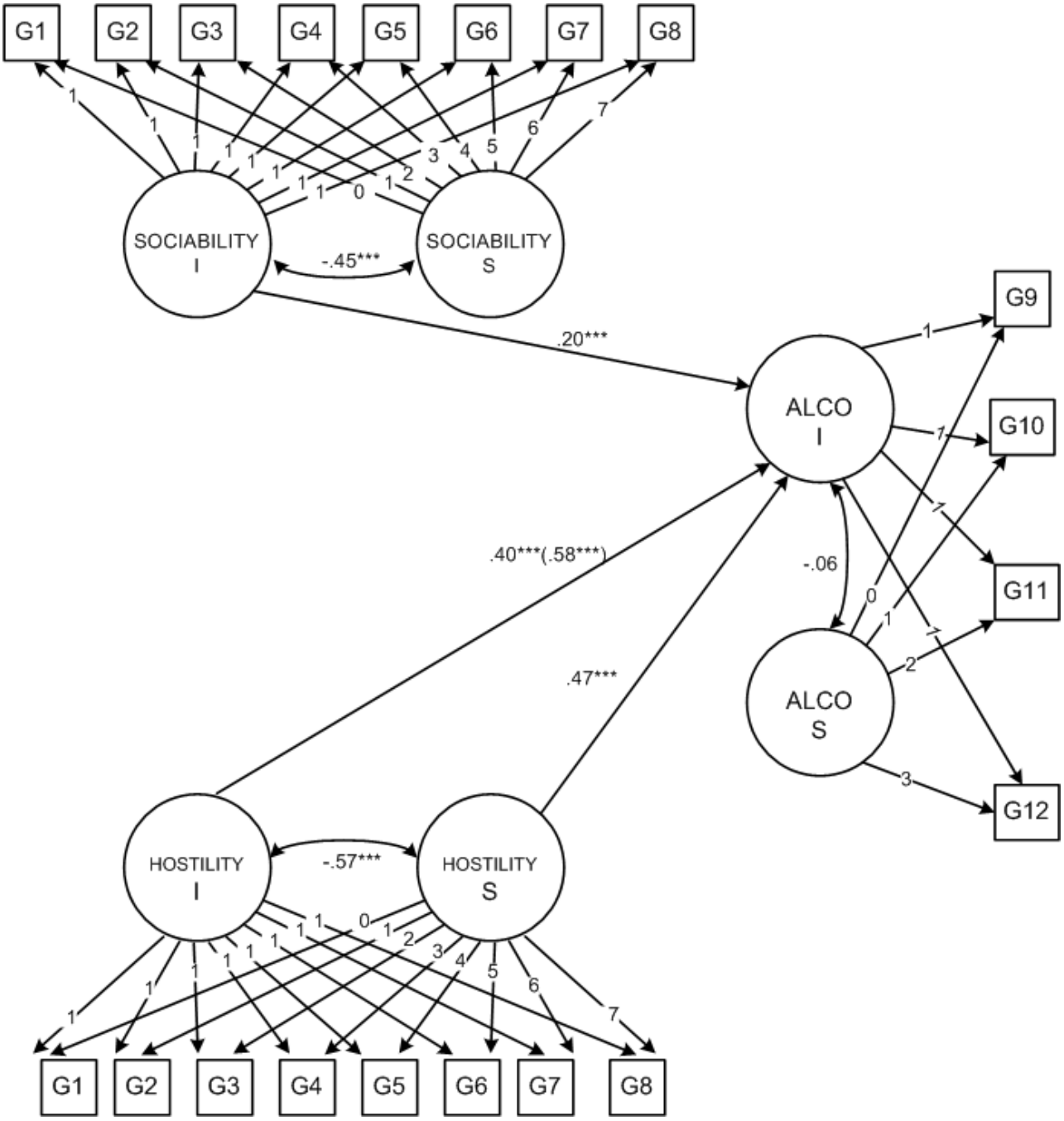

Figure 3.

Hostility and sociability in elementary and middle school predicting alcohol use in high school.

NOTE: Hostility and sociability were measured at seven assessments (T1 – T7) and alcohol use was measured at four assessments (T5-T8). Therefore, using cohort-sequential analyses sociability and hostility factors are represented by 8 grades in elementary and middle school (1^{st}-8^{th}) and alcohol use is represented by 4 grades in high school (9^{th}-12^{th}). Only significant standardized structural paths are shown. Where there were significant gender differences, estimates are shown separately for boys and girls (girls are in parentheses). Several residual

correlations and correlations among the intercepts and slopes of hostility and sociability were estimated, but are not shown. I = intercept, S = slope.
* p = <.05. ** p = < .01. *** p = < .001.

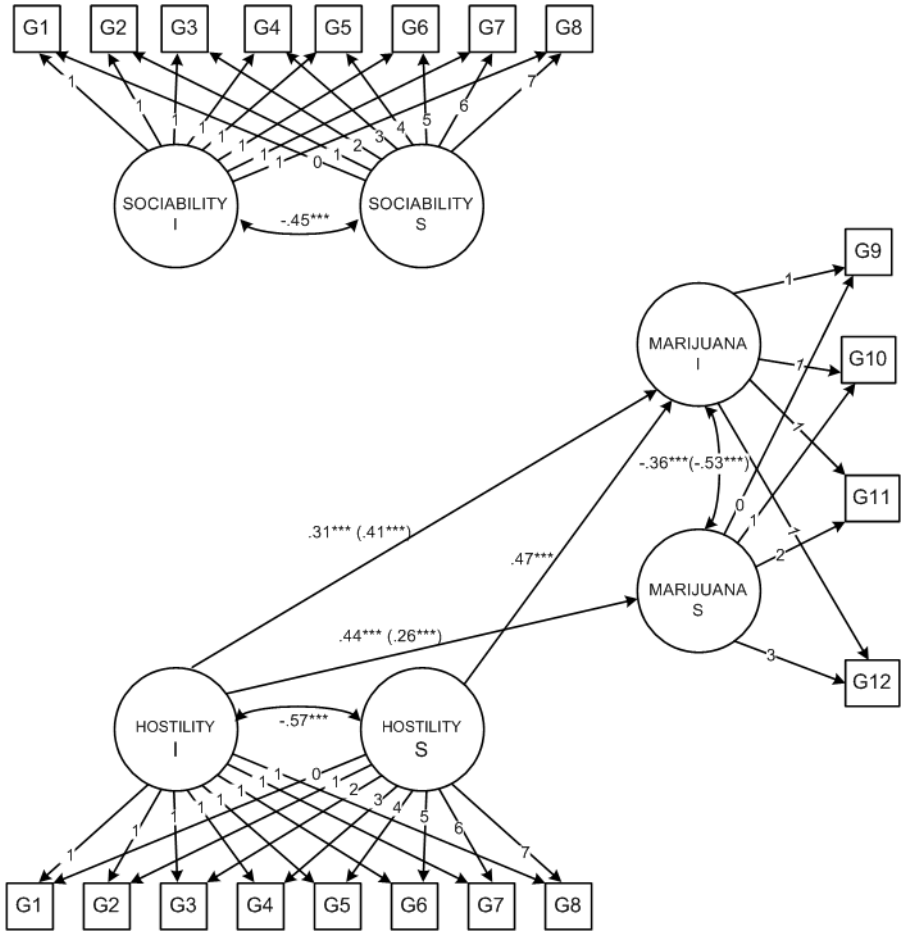

Figure 4.

Hostility and sociability and in elementary and middle school predicting marijuana use in high school.

NOTE: Hostility and sociability were measured at seven assessments (T1 – T7) and marijuana use was measured at four assessments (T5-T8) for 6th-10th grade at T5 through 9th-12th grade at T8. Therefore, using cohort-sequential analyses sociability and hostility factors are represented by 8 grades in elementary and middle school (1st-8th) and marijuana use is represented by 4 grades in high school (9th-12th). Only significant standardized structural paths are shown. Where there were significant gender differences, estimates are shown separately for boys and girls (girls are in parentheses). Several residual correlations and correlations among the intercepts and slopes of hostility and sociability were estimated, but are not shown. I = intercept, S = slope.

* p = <.05. ** p = < .01. *** p = < .001.

Table 1
Means and Standard Deviations of Personality Variables by Gender

	Boys		Girls	
Variable	***M***	***SD***	***M***	***SD***
Sociability				
1st grade	3.02	.79	3.23	.71
2nd grade	3.06	.91	3.19	.78
3rd grade	3.00	.87	3.16	.80
4th grade	3.08	.89	3.26	.74
5th grade	3.04	.91	3.23	.82
6th grade	2.85	.93	3.09	.82
7th grade	2.83	.95	3.11	.83
8th grade	2.87	.77	3.04	.74
Hostility				
1st grade	.83	.75	.69	.68
2nd grade	.72	.70	.73	.77
3rd grade	.76	.74	.77	.73
4th grade	.65	.68	.69	.71
5th grade	.66	.66	.70	.74
6th grade	.82	.70	.77	.74
7th grade	.73	.71	.67	.71
8th grade	.71	.63	.69	.66

Note. Sociability and hostility were measured on 5-point scales; higher scores indicate higher trait levels.

Table 2
Means and Standard Deviations of Substance Use Variables by Gender

	Boys		Girls	
Variable	***M***	***SD***	***M***	***SD***
Cigarettes				
9th grade	.44	1.07	.59	1.30
10th grade	.67	1.33	.91	1.61
11th grade	1.01	1.57	1.07	1.75
12th grade	1.39	1.78	1.30	1.86
Alcohol				
9th grade	.91	1.15	1.09	1.10
10th grade	1.18	1.27	1.29	1.26
11th grade	1.35	1.23	1.49	1.27
12th grade	1.79	1.38	1.68	1.33
Marijuana				
9th grade	.51	1.17	.53	1.12
10th grade	.71	1.35	.78	1.32
11th grade	.92	1.48	.82	.126
12th grade	1.11	1.55	.94	1.30

Note. Cigarette, alcohol, and marijuana use were measured on 6-point scales: 0 = never, 5 = some each day.

Table 3

Fit Indices for Univariate Latent Growth Models

Factor	χ^2	*df*	CFI	RMSEA	90% CI of RMSEA
Hostility	93.28**	64	.98	.03	.02 - .04
Sociability	102.21**	63	.97	.03	.02 - .05
Cigarettes	19.34*	13	.99	.03	.00 - .06
Alcohol	14.63*	13	.99	.04	.02 - .05
Marijuana	33.97**	13	.98	.06	.03 - .08

Note. N = 1,074 for hostility and sociability; N = 960 for cigarettes, alcohol, and marijuana. CFI = comparative fit index; RMSEA = root mean square of approximation; CI = confidence interval.

* $p < .05$.

** $p < .01$.

Table 4
Growth Factors for Univariate Latent Growth Models

	Boys		Girls	
Growth Factors	**Mean**	**Variance**	**Mean**	**Variance**
Hostility				
Intercept	.70***	.32***	.70***	.32***
Slope	.002*ns*	.01***	.002*ns*	.01***
Sociability				
Intercept	3.12***1*	.49***2*	3.33***	.38***
Slope	-.04***	.004***	-.04***	.004***
Cigarette Use				
Intercept	.50***	.96***3*	.50***	1.56***
Slope	.28***	.23***	.28***	.23***
Alcohol Use				
Intercept	.93***4*	.87***	1.07***	.87***
Slope	.22***	.08***	.22***	.08***
Marijuana Use				
Intercept	.53***	1.11***	.53***	1.11***
Slope	.17***	.18***	.17***	.18***

Note: These coefficients are unstandardized. Chi-square difference tests showed gender differences:

1 $x^2_{diff}(1) = 26.20$, $p < .001$

2 $x^2_{diff}(1) = 8.01$, $p < .01$

3 $x^2_{diff}(1) = 17.20$, $p < .001$

4 $x^2_{diff}(1) = 4.16$, $p < .05$.

* $p < .05$.

** $p < .01$.

*** $p < .001$.