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Behavioral Control and Resiliency in the Onset of Alcohol and Illicit Drug Use: A Prospective Study from Preschool to Adolescence

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Abstract

We examined the developmental trajectories of behavioral control and resiliency from early childhood to adolescence and their effects on early onset of substance use. Behavioral control is the tendency to express or contain one's impulses and behaviors. Resiliency is the ability to adapt flexibly one's characteristic level of control in response to the environment. Study participants were 514 children of alcoholics and matched controls from a longitudinal community sample (Time 1 age in years: $M=4.32$, $SD=0.89$). Children with slower rates of increase in behavioral control were more likely to use alcohol and other drugs in adolescence. Children with higher initial levels of resiliency were less likely to begin using alcohol.

Substance use and abuse comprise one of the most important public health problems in the United States (Johnston, O'Malley, & Bachman, 1996). Developmentally, early onset of alcohol and other drug use in adolescence is a marker of sustained problem use (Webb, Baer, Caid, McLaughlin, & McKelvey, 1991; White, 1992). Thus, it is particularly important to understand the antecedents of early alcohol use onset in teenagers. The effort to use early personality antecedents to predict the development of psychopathology has a long and rich theoretical and conceptual history (J. Block, Block, & Keyes, 1988; Caspi, Moffitt, Newman, & Silva, 1996; Rothbart & Ahadi, 1994). However, empirical validation of key personality antecedents to substance use is less extensive. Although emerging evidence suggests that risk and protective factors can be identified early in development (Kellam, Ensminger, & Simon, 1980; Masse & Tremblay, 1997), much more remains to be done to fully understand and characterize these early personality antecedents (Zucker, 1994; Zucker & Fitzgerald, 1991). This article examined two early childhood personality characteristics that may lead to increased risk for early onset of substance use in adolescence.

Specifically, we examined the developmental trajectories of *behavioral control* and *resiliency* in relation to early onset of alcohol and drug use. Behavioral control refers to the tendency to express or contain one's impulses, motor responses, and behaviors. Resiliency refers to the ability to adapt flexibly one's characteristic level of control in response to the

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environment. These two constructs have their origins in the seminal work of Block and Block on ego control and ego resiliency (J. Block, 1950; J. H. Block, 1951; J. H. Block & Block, 1980), and are theoretically tied to the meticulous and comprehensive work of Eisenberg and colleagues on reactive control and resiliency (Eisenberg, Champion, & Ma, 2004; Eisenberg & Spinrad, 2004; Eisenberg, Zhou et al., 2003). We use the terms “behavioral control” and “resiliency” instead of alternative terms to maintain consistency with the current substance abuse risk literature (National Institute of Alcohol Abuse and Alcoholism, 2000; Sher, 1991). Our assessment of these constructs closely followed that of Eisenberg and colleagues (Eisenberg, Fabes, Guthrie, & Reiser, 2000; Eisenberg, Fabes et al., 1997; Eisenberg, Guthrie et al., 1997).

Behavioral Control & Resiliency: Conceptual Background & Links to Self-regulation

In the search for early childhood personality dimensions that may serve as a diathesis for substance abuse risk, behavioral control and resiliency are among the top candidates. Both concepts are linked to behavioral and emotional regulation. Behavioral control and resiliency have their conceptual roots in the work of the Blocks (J. Block, 1950; J. H. Block, 1951; J. H. Block & Block, 1980), who identified related constructs of ego control and ego resiliency.

It is important to note that the construct of resiliency in this study bears no direct relation to the idea of resilience to adversity in developmental psychopathology (Luthar, Cicchetti, & Becker, 2000; Luthar & Zelazo, 2003; Masten, 2001). It may well be that individuals high in resiliency (as defined in this article) are able to overcome adversity in the environment. However, personality resiliency is only one of the many factors that affect developmental resilience.

In an effort to describe how emotional and behavioral regulation affect behavior, Eisenberg and colleagues proposed a theory that links self-control, regulation, emotionality, and resiliency (Eisenberg, Champion et al., 2004; Eisenberg & Spinrad, 2004; Eisenberg, Valiente et al., 2003; Eisenberg, Zhou et al., 2003). They differentiated between two types of control, reactive control (less voluntary control processes that are automatic, reflexive, and unintentional) and effortful control (voluntary, goal-oriented control processes). They argued that only effortful control represented emotion and behavioral regulation. Although Eisenberg and colleagues once considered ego control a measure of behavioral regulation (Eisenberg et al., 2000; Eisenberg et al., 1996), they now believe that ego control reflects primarily less voluntary, reactive control processes. Our construct of behavioral control herein is closely related to Eisenberg et al.’s construct of reactive control. Eisenberg and colleagues adopted the Blocks’ definition of ego-resiliency and renamed it resiliency. They also developed conceptually “purer” and empirically shortened measures of control and resiliency.

Another important component in Eisenberg et al.’s theory is emotionality, which refers to the tendency to experience negative emotions intensely. Dispositional negative emotionality and control processes jointly affect resiliency, social and emotional functioning (Eisenberg, Fabes et al., 1997; Eisenberg, Guthrie et al., 1997; Eisenberg, Liew, & Pidada, 2004). Negative emotionality is measured by items that pertain to the intensity of negative emotions (e.g., Eisenberg, Guthrie et al., 1997).

Behavioral Control, Resiliency, & Emotionality: Relationships to Alcohol & Drug Use

Reflecting their broad and ongoing explanatory appeal, behavioral control and resiliency have been associated with a wide range of behaviors and psychopathology in childhood and

adolescence. For instance, ego control (closely related to behavioral control) was associated with the ability to delay gratification (Funder & Block, 1989; Funder, Block, & Block, 1983), the absence of internalizing and externalizing problems (Huey & Weisz, 1997) and socially appropriate behavior (Eisenberg, Valiente et al., 2003). Ego resiliency (closely related to resiliency) was negatively associated with egocentrism (Gjerde, Block, & Block, 1986), depression, and internalizing problems and positively associated with effective social interaction (J. Block & Kremen, 1996). Using the same measure as the one used in this article, Eisenberg, Guthrie et al., (1997) found that resiliency was positively related to social status.

However, there is only scant evidence to evaluate whether behavioral control and resiliency are prospectively related to early onset of drug or alcohol use. The most direct evidence comes from a longitudinal study by the Blocks and their colleagues (J. Block et al., 1988; Shedler & Block, 1990). Lower levels of ego control in early childhood predicted marijuana use at age 14 for both boys and girls (J. Block et al., 1988). Among girls, lower levels of both ego control and ego resiliency in childhood predicted hard drug use in early adolescence. In contrast, only lower levels of ego control predicted hard drug use for boys. Follow up of the same sample at age 18 again showed that lower levels of ego control were associated with more frequent drug use (Shedler & Block, 1990). However, alcohol use was not examined in either study.

Indirect evidence linking early personality traits to alcohol and drug use support the idea that behavioral control and resiliency may predict substance use. African-American first graders who were rated by their teachers as aggressive were more likely to use drugs and alcohol ten years later (Kellam et al., 1980). In a longitudinal study in Montreal, high novelty seeking (a tendency to be impulsive, excitable, and hyperactive) and low harm avoidance (a tendency to be uninhibited and to react intensely to negative stimuli) measured at ages 6 and 10 predicted onset of cigarette smoking, drunkenness, and other drug use in adolescence (Masse & Trembley, 1997). A longitudinal study of children in New Zealand found that undercontrolled (impulsive, restless, and distractible) 3-year-olds were more likely to have an anti-social personality disorder at 21 and have alcohol-related problems. Aggressive behavior has been linked to disinhibition or a lack of self-control (J. Block et al., 1988; Nigg, 2000). Impulsivity and distractibility are conceptually related to low behavioral control and low resiliency (J. Block, 1950; J. H. Block, 1951; J. H. Block & Block, 1980). Thus there is some indirect evidence that low behavioral control and low resiliency predict alcohol and drug use.

The effects of emotionality on drug use have not been investigated. However, it appears that emotionality moderates the relationship among ego control and some outcomes (Eisenberg, Fabes et al., 1997; Eisenberg, Guthrie et al., 1997; Eisenberg, Liew et al., 2004). For instance, emotionality moderated the effect of ego control on socially appropriate behavior. The effect of ego control was particularly strong among children of high negative emotionality (Eisenberg, Guthrie et al., 1997). In two other studies, emotionality and self-regulation measures jointly predicted parental and teacher reports of appropriate social behavior (Eisenberg, Fabes et al., 1997) and socioemotional functioning, e.g., social skills, adjustment, shyness, prosocial tendencies and peer liking (Eisenberg, Liew et al., 2004).

The review above shows that several key questions remain unanswered. First, prior studies never examined the developmental trajectories of behavioral control and resiliency -- In what ways do the two constructs develop over time? Are the two developmental trajectories related to one another? Second, though data link behavioral control and resiliency to drug use, no study has prospectively examined the effects of the two constructs on early onset of alcohol use and alcohol-related problems (e.g., drunkenness, miss school due to drinking). Third, prior studies rarely examined *specificity* of relations between the two constructs and particular forms of substance use. Do behavioral control and resiliency predict the use of certain drugs, or do the

two constructs predict substance use in general? Fourth, does emotionality moderate the effects of behavioral control and resiliency on alcohol and drug use?

In examining the effects of behavioral control and resiliency on substance use among adolescents, an important factor to consider is parental substance use problems. This issue is especially important given that the participants of the study were children of alcoholics and ecologically comparable but nonalcoholic controls. Parental alcoholism is robustly related to early onset of alcohol use as well as alcohol problems among the offspring (Chassin, Pitts, DeLucia, & Todd, 1999; Sher, 1991; Zucker, Ellis, Bingham, & Fitzgerald, 2000). Currently, there are no data on whether parental alcoholism is related to the development of behavioral control and resiliency. But given that parental alcoholism is linked to a variety of offspring behavior, it is quite possible that parental alcoholism may affect the development of behavioral control and resiliency. Prior to examining the relationship among behavioral control, resiliency, and substance use, we examined the effects of parental alcoholism on behavioral control and resiliency. Because parental alcoholism is a robust predictor of adolescent substance use, all analysis controlled for its effects on substance use outcomes.

Another important issue is the need to determine if the effects of behavioral control and resiliency are distinct from effects of externalizing and internalizing problems. Prior research has indicated that externalizing problems predict later substance use (Chassin et al., 1999; Sher, 1991; Zucker, Ellis et al., 2000). Although the complex issue of the relation between psychopathology and personality is well beyond the scope of this essay (see Markon et al., 2005), we recognize this issue by controlling for the effects of internalizing and externalizing problems in our models to make sure that the results are not simply a recapitulation of those prior findings, and we consider this issue again in our discussion later.

Overview of this study

The present study had three aims. First, we examined the developmental trajectories of behavioral control and resiliency from early childhood to adolescence and characterized the relationships between these two trajectories. Second, we ascertained the effects of these trajectories on onset of alcohol and other drug use during adolescence. Third, we examined whether the effects of behavioral control and resiliency on later drug use varied among children with different levels of emotionality.

Method

Participants

The present study is part of the ongoing Michigan Longitudinal Study (Zucker, Ellis, Bingham, & Fitzgerald, 1996; Zucker & Fitzgerald, 1991; Zucker, Fitzgerald et al., 2000). The current sample consists of 514 children of alcoholics (COAs) and matched controls (71% boys, 29% girls; 75% COAs; 25% controls; 72% have an alcoholic father; 32% have an alcoholic mother). The mean education level for mothers and fathers of the participants at Time 1 were 13.37 (SD = 1.92) and 13.74 (SD = 2.25) respectively (i.e., one year beyond high school). The average annual family income at Time 1 was \$35,434 (SD = \$16,826). Respondents were interviewed at three-year intervals. The data presented in this paper involve the first five waves of the study. The children were 3–5 years old at Time 1, 6–8 years old at Time 2, 9–11 years old at Time 3, 12–14 years old at Time 4 and 15–17 years old at Time 5. In order to be included in this paper, all children must have data on the substance use outcomes and at least one wave of data on behavioral control and resiliency. We examined whether the 514 children in this study were different from children excluded from the study. No significant differences between the two groups of children were found on parental alcoholism status ($\chi^2(1)=0.29$, $N=601$, $p=0.59$).

number of alcoholic parents, $t(599)=1.33$, $p=0.18$, and gender of participant ($\chi^2(1)=0.39$, $N=601$, $p=0.53$).

The Michigan Longitudinal Study recruited a population-based sample of alcoholic men, their partners (whose substance abuse status was free to vary), and their initially 3–5-year-old sons (male target child, MTC). Both biological parents were required to be coupled and living with the child at the time of Time 1 recruitment. Study exclusionary criteria ruled out the presence of fetal alcohol syndrome. A group of families who resided in the same neighborhoods as the alcoholic families was recruited as controls. Parents in the control group had no lifetime history of substance abuse/dependence; offspring were age matched to the male child in the alcoholic family residing in the same neighborhood (for a detailed description of the recruitment strategies and eligibility criteria, see (Zucker, Fitzgerald et al., 2000). Subsequently, other siblings of the MTC, who were within an age range of ± 8 years were also invited into the study.

All families were Caucasian-Americans. In the area where we sampled, less than 4 percent of the population meeting inclusion criteria were non-Caucasian. Given the study's sample size, if non-Caucasian ethnic/racial groups were included, the number available would not permit any effective analysis to be done on this variation. As there is an extensive literature showing a relationship between substance abuse and ethnic/racial status, including such variation in the study without being able to statistically model its effects would only contribute to error. Therefore the investigators originally opted to exclude this variation. The study is currently recruiting an additional sample of both African-American and Hispanic families using parallel recruitment criteria.

Procedures

Trained interviewers who were blind to family diagnostic status collected the data. The contact time for each family varied, depending on data collection wave. Typically, each parent was involved for 9–10 hours and each child for seven hours spread over seven sessions. A variety of age-appropriate tasks (questionnaires, interviews, and interactive tasks) were administered, and most of the contacts occurred in the families' homes. Arrangement was made to collect data from families who had relocated. No families were lost due to relocation.

Measures

Behavioral control and resiliency (ages 3–14)—The two constructs were measured by clinician ratings using the California Child Q-sort (CCQ; (Block, 1980 #43)) beginning when participants were three to five years old (Time 1) and every three years afterwards until participants were 12 to 14 years old (Time 4). The instrument is an adaptation of the extensively used California Q-Sort. 100 statements that portray a variety of different behavioral adaptations were utilized. The brief descriptive statements were on cards and the clinician sorted these cards into a normally distributed pattern that ranges from items that are most to least salient descriptors of the child's behavior. The clinicians who conducted the assessment of the child in the Michigan Longitudinal Study also completed the CCQ ratings. Thus they knew the respondent well. In typical Q-sort studies, prototypes of behavioral control and resiliency are created from all items and each child's profile is correlated with the prototype. However, some of the Q-sort items pertain primarily to emotion and externalizing behavior and thus overlap with other constructs in this study. (Eisenberg, Guthrie et al., 1997) developed a list of items to measure behavioral control and resiliency that are relatively independent of emotion and antisocial behavior. We adopted this list. Behavioral control consisted of 19 items – items 8, 35, 41, 52, 59, 66, 67, 86, 98, and 99; reversed scores for items 12, 13, 21, 26, 34, 63, 65, 82, and 84). Examples include “Is inhibited and constricted,” “Has a rapid personal tempo; reacts and moves quickly” (-), “Is reflective; deliberates before speaking or acting.” Resiliency

consisted of 23 items – items 16, 19, 25, 28, 36, 40, 43, 69, 73, 81, 83, 88, 89, 96; reversed scores for items 39, 45, 46, 49, 50, 55, 77, 78, and 79. Examples are “Is vital, energetic, lively,” “Is curious eager to learn, open to new experiences,” “Tends to go to pieces under stress (-).” Table 1 reports the reliability (Cronbach alphas) of behavioral control and resiliency as a function of age.

Emotionality (ages 3–14)—Negative emotionality from early childhood to adolescence (Time 1 to Time 4) were measured by 11 items in the Q-sort – items 23, 24, 33, 54, 56, 60, 64, 75; reversed scores for items 91, 94, and 95 (Eisenberg, Guthrie et al., 1997). Examples of these items include “Cries easily, has rapid shifts in mood,” “Is emotionally labile,” “Is calm and relaxed, easy going(-),” “Tends to brood and ruminate or worry”. See table 1 for the reliability of emotionality as a function of age.

Alcohol and other illicit drug use (ages 12–17)—Substance use in adolescence (Time 4–5) was measured by the Drinking and other Drug Use History Questionnaire - Youth Version (Zucker & Fitzgerald, 2002). All items in this instrument have been extensively used in a variety of survey and clinical settings. The questionnaire measures the frequency and quantity of alcohol use and problems, and the frequency of other drug use and problems. Two items were used to assess onset of drinking and drunkenness respectively: “How old were you the first time you ever took a drink (not just a sip)?” and “How old were you the first time you drank enough to be drunk?” From these responses, the following variables were created: **onset of drinking by age 14** (0=no, 1=yes), **onset of drunkenness by age 17** (0=no, 1=yes), and **age of onset of first drinking and drunkenness**.

National data has shown that median age of first alcohol use is between 14 and 15 years old (Johnston, O’Malley, Bachman, & Schulenberg, 2004), and median age of first drunkenness is 17 (Johnston, O’Malley & Bachman, 2003). Therefore we considered onset of drinking by age 14 to be early onset. We regarded the drunkenness experience an indicator of problem regarding drinking and thus were interested in whether drunkenness occurred at any time during adolescence, not just early adolescence. Early onset of drinking and onset of drunkenness during adolescence have been shown to be very robust predictors of subsequent alcohol problems (Grant & Dawson, 1997; Gruber, DiClemente, Anderson, & Lodico, 1996).

Number of alcohol-related problems were measured by 24 questions. Each question mentioned an alcohol related problem. Participants were asked whether they had any of those problems happened to them because of their drinking. Examples of these problems are “got into trouble with my teachers or principal because of my drinking,” “got into trouble with the police because of my drinking,” “missed school because of my drinking,” “lost friends because of my drinking.”

Finally, **onset of other illicit drug use by age 17** (0=no, 1=yes) was gathered by questions regarding lifetime use of illicit drugs. These drugs include marijuana, inhalants, amyl or butyl nitrites, amphetamines, LSD and other psychedelic drugs, crack and other forms of cocaine, anabolic steroids, tranquilizers, heroin, and opioids other than heroin. Lifetime use of marijuana was measured by the question, “On how many occasions (if any) have you smoked marijuana or hashish in your lifetime?” Questions about the use of other illicit drugs were worded similarly.

Internalizing and externalizing problems (ages 12–14)—Maternal ratings of adolescent internalizing and externalizing problems were measured by the Child Behavior Rating Scale (Achenbach, 1991). We opted to use the maternal ratings because (i) mothers were the primary caretakers of adolescents in most families and (ii) mothers’ and fathers’ ratings on internalizing and externalizing problems only had a low to moderate correlation

from childhood to adolescence. For internalizing problems, the correlation between mothers' and fathers' ratings was .19 at Time 1 (N=324, $p<.01$), .17 at Time 2 (N=280, $p<.01$), .27 at Time 3 (N=328, $p<.001$), and .19 at Time 4 (N=343, $p<.001$). For externalizing problems, the correlation was .37 at Time 1 (N=324, $p<.001$), .43 at Time 2 (N=281, $p<.01$), .52 at Time 3 (N=328, $p<.001$), and .58 at Time 4 (N=343, $p<.001$). Maternal ratings of adolescent internalizing and externalizing problems show an acceptable level of internal consistency and external validity (Achenbach, 1991).

Parental alcoholism—Parental lifetime alcoholism when the child was 3–5 was assessed by three instruments: the Short Michigan Alcohol Screening Test (Selzer, Vinokur, & van Rooijen, 1975), the Diagnostic Interview Schedule Version III (Robins, Helzer, Croughan, & Ratcliff, 1980), and the Drinking and Drug History Questionnaire (Zucker, Fitzgerald, & Noll, 1990). On the basis of information collected by these instruments, diagnoses of parental alcoholism were made by a trained clinician using DSM IV criteria. The availability of three sources of information collected over three different sessions, separated sometimes by as much as several months, served as an across method validity check on respondent replies. In cases of discrepant information, the data represented by the majority of information sources was used in establishing the diagnosis. Inter-rater reliability for the diagnosis was excellent ($\kappa=.81$).

Children were coded as having an alcoholic parent if either parent met lifetime criteria for alcohol abuse or dependence at the age 3–5 assessment period. Lifetime parental alcoholism may change over time and therefore may be different for siblings within the same family. Therefore all indicators of parent alcoholism were treated as an individual-level rather than a family-level variable.

Plan of analysis

This paper has three goals. First, we describe the developmental trajectories of behavioral control and resiliency from early childhood to adolescence and the relationship between these trajectories. Second, we test the effects of these trajectories on alcohol and substance use outcomes. Third, we examine whether the effects of behavioral control and resiliency differ among children of low and high emotionality. We examined these three issues using a series of latent growth models (LGM; Duncan, 1995; McArdle & Epstein, 1987; Meredith & Tisak, 1990; Muthen & Curran, 1997).

We opt to (i) use age as the unit of time instead of wave and (ii) treat time more flexibly by allowing the spacing and the number of measurements to vary across individuals in our analysis (Metha & West, 2000; Singer & Willet, 2003) for three reasons. First, there is variability in age within the same waves (e.g., children were 3–5 were in wave 1). Second, there is variability in the spacing of waves. Ideally, each child was assessed every 3 years, but in reality, the spacing of waves varied somewhat due to scheduling difficulties and respondents' availability. Third, there is variability in the number of waves per respondent. Of the 514 children who were included in this study, 154 had four waves of data on behavioral control and resiliency, 152 had three waves, 114 had two waves, and 94 had one wave of data. Due to the data structure, we chose statistical techniques that will allow us to obtain unbiased estimates of population parameters.

Because of the above three reasons, our data are unbalanced. (Metha & West, 2000) described two methods to deal with the estimation of growth models with unbalanced data (i.e., different number of waves and different spacing of waves among individuals). One method is to treat the data as missing and estimate the model using the Full Information Maximum Likelihood estimator. This method could lead to computational difficulties if the amount of missing data is large. Another method is to allow the factor loadings in the LGM models (Λ) to vary across

individuals (Bauer, 2003; Curran, 2003; Curran, Bauer, & Willoughby, 2004). This is the method that we use. All analyses were carried out in the framework of latent growth models with random times of observation via MPLUS 3.0 (Muthen & Muthen, 2004).

To address our first aim, unconditional latent curve models were fitted separately to examine the developmental trajectories of behavioral control and resiliency (Figure 1). The dependent variables were measures of behavioral control and resiliency at various time points. Each model consisted of two latent factors. The first latent factor represented the intercept and the second latent factor represented the slope. The means of these latent factors are the growth parameters of the whole sample. The variance of these latent factor scores reflects the individual variation around the overall growth parameters. The four repeated measures of behavioral control and resiliency over time are the indicators of the latent factors.

When latent growth models are estimated in the structural equation modeling framework, the growth of variables can be measured in the following measurement model –

$$Y_i = v_i + \Lambda\eta_i + \varepsilon$$

where Y_i is a $T_i \times 1$ vector of repeated measures of the variable Y for individual i , v_i is $T_i \times 1$ vector of intercepts of the repeated measures of behavioral control (changes in resiliency was estimated in a separate model), Λ is a $T_i \times k$ matrix of factor loadings on the growth factors, η_i is a $k \times 1$ vector of latent growth factors, and ε is a $T_i \times 1$ vector of time-specific measurement errors. v_i is fixed to zero for identification purposes. By choosing the loading matrix Λ appropriately, the above formulation can accommodate growth curves of various shapes. In this paper, we use linear growth models only. When specialized to linear growth curves, the above equation can be written in matrix form as

$$\begin{bmatrix} Y_{i1} \\ Y_{i2} \\ M \\ Y_{iT_i} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 1 & 1 \\ M & M \\ 1 & T_i - 1 \end{bmatrix} \begin{bmatrix} \eta_{\alpha i} \\ \eta_{\beta i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{i1} \\ \varepsilon_{i2} \\ M \\ \varepsilon_{iT_i} \end{bmatrix}$$

$\eta_{\alpha i}$ is the initial status of behavioral control at the first measurement. $\eta_{\beta i}$ is the growth factor of behavioral control over time. $[0, 1, \dots, T_i - 1]$ are the loadings for the linear trajectory across the four time points. To take into account the unbalanced nature of the data – we allowed Λ to vary across individuals (Figure 1). In matrix form, the LGM models with case-varying factor loading can be written as

$$\begin{bmatrix} Y_{i1} \\ Y_{i2} \\ M \\ Y_{iT_i} \end{bmatrix} = \begin{bmatrix} 1 & \beta_{1i} \\ 1 & \beta_{2i} \\ M & M \\ 1 & \beta_{ii} \end{bmatrix} \begin{bmatrix} \eta_{\alpha i} \\ \eta_{\beta i} \end{bmatrix} + \begin{bmatrix} \varepsilon_{i1} \\ \varepsilon_{i2} \\ M \\ \varepsilon_{iT_i} \end{bmatrix}$$

We estimated our models using MPLUS 3.0 because it offers a straightforward way to estimate LGM models with random times of observation.

After examining the developmental trajectories of behavioral control and resiliency separately, we estimated their relationship by parallel process latent growth models (parallel process means examining two latent trajectories simultaneously). Specifically, the following correlations were estimated – correlations between the intercept and slope factors of each construct, correlations between the intercept factors of both constructs, correlations between the slope factors of both constructs, as well as correlations between the intercept factors of one construct and the slope factors of the other constructs.

To address our second aim, the effects of the growth trajectories of behavioral control and resiliency on early substance use outcomes were ascertained by a series of structural equation

models (Figure 2). One set of analyses included age of participant, parental alcoholism¹, and adolescent externalizing problems as predictors (so that their effects on the dependent variables can be controlled for) while another set of analyses included age of participant, parental alcoholism, and adolescent internalizing problems as predictors. Because the two problems show a moderate to high correlation empirically (Achenbach & Edelbrock, 1983; Kruger, Caspi, Moffitt, & Silva, 1998; Wong, Zucker, & Fitzgerald, 2004), they were not used in the same model to avoid problems of estimation.

All dichotomous dependent variables were transformed into log odds in the analyses, $\text{logit}(p) = \log_e \frac{p}{1-p}$ (let p = probability, then $\text{odds} = \frac{p}{1-p}$ and $p = \frac{\text{odds}}{1 + \text{odds}}$). The path coefficients were expressed in a logit scale and could be converted into odds ratio logit ($\text{odds} = e^{\text{logit}}$).

Age of onset of drinking and drunkenness were censored variables (i.e., among participants who never reported drinking or being drunk, it was unclear whether they would eventually drink or gotten drunk). Discrete-time survival analyses were conducted to estimate the hazard probability of first drinking and drunkenness (Muthen & Masyn, 2005).

The model for onset of first drinking is specified as follows:

$$\text{logit } h(t_j) = \alpha_j + \beta_1 PA + \beta_2 BCI + \beta_3 BCS + \beta_4 RI$$

where $h(t_j)$ is the hazard probability of drinking at a certain age, α_j is the baseline logit hazard function, $\beta_1 PA$ is the effect of parental alcoholism on the logit hazard function, $\beta_2 BCI$ is the effect of behavioral control intercept factor, $\beta_3 BCS$ is the effect of behavioral control slope factor, $\beta_4 RI$ is the effect of the resiliency intercept factor. A similar model was specified for first drunkenness.

To address our third aim, we tested whether the effects of the growth trajectories of behavioral control and resiliency on early substance use outcomes varied in low and high emotionality groups. In preliminary analyses, the unconditional latent growth curve model showed that there was no systematic change in emotionality over time. Therefore participants were placed into either low or high emotionality groups based on a median split on their average scores of emotionality over four time points. For each alcohol and drug use outcome, two sets of nested models were analyzed to ascertain whether the effects of behavioral control were similar in low and high emotionality groups. In Model 1, all parameters were constrained to be the same in both groups. Model 2 allowed the effects of the latent intercept and slope factors of behavioral control to be the different in both groups. The two models are nested within one another (i.e., every parameter in Models 1 are also in Model 2), the deviance statistics ($-2LL$) of each model can be compared to determine whether the specific constraints set up in the models hold (Singer & Willet, 2003). The difference in the deviance statistic between any two models (Δd) is distributed asymptotically as a χ^2 distribution with degrees of freedom equal to the number of constraints imposed. For example, if Δd between Model 1 and Model 2 reached a critical value associated with 2 d.f., the null hypothesis that the specific constraints in Model 1 can be rejected, indicating the effects of the intercept and slope factors may be different for students with different emotionality. Similar analyses were conducted to examine the effects of resiliency on outcome variables.

Lastly, it is useful to note that some participants in our study came from the same family. In deciding whether to model this characteristic in the analyses, we used the rule of thumb suggested by Muthen & Satorra (1995) and Muthen (2000). The rule of thumb is based on the results of a Monte Carlo study. The rule states that when the design effect is greater than 2, the clustering of the data needs to be taken into account in the analysis. When the design effect is

less than 2, ignoring the clustering of data does not significantly affect the analysis. The design effect is a function of the intraclass correlation and cluster size and is defined as $1 + (\text{average cluster size} - 1) * \text{intraclass correlation}$. In our data, the average cluster size is 1.77. Even when the intraclass correlations on the dependent variables were equal to 1, the design effect would be less than 2. Thus the lack of independence in the data in some families (i.e., some families have more than one child in the study) did not significantly bias our analysis.

Results

Table 1 presents the means, standard deviations, and the alphas of behavioral control, resiliency, and emotionality as a function of age. About one-half of our sample reported using some form of substance use in their adolescence. Specifically, 44.4% began to drink by age 14. Between the ages of 12 and 17, 41.2% reported having being drunk at least once, 39.9% experienced one or more alcohol-related problem, and 58.2% had used drugs other than alcohol.

Question 1A. Developmental trajectories of behavioral control and resiliency

Behavioral control—The mean estimates for both the intercept ($\hat{u}_{a1} = 4.64$ (0.08), $p < 0.001$) and slope factors were significant ($\hat{u}_{b1} = 0.04$ (0.01), $p < 0.001$). The average intercept at the initial assessment period was 4.64, with a significantly positive linear slope of .04 unit per year. The variance estimates for both the intercept ($\hat{\sigma}_{a1}^2 = 0.83$ (0.24), $p < 0.001$) and slope factors ($\hat{\sigma}_{\beta1}^2 = 0.01$ (.002), $p < 0.001$) were also significant, indicating that there were substantial individual differences in the initial status and changes in the linear slope. There was a significant estimate for the covariance between the intercept and the slope factors ($\hat{\gamma}_{a1\beta1} = 0.05$ (0.02), $p < 0.05$), which was equivalent to a correlation of $r = -0.7$. Those with lower levels of control in early childhood showed faster rates of increase (i.e., improvement) in control over time. There was no evidence of a quadratic growth factor.

Resiliency—The unconditional model showed that the mean and variance estimates of the intercept factor were significant while the mean and variance estimates of the slope factor were not. The average intercept of resiliency at the initial assessment period was 5.85 ($\hat{u}_{a2} = 5.85$ (0.03), $p < 0.001$). Children differed significantly from one another in their initial resiliency scores ($\hat{\sigma}_{a2}^2 = 0.19$ (0.03), $p < 0.001$). There was no significant change in the mean level of resiliency over time ($\hat{u}_{\beta2} = 0.01$ (0.01), $p = 0.86$) and no individual differences in the rate of change ($\hat{\sigma}_{\beta2}^2 = 0.00$ (0.00), $p = 0.24$), suggesting this was a stable trait. The slope factor was therefore dropped from subsequent analyses.

Question 1B. The relationship between behavioral control and resiliency

We examined the longitudinal relationship between behavioral control and resiliency by a parallel process unconditional latent growth model (parallel process means examining two latent trajectories simultaneously). Consistent with the findings reported above, the correlation between the intercept and slope factors of behavioral control was significant ($\hat{\gamma}_{a1\beta1} = 0.05$ (0.02), $p < 0.05$). However, the correlation between behavioral control intercept and resiliency intercept was non-significant. The correlation between behavioral control slope and resiliency intercept was also non-significant.

Given the theories described earlier (Block & Block, 1980; Eisenberg et al., 2000), we tested whether the two trajectories had a quadratic relationship with one another. We created a

quadratic term for the latent intercept factor of behavioral control and analyzed its relationship with the resiliency intercept factor. The analyses revealed that the latent intercept of behavioral control had a quadratic relationship with the latent intercept of resiliency, indicating that either lower or higher levels of behavioral control were related to lower levels of resiliency ($\hat{\gamma}_{\alpha 1a2} = 4.32 (0.73)$, $p < 0.001$; $\hat{\gamma}_{\alpha 1^2a2} = -0.48 (0.08)$, $p < 0.001$; Figure 3).

Question 2. The effects of behavioral control and resiliency on substance use

We first tested whether gender had any effect on the outcomes and whether gender interacted with behavioral control and resiliency to predict onset of drinking by 14. All of these effects were non-significant, and so were eliminated from the subsequent analyses.

We then examined whether the effects of behavioral control and resiliency on substance use were similar among children of alcoholics and controls. The analyses indicated that the intercept factors of behavioral control and resiliency had similar effects on both groups of children on all substance use variables. However, the slope factor of behavioral control had a stronger effect on number of alcohol problems among children of alcoholics than controls (children of alcoholics: $\beta = -27.92 (20.60)$, $p = 0.18$; controls: $\beta = -68.68 (18.74)$, $p < 0.001$). As the overall patterns of results are similar among children of alcoholics and control, all analyses were carried out on the whole sample. It is useful to note children of alcoholics had lower levels of resiliency than controls in early childhood ($\beta = -0.19 (0.07)$, $p < 0.01$). However, children of alcoholics and controls had similar initial levels ($\beta = 0.00 (0.19)$, $p = 1.00$) and growth rate ($\beta = -0.02 (0.02)$, $p = 0.99$) of behavioral control.

We have also considered including anti-social personality disorder (ASPD) as an independent variable in the model. This disorder has been shown to be highly comorbid with alcoholism. Our analyses indicated that when both parental alcoholism and parental diagnosis of anti-social behavior were in the analyses, only parental alcoholism significantly predicted the dependent variables. The effects of ASPD on all dependent variables were non-significant (all $p > 0.4$). A large number of independent variables may affect the stability of the estimation of model parameters. We therefore decided to eliminate parental history of anti-social behavior from the model.

Below we examine the effects of behavioral control and resiliency on each substance use variable. All analyses control for the effects of parental lifetime alcohol diagnosis and age of respondents.

Onset of drinking by age 14—Having an alcoholic parent significantly increased the risk of early onset of drinking. When compared to controls, children of alcoholics were three times more likely to have started drinking by age 14. Additionally, older adolescents were more likely to have started drinking than younger adolescents. Controlling for parental alcoholism, age, and other independent variables, children with lower initial levels of behavioral control in early childhood were more likely to start drinking in early adolescence. As the latent intercept of behavioral control increased by one standard deviation (0.889), the odds of drinking by age 14 decreased by a factor of about 45% ($e^{-0.898 \times 0.889} = 0.45$). Children with slower rates of increase in behavioral control over time were more likely to use alcohol when they were adolescents. As the latent slope of behavioral control increased by one standard deviation, the odds of drinking by age 14 decreased by a factor of about 22%. Those with higher initial levels of resiliency were less likely to use alcohol by 14. When the latent intercept of resiliency increased by one standard deviation, the odds of drinking by age 14 decreased by a factor of 62%.

We further analyzed the effects of behavioral control and resiliency on early onset of drinking while adding adolescent externalizing and internalizing problems in the model. Table 2 showed that higher levels of externalizing problems were associated with early onset of drinking. With

externalizing problems controlled in the model, the slope factor of behavioral control continued to have a significant effect on early onset of drinking. The intercept factors of behavioral control and resiliency became non-significant. Internalizing problems were not related to early onset of drinking, but when they were in the model, the effect of behavioral control remained significant while the effect of resiliency became non-significant.

Onset of drunkenness by age 17—Children of alcoholics were four times more likely than controls to report having been drunk at least once by age 17. Older adolescents were also more likely than younger adolescents to experience drunkenness. Controlling for parental lifetime alcohol diagnosis and age, the latent intercept and latent slope of behavioral control negatively predicted onset of any drunkenness by age 17. Children with lower initial levels of behavioral control in early childhood were more likely to be drunk in adolescence. As the latent intercept of behavioral control increased by one standard deviation, the odds of experiencing drunkenness by age 17 decreased by a factor of about 30%. Moreover, children with slower rates of increase in behavioral control were more likely to experience drunkenness in adolescence. As the latent slope of behavioral control increased by one standard deviation, the odds of experiencing drunkenness by age 17 decreased by a factor of 15%. No significant relationship between resiliency and onset of drunkenness was found (Table 2). Including externalizing or internalizing problems in the analyses did not change the relationship between behavioral control and drunkenness.

Age of onset of first drinking and first drunkenness—Discrete-time survival analyses were used to estimate the age of onset of first drinking and drunkenness. Age categories were combined: period 1=age 2–3, period 2=age 4–5, 3=age 6–7, 4=age 8–9, 5=age 10–11, 6=age 12–13, 7=age 14–15, and 8=age 16–17. This re-categorization is necessary for both the analyses on drinking and drunkenness. Without combining age categories, the analyses would not converge because there were zero observations in some categories (i.e., no participants reported having their first drink at age 9). The observed hazards for onset of first drinking at each period are 0.012, 0.022, 0.016, 0.039, 0.075, 0.402, 0.698, and 0.964. The observed hazards for onset of first drunkenness at each period are 0.004, 0.002, 0.008, 0.002, 0.032, 0.232, 0.639, and 0.930.

Age of onset of first drinking was influenced by parental alcoholism and the latent slope of behavioral control (Table 3). When compared to controls, the odds of first drinking were twice as high among children of alcoholics (estimated odds ratio = $e^{0.74} = 2.09$, $p < 0.001$). For all participants, as the latent slope of behavioral control increased by one standard deviation (0.07), the odds of first drinking decreased to 22% of the original odds ($e^{-.21.652*0.07} = 0.216$, $p < 0.05$). Including externalizing and internalizing problems as predictors did not appear to change the significant association between behavioral control and the hazard probability of first drinking. For simplicity sake, we presented the results without externalizing and internalizing problems in Table 3. Results including externalizing and internalizing problems are available upon request. The model-estimated hazard probabilities of first drinking among children of alcoholics with slower (–1SD), average (mean), and faster growth rates (+1SD) of behavioral control were plotted in Figure 4. The group with the slowest rate of increase in behavioral control had the highest probability of onset of drinking at any age.

Similar results were observed for the hazard of first drunkenness (Table 3). Again, parental alcoholism significantly predicted first onset of drunkenness. Holding other independent variables constant, as the latent slope of behavioral control increased by one standard deviation (0.07), the odds of first drunkenness decreased to 16% of the original odds ($e^{-.25.637*0.07} = 0.163$).

Number of alcohol-related problems by age 17—Having an alcoholic parent was associated with higher number of alcohol-related problems. On the average, children of alcoholics reported 1.05 units more alcohol-related problems than controls. Controlling for parental alcohol diagnosis and age, the latent slope of behavioral control negatively predicted number of alcohol-related problems (e.g., missed school due to excessive drinking). When the slope of behavioral control increased by one standard deviation (0.07), the number of alcohol problems was expected to decrease by 2 units ($-28.294 \times 0.07 = -2$). There was no significant relationship between resiliency and early onset of alcohol-related problems. Including externalizing and internalizing problems in the analyses did not change the pattern of findings.

Onset of any illicit drug use by age 17—In contrast to the pattern of results presented earlier, parental alcoholism did not significantly predict onset of illicit drug use. The latent intercept and slope factors of behavioral control negatively predicted onset of any illicit drug use. Children with lower initial levels of behavioral control and slower rates of increase in behavioral control were more likely to use any form of illicit drugs by age 17. As the latent intercept of behavioral control increased by one standard deviation, the odds of onset of illicit drug use by age 17 decreased by a factor of about 41%. As the latent slope of behavioral control increased by one standard deviation, the odds of onset of illicit drug use by age 17 decreased by a factor of about 37%. No relationship between resiliency and the outcome was found.

Including adolescent externalizing problems in the model did not change the effect of the behavioral control slope on the onset of illicit drug use. However, the effect of the behavioral control intercept decreased to non-significance. When internalizing problems were analyzed, the effects of both the intercept and the slope factors of behavioral control did not change.

Internalizing and externalizing problems—In the preceding sections, we used internalizing and externalizing behavioral problems for purpose of statistical control. However, we also wondered if behavioral control or resiliency predicted those problems. Children with lower initial levels of resiliency were rated by their mothers as having more internalizing and externalizing problems in adolescence. In contrast, children with lower initial levels and slower growth rates of behavioral control had higher maternal ratings of externalizing problems in adolescence (Table 4).

Question 3. Do the effects of behavioral control and resiliency on substance use change in low and high emotionality children?

To evaluate whether behavioral control affected substance use differently in low vs. high emotionality groups, we compared the deviance statistic of two nested SEM models for each outcome. Model 1 constrained all parameters to be the same in both groups. Model 2 allowed the effects of the latent intercept and slope factors of behavioral control to be different in the two groups.

The two models did not differ significantly for onset of drinking by age 14: Model 1 vs. Model 2: $\chi^2(2) = 4.70$, $p=0.09$; onset of drunkenness by age 17 - Model 1 vs. Model 2: $\chi^2(2) = 1.084$, $p=0.58$; onset of alcohol-related problems by age 17 - Model 1 vs. Model 2: $\chi^2(2) = 0.084$, $p=0.96$; and onset of other drug use by age 17 - Model 1 vs. Model 2: $\chi^2(2) = 1.19$, $p=0.55$. However, the two models were significantly different for number of alcohol-related problems, $\chi^2(2) = 18.648$, $p<0.001$. Subsequent analyses showed that a lower initial level of behavioral control was associated with higher number of alcohol-related problems in both groups. When the initial level of behavioral control decreased by one standard deviation, number of alcohol problems was expected to increase by 0.4 in the low emotionality group and 0.6 in the high emotionality group. However, the growth rate in behavioral control had a stronger positive effect (twice as big) on the high emotionality group than the low emotionality group. When

the slope of behavioral control decreased by one standard deviation, the number of alcohol problems was expected to increase by 1.2 in the low emotionality group and 2.6 in the high emotionality group.

Similar analyses were performed to test whether resiliency affected substance use differently in the two groups. However, the analyses could not be conducted due to insufficient variance in the resiliency intercept in the low emotionality group.

Discussion

We examined the effects of behavioral control and resiliency on early onset of drinking and onset of illicit drug use among children of alcoholics and ecologically comparable but nonalcoholic controls. The study extended previous research on personality antecedents of early onset of substance use by (i) describing the characteristics of the developmental trajectories of behavioral control and resiliency; (ii) ascertaining the effects of the developmental trajectories of behavioral control and resiliency on important adolescent outcomes while controlling for the effects of internalizing and externalizing problems; and (iii) testing whether emotionality moderates the effects of behavioral control and resiliency on substance use outcomes. Linear growth curve models showed that behavioral control increased whereas resiliency remained stable over time. A curvilinear relationship between the two constructs existed over time, such that extremely low and extremely high levels of behavioral control were associated with lower levels of resiliency. Moderately high levels of behavioral control were associated with higher levels of resiliency.

Having an alcoholic parent significantly increased the risk of early onset of alcohol use and subsequent alcohol problems. When compared to controls, children of alcoholics were three times more likely to begin drinking by age 14, four times more likely to experience drunkenness by age 17, and on the average reported 1.05 units more alcohol-related problems. These findings are consistent with past studies (e.g., Chassin et al., 1999; Sher, 1991). A combination of genetic and environmental factors probably explains the early onset of alcohol use and problems among children of alcoholics (Zucker, 2006). It is important to note that children of alcoholics were not more likely than controls to begin using other illicit drugs by age 17. Thus having an alcoholic parent appeared to increase the risk for certain alcohol-related behaviors, but not behaviors related to other drugs. Parental alcoholism did not moderate the effects of behavioral control and resiliency on substance use. The relationship between behavioral control/ resiliency and substance use was similar in children of alcoholics and controls.

Controlling for parental alcoholism, children with slower rates of increase in behavioral control over time were more likely to drink at an early age (i.e., age 14), to report having been drunk, to have more alcohol-related problems and to have used drugs other than alcohol. These findings extend our understanding of how early personality traits may lead to onset of drinking and illicit drug use. Although low behavioral control was related to externalizing problems, behavioral control predicted substance use even when externalizing problems were controlled for. This provides theoretical support for distinguishing the personality trait of behavioral control from the psychopathological construct of externalizing problems, and shows that the trait carries important incremental predictive power from childhood into adolescence. Although externalizing problems are expected to be related to personality, the integration of these two domains or perspectives for describing child adjustment is as yet unresolved. It was therefore important to examine the unique effects of personality with global measures of psychopathology controlled. Adolescents with higher initial levels of resiliency were less likely to start drinking by age 14 and less likely to have either internalizing or externalizing problems. Emotionality moderated the effects of behavioral control on number of alcohol-related problems. When compared to participants of low negative emotionality, a faster rate of increase

in behavioral control predicted less alcohol-related problems in participants of high negative emotionality. We comment further on each finding.

Development of behavioral control and resiliency

Participants in this study varied in the initial status and the rate of change of behavioral control. Behavioral control increased over time, as indicated by the significant latent slope factor. As children matured, they became less impulsive and more controlled. This is consistent with other developmental findings that children's self control develops with age (J. Block et al., 1988; Kellam et al., 1980; Masse & Tremblay, 1997). On the other hand, resiliency remained stable over time, as indicated by the non-significant means and variance of the latent slope factor. Resilient children remained resilient adolescents. Less resilient children remained less resilient adolescents.

Because different raters interviewed the participants and did the Q-sort ratings at each wave, the probability that the results simply reflect rater bias is low. The lack of change in resiliency scores over time may imply that regulatory skills related to resiliency are rooted in early temperament and that this temperament is stable. Alternatively, it may suggest that the environment of the children in this study is consistent (e.g., consistently high in conflict) and such consistency sustains the kind of individual trait stability observed here. If the environment of the child remains consistent and requires the child to behave in a certain way (e.g., exhibiting a high level of behavioral control), there will be fewer opportunities for the child to vary levels of control and acquire the skills necessary to be resilient. However, as our participants approach late adolescence and have more independence from their family, we may see more changes in individual differences in resiliency.

The relationship between behavioral control and resiliency observed here is consistent with theoretical expectations (J. H. Block and Block, 1980; Eisenberg et al., 2000). To our knowledge, this is the first study to demonstrate how the two traits are related to one another longitudinally. Children with lowest or highest levels of behavioral control were the least resilient in a developmental fashion. Children with moderately high levels of behavioral control were the most resilient.

Early personality and adolescent alcohol and illicit drug use

A low initial level and a slow rate of increase in behavioral control predicted substance use outcomes. The effect held even after controlling for the effects of internalizing and externalizing problems. In contrast, a low initial level resiliency predicted early onset of alcohol use only, but not onset of other drug use. These findings are similar to the data reported by Block et al. (1988) and Shedler et al., (1990). In these studies, lack of ego control predicted drug use more consistently than resiliency. Block et al. (1988) has argued that behavioral control is a key personality characteristic that leads to the values, personal susceptibilities, and the external circumstances associated with drug use in adolescence. Though low behavioral control may initially get some adolescents into trouble, it is the presence or absence of resiliency that determine whether adolescents will develop more serious problems related to drug use. According to this view, the deleterious effects of low resiliency will become apparent as individuals approach late adolescence and early adulthood. This study focused on early to mid-adolescence (80% of participants were younger than 16 when they provided substance use data), which may explain the stronger finding of behavioral control on drug use.

Our findings indicated that early childhood characteristics predicted onset of alcohol use by age 14. Early onset of alcohol use is associated with a greater likelihood of developing problem drinking in adolescence (Ellickson et al., 2003; Fergusson et al., 1994; Gruber et al., 1996; Hawkins et al., 1997; Pederson & Skrandal, 1998) as well as alcohol abuse or dependence in

adulthood (Chou & Pickering, 1992; DeWit et al., 2000; Grant & Dawson, 1997; Grant et al., 2001; Pitkanen et al., 2005; Warner & White, 2003; York et al., 2004). Moreover, early onset of alcohol use is also associated with other risky behaviors, such as early onset of sexual intercourse and teenage pregnancy (Miller & Moore, 1990; Urdu & Campbell, 1994). These findings, together with other longitudinal studies linking behaviors in early childhood and alcohol / drug use in adolescence (e.g., Kellam et al., 1980, J. Block et al., 1988, Masse & Tremblay, 1997), suggest that substance abuse prevention programs begin in early childhood may yield fruitful results. If early childhood behaviors put individuals at risk for alcohol and drug use, then programs aiming at changing those behaviors may protect individuals from experimenting with drugs and alcohol at an early age. These programs might focus on teaching youngsters skills related to delay of gratification, regulation of negative emotions and related behaviors, as well as strategies related to attention focusing and distraction (i.e., diverting attention from unpleasant or task-irrelevant information; Eisenberg & Spinard, 2004).

It is important to note that onset of alcohol and drug use does not necessarily imply subsequent problems. National data show that about 23% of U.S. adolescents aged 12–15 have used alcohol in the past 30 days and 11% of adolescents aged 12 to 17 have used illicit drugs in the past month (SAMHSA, 2004). Among those adolescents who used alcohol or drugs, only a subgroup will continue to develop alcohol or drug-related problems. The task of identifying this subgroup and the risk factors that lead to problematic substance use remains an important issue for researchers. The developmental trajectories of behavioral control and resiliency are related to onset of drinking, drunkenness, use of other illicit drug use and number of alcohol problems in adolescence. It is possible that behavioral control (lower initial levels, lower rates of increase over time) and resiliency (lower initial levels) may be important risk factors of problematic substance use in late adolescence and early adulthood. As our study progresses, we intend to track these relationships and examine possible mediators and moderators.

Emotionality did not moderate the relationship between behavioral control and most substance use variables except number of substance use problems. A faster rate of increase in behavioral control was related to a lower number of alcohol problems in the high emotionality group than the low emotionality group. This is consistent with the argument of Eisenberg, Guthrie et al. (1997), who suggested that regulatory processes such as behavioral control are more important for individuals who are high in negative emotionality (i.e., prone to negative emotions). Because this is the first study that examines the longitudinal relationship between behavioral control and alcohol/ drug use in children varying in emotionality, replication of this moderator effect is needed.

Past research has found gender differences with regard to how behavioral control and resiliency affect behavior (J. Block et al., 1988; J. Block, Gjerde, & Block, 1991). For instance, ego undercontrol and low resiliency at age 3 to 4 predicted drug use at age 14 in girls whereas only ego undercontrol predicted adolescent drug use in boys. We did not find any gender differences in the effects of behavioral control and resiliency on alcohol and drug use outcomes. For both boys and girls, lower levels of behavioral control and resiliency predicted alcohol and drug use outcomes. There were also no gender differences in the frequency of all the alcohol and drug use outcomes. In comparison to the Berkeley sample, the present sample is larger and comes from a high-risk background (i.e., children of alcoholics and controls from comparable low socioeconomic neighborhoods). Given the greater likelihood of substance use in this sample, gender differences may either be nonexistent or more muted.

Limitations and future directions

Our study has several limitations and our results point to several directions for future research. First, we did not examine factors that may affect the trajectories of behavioral control and resiliency. Examples include parent psychopathology, family conflict, positive and negative

interactions among family members (Loukas, Zucker, Fitzgerald, & Krull, 2003). Second, we examined outcomes in early to mid-adolescence. As the sample moves into late adolescence and early adulthood, the effects of behavioral control and resiliency on substance use and behavioral problems may change. For instance, though behavioral control is a protective factor for onset of alcohol use in early adolescence, extremely high levels of control (i.e., overcontrol) and low levels of resiliency may contribute to the development of negative affect in late adolescence and early adulthood, which in turn may lead to the onset of substance use. Future studies need to address the effects of behavioral control and resiliency on substance use using longitudinal data spanning a wider age range than the one reported here. Third, we did not examine the possible reciprocal relationship between behavioral control / resiliency and substance use. For instance, while low levels and slow rates of increase in behavioral control increase the probability of alcohol use, once alcohol use is initiated and escalated, it may decrease one's ability to control impulses and behavior. To fully examine the bidirectional relationship between behavioral control / resiliency and substance use, one needs data on substance use in late adolescence and early adulthood, when individual differences in substance use becomes more pronounced. Future studies including data from those developmental periods will help to address this issue. Finally, all participants were Caucasian and were living with both of their biological parents at Time 1. The findings may not generalize to children in other racial or ethnic groups and children who do not start out in intact families. Future research is necessary to ascertain whether the results of this study can be replicated in other samples.

Concluding remarks

This study has shown that the developmental trajectories of behavioral control and resiliency from early childhood to adolescence predicted onset of alcohol and drug use in adolescence. The effects of the trajectories on the outcomes remained even after statistically controlling for the effects of externalizing problems, a well-known risk factor for alcohol and drug use disorder (see Zucker, 2006 for a review). Both behavioral control and resiliency are theoretically related to self-regulation. The presence of regulatory skills and habits, or lack thereof, may be a crucial factor influencing important developmental outcomes in adolescence. Helping children to develop such skills and habits may prove to be promising in intervention and prevention programs for substance use problems in adolescence and thereafter.

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Figure 1.
Unconditional latent growth model of behavioral control.
Note: η_α is the latent intercept factor of behavioral control. η_β is the latent slope factor of behavioral control. An unconditional latent growth model of resiliency was also estimated.

Figure 2.

Hypothetical structural equation model of the effects of behavioral control and resiliency on risk behaviors.

Note: Adolescent internalizing problems were included in separate models.

Figure 3.
Estimated relationship between behavioral control and resiliency.

Figure 4.

Fitted hazard function of the age of onset of alcohol use among children of alcoholics.

Note: Age categories: 1=age 2–3, 2=age 4–5, 3=age 6–7, 4=age 8–9, 5=age 10–11, 6=age 12–13, 7=age 14–15, and 8=age 16–17.

Table 1

Descriptive statistics for behavioral control, resiliency, and emotionality

Age	N	Behavioral control (range: 1–9)		Resiliency (range: 1–9)		Emotionality (range: 1–9)	
		Mean (SD)	α	Mean (SD)	α	Mean (SD)	α
2	13	4.21 (1.11)	.84	5.39 (.88)	.85	4.91 (1.14)	.85
3	132	4.55 (1.15)	.85	5.61 (.94)	.88	4.48 (1.28)	.86
4	118	4.73 (1.09)	.85	5.90 (.84)	.85	4.10 (1.16)	.84
5	94	5.21 (1.01)	.87	6.23 (.73)	.78	3.60 (.85)	.75
6	119	4.87 (1.27)	.90	5.83 (.94)	.89	4.22 (1.22)	.86
7	114	5.03 (1.06)	.83	5.70 (.94)	.87	4.49 (1.33)	.86
8	110	5.12 (1.01)	.83	5.95 (.82)	.85	4.09 (.99)	.76
9	146	4.90 (1.16)	.87	5.72 (.93)	.87	4.47 (1.28)	.85
10	159	4.94 (1.06)	.85	5.77 (.89)	.86	4.51 (1.20)	.83
11	113	4.78 (1.05)	.85	5.88 (.89)	.86	4.39 (1.24)	.84
12	166	5.26 (.97)	.83	5.91 (.88)	.86	4.13 (1.08)	.82
13	140	5.15 (1.01)	.83	5.94 (.83)	.84	4.06 (1.12)	.81
14	121	5.15 (1.02)	.85	5.87 (.91)	.87	4.19 (1.15)	.83

Table 2

Parameter Estimates and Standard Errors Predicting Alcohol and Other Drug Use

Predictor variables	Drinking by 14		Drunkennes by 17		# Alcohol prob.		Drug use by 17		OR	
	Parameter	SE	Parameter	SE	Parameter	SE	Parameter	SE	OR	OR
Parental alcoholism	1.125***	0.313	1.520***	0.401	1.047**	0.336	0.481	0.829	1.618	
Age	.594***	0.090	1.006***	0.163	0.574***	0.075	0.989***	0.090	2.688	
Behavioral control intercept	-0.898**	0.339	-1.350***	0.437	-0.834	0.444	-0.984**	0.300	0.407 ^a	
Behavioral control slope	-21.319*	8.703	-26.615*	11.515	-28.294**	10.535	-12.694**	4.887	0.374 ^a	
Resiliency intercept	-1.044*	0.511	-0.579	0.614	-0.704	0.673	-0.477	0.443	0.812 ^a	
Parental alcoholism	1.289***	0.322	1.508***	0.389	1.206***	0.374	0.536***	0.324	1.709	
Age	0.494	0.080	0.916	0.134	0.517	0.086	1.031	0.108	2.803	
Externalizing problems	0.043*	0.019	0.048*	0.022	0.099	0.023	0.078**	0.024	1.081	
Behavioral control intercept	-0.593	0.328	-1.160**	0.392	-0.443	0.475	-0.862	0.332	0.469 ^a	
Behavioral control slope	-16.701*	8.437	-22.571*	10.073	-23.577*	10.444	-7.680	4.876	0.581 ^a	
Resiliency intercept	--	--	--	--	--	--	--	--	--	
Parental alcoholism	1.355***	0.336	1.610***	0.417	1.332***	0.379	0.610	0.324	1.840	
Age	0.507***	0.086	0.946***	0.157	0.533***	0.087	1.040***	0.110	2.829	
Internalizing problems	0.016	0.025	0.002	0.029	0.057	0.031	0.039	0.030	1.039	
Behavioral control intercept	-0.789*	0.342	-1.378**	0.430	-0.877	0.494	-1.169	0.339	0.359 ^a	
Behavioral control slope	-19.896*	9.794	-26.490*	12.250	-30.313*	12.044	-11.598*	5.105	0.440 ^a	
Resiliency intercept	--	--	--	--	--	--	--	--	--	

^aNote. Estimated odds of event occurrence when the respective explanatory variable increased by one standard deviation.

--The latent intercept of resiliency was dropped from the model because it was not a significant predictor of alcohol and drinking outcomes. Alcohol and other drug use outcome variables are onset of drinking by age 14 (0=no, 1=yes), onset of drunkennes by age 17 (0=no, 1=yes), number of alcohol-related problems (e.g., missed school due to excessive drinking), and onset of other illicit drug use by age 17 (0=no, 1=yes).

* p<.05

** p<.01

*** p<.001.

Table 3
Discrete Time Survival analyses Predicting Age of Onset of First Drinking and Drunkenness Episodes

Predictor variables	Parameter	Age of onset of first drinking SE	OR	Parameter	Age of onset of first drunkenness SE	OR
Parental alcoholism	0.740**	0.242	2.096	1.196***	0.338	3.307
Behavioral control intercept	-0.599	0.332	0.587 ^a	-0.709	0.386	0.528 ^a
Behavioral control slope	-21.652*	10.697	0.216 ^a	-25.637*	12.434	0.163 ^a
Resiliency intercept	-0.852	0.569	0.688 ^a	-0.564	0.579	0.782 ^a

Note. For clarity, the maximum likelihood estimates of the baseline logit hazard function are not presented.

^a Estimated odds of event occurrence when the respective explanatory variable increased by one standard deviation.

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

Table 4
Parameter Estimates and Standard Errors Predicting Adolescent Externalizing and Internalizing Problems

Predictor variables	Externalizing problems		Internalizing problems	
	Parameter	SE	Parameter	SE
Parental alcoholism	1.157	0.806	0.341	0.630
Age	0.292	0.402	-.222	0.300
Behavioral regulation intercept	-4.736***	1.000	0.129	0.640
Behavioral regulation slope	-82.127*	32.112	-13.661	12.246
Resiliency intercept	-6.115***	1.871	-3.923***	1.152

* Note. $p < .05$

** $p < .01$

*** $p < .001$.