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Effortful Control Predicts Adolescent Antisocial-Aggressive Behaviors and Depressive Symptoms: Co-occurrence and Moderation by Impulsivity

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Abstract

Effortful control is associated with fewer antisocial-aggressive behaviors (AAB) and depressive symptoms (DEP), but impulsivity may moderate these relations. However, few researchers have considered the effects of AAB-DEP co-occurrence. A multi-informant, multi-method approach assessed 5–10 year olds' effortful control and impulsivity and, 5–6 years later, their AAB and DEP ($N=474$). Participants were non-Hispanic Caucasian (59.2%) or Hispanic (27.9%) from a southwestern U.S. metropolitan area. Low effortful control predicted pure AAB. Low effortful control and low impulsivity predicted pure DEP and co-occurring AAB-DEP. An effortful control-by-impulsivity-by-age interaction predicted pure AAB and co-occurring AAB-DEP. For older adolescents, lower effortful control predicted more symptoms only at average and high impulsivity. Results highlight multiple pathways to pure DEP vs. pure AAB or co-occurring AAB-DEP.

Childhood temperamental characteristics are well-known predictors of adolescent problem behaviors (Nigg, 2006). Understanding the early temperamental characteristics that underlie problem behaviors is important because it may help elucidate developmental pathways to adolescent problem behaviors (Rothbart & Bates, 2006). Indeed, adolescence is a crucial developmental period during which adaptive or maladaptive developmental trajectories can be established and/or changed (Cicchetti & Rogosch, 2002).

Effortful Control and Risk for Antisocial-Aggressive Behaviors and Depressive Symptoms

Temperament is defined as biologically-based individual differences in reactivity (responsivity to changes in stimulation) and regulation (modulation of reactivity; Rothbart & Derryberry, 1981). An important regulatory component of temperament is effortful control, which is the self-regulatory dispositional capacity defined as, “the efficiency of executive attention-including the ability to inhibit a dominant response and/or to activate a subdominant response, to plan, and to detect errors” (Rothbart & Bates, 2006, p. 129). Researchers consider effortful control to be an active, flexible, and voluntary form of

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regulation that allows individuals to respond adaptively to the situation at hand (Eisenberg, Spinrad, & Morris, 2002). Effortful control consists of several dimensions, including inhibitory control (ability to willfully inhibit or plan behavior), attentional focusing (willfully maintaining attentional focus), and attentional shifting (willfully shifting attention to deal with task demands; Eisenberg et al., 2001). These dimensions are highly inter-correlated and consistently load on a single effortful control factor (e.g., Rothbart, Ahadi, Hershey & Fisher, 2001). It should be noted that the construct of effortful control overlaps with executive functioning. Distinctions between effortful control and executive functioning are complex and beyond the scope of this manuscript, but see Zhou, Chen, and Main (2012) for a detailed discussion.

Research suggests that low levels of effortful control contribute to the risk for aggressive and antisocial behaviors (AAB) and depressive symptoms (DEP; Compas, Connor-Smith, & Jaser, 2004; Dennis & Brotman, 2003; Loukas & Roalson, 2006; Moriya & Tanno, 2008; Verstraeten, Vasey, Raes, & Bijttebier, 2009). Effortful control might relate to AAB and DEP for several reasons. Children who are unable to inhibit inappropriate behaviors, willfully shift attention towards important task demands, or focus attention when necessary are likely to show conduct problems and aggressive behaviors in school, family, and peer contexts. Moreover, children who are unable to shift attention away from negative thoughts or feelings or to activate behavior are likely to experience increased sadness, rumination, or decreased contact with rewarding activities and thus are at risk for DEP. Therefore, one goal of the current study was to test the prospective main effects of childhood effortful control on adolescent AAB and DEP.

The idea that low effortful control predicts *both* AAB and DEP may be somewhat surprising because factor analytic work shows that AAB and DEP lie on distinct spectra of symptomatology in both childhood and adolescence (i.e., internalizing vs. externalizing; Achenbach & Edelbrock, 1978). However, theory and empirical evidence suggest that other temperamental characteristics may differently *moderate* the relation of effortful control to these divergent outcomes. This phenomenon has been referred to as multifinality, which suggests that diverse outcomes can be the result of a similar starting point depending on the influence of other vulnerabilities (Cicchetti & Rogosch, 2002). Thus, the primary goal of the current study was to test whether the divergent outcomes of adolescent AAB and DEP were predicted by childhood effortful control, but only as moderated by another vulnerability, namely, impulsivity.

The Role of Impulsivity

Impulsivity is a reactive component of temperament which might be important in predicting AAB and DEP and in moderating the relation of effortful control to AAB and DEP (Rothbart & Bates, 2006). Impulsivity is one behavioral manifestation of a larger temperamental 'approach' system and has been defined as speed of response initiation (Rothbart et al., 2001) and immediate responsiveness to signals of reward (Ahadi & Rothbart, 1994). Unlike the more voluntary and flexible temperamental characteristic of effortful control, researchers consider impulsivity to be more automatic and not usually under voluntary control (Eisenberg et al., 2002). According to Eisenberg et al. (2002),

individuals high in impulsivity often approach situations without thinking. At the other extreme, individuals low in impulsivity display high levels of involuntary inhibition, overcontrolled behavior, and lack flexibility in novel or stressful situations.

Studies of community samples demonstrate that children who are high in impulsivity display higher AAB (Eisenberg et al., 2001, 2007, 2009). This is likely due to the fact that they are ‘pulled’ by potential rewards and desires without adequate reflection, which might lead to socially inappropriate or aggressive behavior. Although it may seem counterintuitive to think of low impulsivity as a risk factor, in fact, studies show that children who are low in impulsivity display higher pure internalizing problems (Eisenberg et al., 2001, 2007, 2009). This relation might be observed for several reasons. Children who are more *involuntarily* inhibited, constrained, or withdrawn might be more prone to peer rejection due to perceptions that they are dull or rigid (Eisenberg et al., 2009). They might also have less motivation or more difficulty approaching potentially rewarding situations, which is characteristic of those with DEP (Henriques & Davidson, 2000). Moreover, research shows that individuals low in impulsivity are more likely to become disorganized, inflexible, or have difficulty recovering following stressful events (Eisenberg et al., 2002). These are some mechanisms that might account for the effect of low impulsivity on internalizing problems and DEP. However, some research also suggests that the relation between impulsivity and maladjustment might be non-linear (Eisenberg et al., 2002). In other words, individuals with very high *or* very low levels of impulsivity might be at risk for negative outcomes, whereas individuals with moderate levels of impulsivity might be well-adjusted. Thus, another goal of the current study was to test both the linear and quadratic main effects of childhood impulsivity on adolescent AAB and DEP.

As noted earlier, both AAB and DEP are related to low levels of effortful control. However, what might differentiate the development of AAB compared to DEP is an underlying propensity towards high or low impulsivity. A deficit in effortful control might predict AAB only for highly impulsive individuals. These individuals have a propensity for incentive-driven approach behaviors (high impulsivity) and also lack the ability to voluntarily control this propensity (low effortful control). On the other hand, a deficit in effortful control might predict DEP only for individuals with low impulsivity. These individuals have a propensity to inflexible, avoidant, and constrained behaviors (low impulsivity) and also lack the ability to voluntarily control this propensity (low effortful control). Consistent with this view, Carver, Johnson, and Joormann (2008) suggested that individuals with both low effortful control and a sensitive reactive approach system (conceptually similar to high impulsivity) might display approach-driven behaviors, such as AAB. In contrast, individuals with both low effortful control and a sensitive reactive avoidance system (conceptually similar to low impulsivity) might display behaviors that are more avoidant and inhibited, such as DEP. Nigg (2006) similarly hypothesized that one important pathway to conduct problems involves high approach, impulsivity, and low effortful control, whereas depression likely involves low approach, high withdrawal, and perhaps low effortful control.

Although these theories have not been widely studied, Rudolph, Troop-Gordon, & Llewellyn, (2013) examined whether social approach and avoidance motivation (related to high and low impulsivity, respectively) moderated the ability of inhibitory control to predict

aggression and DEP in children from a community sample. Low inhibitory control predicted aggression only for boys with high social approach and low social avoidance motivation. In contrast, low inhibitory control predicted DEP only for girls with high social avoidance motivation. In sum, the primary goal of the present study was to test the unique main effects of effortful control and impulsivity and their interaction in predicting adolescent AAB and DEP. In addition, we tested whether impulsivity had non-linear (i.e., quadratic) main effects on outcomes.

Distinctiveness of Effortful Control and Impulsivity

It is important to note that effortful control and impulsivity share some conceptual similarities in Rothbart's theoretical model (Rothbart & Derryberry, 1981). For instance, low effortful control and high impulsivity both involve the inability to inhibit behavior. However, despite this conceptual overlap, effortful control and impulsivity are theoretically distinct constructs in Rothbart's model. First, effortful control is a broader construct than impulsivity because it includes multiple dimensions such as attentional shifting and focusing. Second, effortful control is part of temperamental regulation, which reflects active and voluntary control. In contrast, impulsivity is a component of temperamental reactivity, which is relatively involuntary and automatic. For example, although a child may have strong tendencies to approach potential rewards (i.e., high impulsivity), he or she may also be able to voluntarily inhibit these tendencies because of effortful control.

In Rothbart's model of temperament (Rothbart & Derryberry, 1981), effortful control and impulsivity would be expected to be correlated because effortful control can be voluntarily mobilized to regulate impulsivity. Thus, theoretically, effortful control and impulsivity represent correlated but distinct constructs. In support of the view that these constructs are distinct, research shows that effortful control and impulsivity each have *unique* effects on internalizing and externalizing problems (Eisenberg et al., 2004; Valiente et al., 2003) and are best modeled as two distinct factors in childhood (Eisenberg et al., 2013; Rothbart et al., 2001). To ensure that effortful control and impulsivity represent distinct constructs in the present data, another goal of the study was to test whether effortful control and impulsivity were best modeled as two distinct factors or as one factor.

The Co-occurrence of AAB and DEP

Previous studies on the relation of temperament to AAB and DEP have not considered the co-occurrence between AAB and DEP, which is higher than expected by chance in adolescence and cannot be accounted for by ascertainment bias (Zoccolillo, 1992). It is important to understand how effortful control and impulsivity uniquely predict and interact to predict AAB and DEP once their co-occurrence has been considered. Elucidating these relations may contribute to the literature on causes of AAB and DEP co-occurrence. Explanations for the co-occurrence of AAB and DEP include, one causes the other, their risk factors are correlated or shared, they are two manifestations of the same underlying liability, the co-occurring presentation shares the same etiology as a 'pure' presentation, and the co-occurring presentation is separate from each 'pure' presentation (Caron & Rutter, 1991). The current study cannot refute explanations wherein AAB causes DEP and vice versa or

the presence of a shared underlying liability. However, the pattern of relations might indicate whether co-occurring AAB-DEP shares the same etiology as pure AAB or DEP or whether the three problems are distinct.

For example, if co-occurring AAB-DEP shares the same risk factors as pure AAB but not pure DEP, this suggests that co-occurring AAB-DEP shares the same etiology as pure AAB. Indeed, research shows that co-occurring AAB-DEP and pure AAB share many risk factors whereas co-occurring AAB-DEP and pure DEP share far fewer (Ezpeleta, Granero, & Doménech, 2005; Zoccolillo, 1992). However, researchers also found differences between co-occurring AAB-DEP and pure AAB (e.g., Simic & Fombonne, 2001). By elucidating some of the basic underlying temperamental predictors of these outcomes, the current study can contribute to understanding causes of AAB and DEP co-occurrence.

The present study also addresses some methodological limitations of previous studies to better characterize co-occurrence. Most studies on AAB and DEP co-occurrence used categorical approaches, such as creating problem groups using cut-offs or examining AAB-by-DEP interactions. However, such cut-off scores are not empirically based (Widiger & Samuel, 2005) and may cause artifactual co-occurrence due to incorrect categorization of problem groups. These approaches are also not in line with research demonstrating that psychological problems are better conceptualized as dimensional (Widiger & Samuel, 2005). Furthermore, measurement error can artificially inflate rates of observed co-occurrence.

Modeling adolescent AAB and DEP symptoms in a bifactor framework addresses many of these issues. ‘Bifactor model’ is the term and method originally introduced by Holzinger and Swineford (1937) that describes a type of factor model. In this model, one general factor reflects the overlap across all items and specific factors reflect the unique variance among subgroups of items (Reise, 2012). Bifactor models have at least two factors (one general and one specific) but they can have multiple specific factors depending on theoretically- or data-driven modeling decisions made by the researcher. To model AAB and DEP co-occurrence, the current study adopted a theory-based approach. All AAB and DEP items were specified as loading onto a “co-occurring” (general) AAB-DEP factor, AAB items were specified as loading onto a “pure” (specific) AAB factor, and DEP items were specified as loading onto a “pure” (specific) DEP factor. Factors were specified to be uncorrelated so that each represented the unique variance after covarying out variance attributable to the other factors.

Thus, ‘scores’ on the general factor represent the degree to which individuals manifest what is unique to all AAB and DEP items after covarying out variance from the specific factors. ‘Scores’ on the specific factors represent the degree to which individuals manifest what is unique to *only* AAB, or *only* DEP items, after covarying out variance from the other two factors. Individuals receive ‘scores’ on all three factors and can have various combinations of ‘scores’ on the three factors. Resulting factors are continuous, error-free, and more in line with a dimensional conceptualization of psychological problems. The current study aimed to characterize AAB and DEP co-occurrence using a bifactor model and to test the main and interactive influences of effortful control and impulsivity on pure DEP, pure AAB, and co-occurring AAB-DEP.

Age and Gender as Potential Moderators of the Interaction between Effortful Control and Impulsivity

Effortful control increases from childhood into adolescence (Murphy, Eisenberg, Fabes, Shepard, & Guthrie, 1999). Due to age-related increases, it is possible that effortful control moderates the effects of impulsivity on problem behaviors either only, or more strongly, at older ages (Valiente et al., 2003). Providing some support for this, two studies found that impulsivity no longer had a unique influence on externalizing problems over and above effortful control for older children. This is likely because older children have more fully developed the flexibility to modulate externalizing-related behaviors and emotions than younger children (Eisenberg et al., 2004; Valiente et al., 2003). The present study tested whether the nature of the interaction between effortful control and impulsivity changed between the ages of 5–10 years in predicting adolescent pure DEP, pure AAB, and co-occurring AAB-DEP.

Gender might also act as a moderator. As noted earlier, Rudolph et al. (2013) found that the combination of low inhibitory control and high social approach *or* low social avoidance motivation predicted aggression for boys. However, the combination of low inhibitory control and high social avoidance motivation predicted DEP for girls. These findings support theories suggesting that AAB and DEP are gender-specific manifestations of poor effortful control (Carver et al., 2008). Thus, we tested whether the effortful control-by-impulsivity interaction differed by gender in predicting adolescent pure DEP, pure AAB, and co-occurring AAB-DEP.

In summary, our first goal was to characterize co-occurrence between AAB and DEP using a bifactor model. It was hypothesized that a model with one general “co-occurring” AAB-DEP factor and two specific “pure” AAB and DEP factors would fit the data well. After testing whether effortful control and impulsivity were distinct factors, the next goal was to test the prospective main and interactive effects of effortful control and impulsivity on continuous and error-free factors of co-occurring AAB-DEP, pure AAB, and pure DEP. In addition to linear main effects, quadratic main effects of impulsivity were tested because both extremely high *and* extremely low impulsivity might predict maladaptive, particularly co-occurring, problems. Because most prior work indicates less overlap between pure internalizing and co-occurring problems than for pure externalizing and co-occurring problems (Eisenberg et al., 2001, 2009; Ezpeleta et al., 2005), we expected high impulsivity to be positively and linearly related to pure AAB and co-occurring AAB-DEP and negatively and linearly related to DEP. We expected low effortful control to be related to higher levels of all three outcomes.

In terms of interactions, we hypothesized that low effortful control would predict pure AAB only at high levels of impulsivity and would predict pure DEP only at low levels of impulsivity. In addition, we tested three-way interactions among effortful control, impulsivity and age and among effortful control, impulsivity, and gender. We hypothesized that the interaction between effortful control and impulsivity would only hold in older adolescents. Because only one study reported moderation by gender (Rudolph et al., 2013), gender moderation of the interaction between effortful control and impulsivity was tested

but no a priori hypotheses were proposed. We expected that the prediction of co-occurring AAB-DEP would be similar to pure AAB based on previous literature indicating that these two forms have similar etiological influences (Ezpeleta et al., 2005). Finally, we tested these associations in a longitudinal sample at high-risk for substance use and related externalizing disorders due to a high prevalence of familial substance use disorder. We had no hypotheses that the pathways of interest would differ for higher-risk and lower-risk children. However, because high-risk samples often show greater variability in problem behaviors compared to typical community samples, the pathways to AAB and DEP will likely be more clearly illuminated in the current study.

Method

Participants

Participants were drawn from a multi-generational longitudinal study of families at varying risk for alcoholism (Chassin, Barrera, Bech, & Kossak-Fuller, 1992). For full details regarding the timing of assessments and design of the larger longitudinal study, refer to Chassin et al. (1992). Participants were from the third generation of the study. Data were drawn from their first three assessments when they were children (T1, years 2001–2006) and adolescents (T2 and T3, years 2006–2013). Five years separated T1 and T2, and 18-months separated T2 and T3. Participants were primarily non-Hispanic Caucasian (59.2%) or Hispanic (27.9%) from a southwestern U.S. metropolitan area. The median household income of the participants was \$51,200 in 2006, slightly lower than the metropolitan area median income at the time (\$54,600). From T1 to T2, retained (87.8%) and attrited participants did not differ in parental alcohol or drug disorder, ethnicity, or gender ($\chi^2 = 2.03, 1.30, 0.44, 0.59, ns$). However, parents of attrited participants had lower education ($t = 2.03, p = 0.05$). From T2 to T3, those retained (91.5%) vs. attrited did not differ in parental drug disorder or gender ($\chi^2(1) = 0.20, 0.99, ns$), but attrited participants were more likely to be Hispanic ($\chi^2(5) = 12.01, p = 0.04$) and to have parents with an alcohol disorder ($\chi^2(1) = 5.65, p = 0.02$). Attrition was small but not entirely random.

Participants were included ($N = 474$) if they were between the ages of 5–10 at T1, 11–17 at T2, and 12–18 at T3 (see Table 1). These criteria reduced age heterogeneity within each wave and captured developmental periods of childhood (T1) and adolescence (T2, T3). Compared to those excluded, those included had higher family history densities of substance disorder, were younger (by design), and had higher impulsivity. Included and excluded participants did not differ in their AAB, DEP, gender, race-ethnicity, or effortful control (see Table 1). Children's data were reported by either one or both biological parents (89.4%), their biological mother and either a step-father or 'other' parent figure (9.1%), or their biological father and either a step-mother or 'other' parent figure (1.5%). Temperament was measured at ages 5–10, baseline AAB and DEP at ages 11–17, and AAB and DEP outcomes at ages 12–18.

Recruitment and Procedure

Original families (the first generation of the study) with at least one parent meeting criteria for DSM-III alcohol abuse or dependence were recruited. Screening criteria were

determined using court records of driving under the influence (DUI), health maintenance organization wellness questionnaires, and community telephone surveys. Parent alcoholism status (using lifetime DSM-III abuse or dependence diagnoses) was verified with an in-person interview or Research Diagnostic Criteria using spousal report. A comparison group of families without an alcoholic parent were recruited using telephone surveys and were matched to families with at least one alcoholic parent on demographic characteristics (e.g., adolescent age, family composition, race-ethnicity, and socioeconomic status). Families with and without alcoholic parents were living in the same neighborhoods. See Chassin et al. (1992) for more details.

The current study used data reported by the third-generation children (current study participants), their parents, and their teachers. When they were 5–10 years old, in-state children and their parents were interviewed at home and invited to participate in a laboratory visit occurring within a few weeks of the home visit. Questionnaires were sent to children's teachers. When they were 11–17 years old, in-state participants and their parents were interviewed at home. Phone interviews or mailed questionnaires were conducted when participants were 12–18 years old. At all assessments, participants and parents provided informed consent and out-of-state participants were interviewed via phone or mailed surveys.

Measures

Descriptive data are shown in Table 1.

Demographic information—Parents reported on participants' age when they were 5–10 years old. Participants self-reported gender, race-ethnicity and age when they were 11–17 and 12–18 years old. Race-ethnicity was dichotomized to compare non-Hispanic Caucasians (59.2%) to all other race-ethnicities.

Family history density of alcohol and drug use disorder (FHD)—Participants' FHD were calculated separately using methods of Zucker, Ellis, and Fitzgerald (1994) and Stoltenberg, Mudd, Blow and Hill (1998). Data from the Computerized Diagnostic Interview Schedule (Robins et al., 2000) and family member report on the Family History-Research Diagnostic Criteria (Endicott, Andreasen, & Spitzer, 1975) determined lifetime drug and alcohol disorder (either DSM-III-R or DSM-IV diagnoses) of the participants' grandparents and parents. Scores required data from at least 1 parent and 2 grandparents to minimize missing data. Grandparents' lifetime drug or alcohol diagnosis was weighted by 0.25, parents' by 0.5, and nonalcoholic relatives were assigned a score of 0. Summed scores were rescaled from 0–2. Because we did not have differential hypotheses about the effect of alcohol vs. drug density, scores were averaged and this composite was used as a covariate in all analyses.

Childhood effortful control and impulsivity—When participants were 5–10 years old (M age = 6.72), mothers, fathers, and teachers rated children's effortful control and impulsivity using the Child Behavior Questionnaire (CBQ; Rothbart et al., 2001; 1 = extremely untrue; 7 = extremely true). To avoid potential item overlap, we excluded items

that reflected problem behaviors using expert ratings as described in Eisenberg et al. (2004). Removed items are reported below. A behavioral measure of effortful control was administered for 5–10 year olds.

Impulsivity: Mother, father and teacher reports on the CBQ impulsivity subscale were used to measure children's impulsivity ($\alpha = 0.67, 0.73, \text{ and } 0.81$, respectively).

Effortful control: Mother, father, and teacher reports on the CBQ attentional focusing, attentional shifting, and inhibitory control subscales were averaged within-reporter to create three separate composites of mother-, father-, and teacher-reported effortful control. Two attentional shifting items were removed due to overlap with problem behaviors (has dreamy quality when others talk to her or him; doesn't seem to hear when I talk to her or him; $\alpha = 0.89, 0.89, \text{ and } 0.95$, respectively after deleting overlapping items).

A behavioral measure of effortful control (puzzle box task) was used to assess children's persistence during a challenging task. A 24 in. X 12 in. X 14 in. box contained a puzzle. The front was covered with a cloth that had sleeves for children's arms and the back was clear Plexiglas. The child could cheat by lifting the cloth and looking at the puzzle. Children were told to assemble the puzzle without looking and if they completed it in 5 minutes, they would receive an attractive prize. Persistence scores were the amount of time the child worked on the puzzle divided by the number of seconds the child was alone with the task and had not completed it. This score reflects the amount of time the child persisted on the task (rather than being off-task or cheating). This task involves several aspects of effortful control: sustained attention, inhibiting a dominant response (e.g., quitting) in favor of a subdominant response, and activation control (activating a subdominant response when the tendency is not to do so; i.e., continuing to try when frustrated). This task has been considered an index of effortful control in several studies, correlates significantly with adult-reported effortful control, and loads in models with adult-reported effortful control in two samples (e.g., Eisenberg et al., 2004; Valiente et al., 2003).

Creating factor scores of effortful control and impulsivity and testing their

distinctiveness: A two-factor correlated-trait correlated-uniqueness model was estimated using maximum likelihood in order to reduce the data, obtain a multiple-method and -reporter measure of effortful control and impulsivity, and test whether effortful control and impulsivity were distinct constructs best modeled as two factors or as one factor. We used Mplus v.7.11 (Muthén & Muthén, 1998–2013). Missing data on endogenous variables were estimated using Full Information Maximum Likelihood. Little's Missing Completely At Random (MCAR) test in SPSS suggested the data met the MCAR assumption ($\chi^2(47) = 42.20, p = 0.67$). Correlations between mother-, father-, and teacher-reported effortful control ranged from 0.31–0.51. Correlations between mother-, father-, and teacher-reported impulsivity ranged from 0.31–0.49. Mother, father, and teacher reports of effortful control and puzzle box scores were specified as indicators of an effortful control factor and mother, father, and teacher reports of impulsivity were specified as indicators of an impulsivity factor. Three within-reporter error covariances were estimated to account for method variance (e.g., a correlation between error terms of mother-reported effortful control and impulsivity, and the same for fathers and teachers).

This two-factor model fit the data significantly better ($\chi^2(1) = 46.27, p < 0.001$; Akaike Information Criteria (AIC) = 8809.19, Bayesian Information Criteria (BIC)=9050.05) than a model in which the correlation between factors was constrained to 1.0 (AIC = 8839.58, BIC = 9076.29). This suggests that effortful control and impulsivity were distinct constructs. Factor loadings for both models were significant and greater than 0.30. The final, better-fitting, two-factor model fit the data well: $\chi^2(10) = 6.50, p = 0.77$, RMSEA = 0.00, CFI = 1.00, SRMR = 0.03. Factor loadings were significant ($p < 0.001$), ranging from 0.32–0.82 and 0.48–0.77 for effortful control and impulsivity, respectively. The latent factors were significantly correlated ($r = -0.62$). Within-reporter error covariances were significant, except for mothers' reports. To decrease complexity, we saved the latent factors of effortful control and impulsivity as factor scores, which are manifest variables, in Mplus. These factor scores were used in all subsequent analyses.

Adolescent problem behaviors—Adolescents self-reported on their DEP using the Withdrawn/Depressed subscale and on their AAB using the Rule-Breaking and Aggressive Behavior subscales of the Child Behavior Checklist (CBCL; Achenbach & Rescorla, 2001) on a three-point Likert scale. Adolescents' reports were chosen for several reasons. First, they reported on the same CBCL items at two waves, allowing for longitudinal prediction. Second, adolescents may be more informative reporters of behaviors intentionally hidden from parents, like AAB, and are considered more valid reporters of their DEP than are parents (Grills & Ollendick, 2002). Third, prediction of adolescent-reported problem behaviors from parent, teacher, and observer ratings of temperament alleviates concerns about shared reporter bias.

Baseline AAB and DEP: 11–17 year-olds' (M age = 12.62), self-reported AAB and DEP items were averaged to form two separate composites of AAB and DEP (covariates).

Outcome reports of AAB and DEP: 12–18 year-olds' (M age = 13.94), self-reported AAB and DEP items were used as indicators of a bifactor model. Due to non-normal distributions, items were dichotomized to reflect presence (1) vs. absence (0) of a symptom in the past three months. The AAB scale contained 29 items and the DEP scale contained 8 items. High rates of AAB endorsement reflect the high-risk nature of the sample (see Table 2).

Data Analysis

Analyses were conducted in Mplus v.7.11 (Muthén & Muthén, 1998–2013). Confirmatory factor analysis evaluated the fit of the hypothesized bifactor model using the means- and variance-adjusted weighted least squares estimator (WLSMV). Missing data on endogenous variables were estimated. WLSMV uses a pairwise present approach to estimate missing data. All AAB and DEP items loaded on a 'co-occurring' factor, AAB items on a 'pure' AAB factor, and DEP items on a 'pure' DEP factor. Factors were not allowed to correlate. Items were deleted from factors if their p -value > 0.10 . Model fit was evaluated using chi-square test of model fit and recommendations by Hu and Bentler (1999): CFI .95, RMSEA .06, and WRMR .90.

Structural equation modeling was conducted using WLSMV, which computes probit parameter estimates for categorical outcomes and ordinary least squares parameter estimates for continuous outcomes. Missing data on exogenous and endogenous variables were estimated using the pairwise present approach. Each outcome (co-occurring AAB-DEP, pure AAB, pure DEP) was predicted in a separate model to maintain orthogonal factors. If outcome factors were *predicted* within the same model, they would correlate with one another through predictor variables (see Keiley, Lofthouse, Bates, Dodge, & Pettit (2003). Note that in each model, the entire bifactor model was estimated, even though the paths from the predictor variables were only tested with one outcome factor at a time. In other words, in a first model, paths were estimated from the predictors and covariates to pure AAB *but not* to pure DEP or co-occurring AAB-DEP. In a second model, paths were estimated from the predictors and covariates to co-occurring AAB-DEP *but not* to pure AAB or pure DEP. In a third model, paths were estimated from the predictors and covariates to pure DEP *but not* to pure AAB or co-occurring AAB-DEP (see Figure 1). Covariates of race-ethnicity and FHD were chosen because each is related to effortful control, impulsivity, AAB, and/or DEP. AAB and DEP composites assessed at 11–17 years were covariates in each model to assess the prospective relation between temperament at 5–10 years and AAB and DEP factors at 12–18 years. Covariates not significantly related to the outcome factor were trimmed, with the exception of DEP and AAB assessed at 11–17 years, which were always retained to control for earlier levels of symptoms.

Mean-centered predictor variables were gender, age, and the multiple-reporter multiple-methods factor scores for effortful control and impulsivity (which were manifest variables because they were factor scores that were saved from the original latent factors in Mplus). A quadratic impulsivity term (i.e., impulsivity multiplied by itself) was also entered to test whether its effects on outcomes were non-linear. Other predictors were the cross-product of the effortful control and impulsivity scores and all possible two- and three-way cross-products of effortful control and impulsivity with age or gender. We did not test interactions between age and gender. These effects tested the hypothesized effortful control by impulsivity interaction and whether this interaction differed by age or gender. Correlations among all predictors and covariates were estimated. Interactions with continuous moderators were probed by computing simple slopes at 1 *SD* below, above, and at the mean of impulsivity, and 1 *SD* below and above the mean of age (Aiken & West, 1991). Three way interactions were probed by computing simple slopes at various combinations of the two moderators (e.g., simple slope of effortful control at 1 *SD* below the means of age and impulsivity). The complex function in Mplus adjusted *SEs* for non-independence of observations because participants were nested in families.

Results

Zero-Order Relations Among Predictors

Table 3 presents correlations, t-tests, and chi-square analyses showing zero-order relations among predictors. Correlations with outcome variables were not included to reduce complexity as there are 34 indicators of the bifactor model (see Table 2). Consistent with predictions, older adolescents and females showed higher effortful control and lower

impulsivity. Higher levels of FHD and 11–17 year olds' (baseline) AAB were significantly correlated with lower effortful control and higher impulsivity. Higher baseline DEP was significantly correlated with lower effortful control but not correlated with impulsivity. Correlations support hypotheses that DEP and AAB are both associated with low effortful control. There was a moderate, significant correlation between baseline DEP and AAB and a high correlation between effortful control and impulsivity. Because the correlation between the effortful control and impulsivity scores creates concerns with multicollinearity, we calculated the variance inflation factor (VIF) for each predictor in the model. VIFs exceeding 7 were considered to be indicative of multicollinearity (Neter, Wasserman, & Kutner, 1989). VIFs ranged from 1.04–2.58, suggesting that multicollinearity was not a concern (also see Additional Analyses below).

Bifactor Model of AAB and DEP

Three items were excluded due to an empty cell in their bivariate table as indicated by Mplus (steals outside home, destroys property, argues). Because empty cells imply a correlation of 1 between two items, it is recommended that only one of the two variables be used in the analysis. Two loadings on the pure AAB factor had significance values > 0.10 (destroys own things, runs away from home) and were removed from that factor only. The final model fit the data well: $\chi^2(495) = 574.13, p = 0.01$, RMSEA = 0.02, CFI = 0.98, WRMR = 0.90. See Table 2.

Structural Equation Models

See Figure 1 for results. First, main linear effects of effortful control and linear and quadratic effects of impulsivity were estimated. Next, interaction effects were included. Race-ethnicity, the quadratic impulsivity term, and the two- and three-way interactions between effortful control, impulsivity, and gender did not significantly predict any of the outcome factors and were trimmed from all models. Age, its two- and three-way interactions with effortful control and impulsivity, and FHD did not predict pure DEP and these terms were trimmed from this model. For interactions, simple slopes probed at 1 *SD* above the mean of age are henceforth referred to as effects for “older adolescents” and simple slopes probed at 1 *SD* below the mean of age are referred to as effects for “younger adolescents” for ease of interpretation. Simple slopes probed at 1 *SD* below the mean, at mean levels, and at 1 *SD* above the mean of impulsivity are referred to as effects at “low,” “mean,” and “high” impulsivity, respectively. Unstandardized coefficients are reported for these simple slopes.

Predictors of the pure AAB factor—Higher baseline AAB, higher FHD, and older age significantly predicted higher pure AAB. Lower effortful control significantly predicted pure AAB ($\beta = -0.24, p = 0.002$) but impulsivity did not ($\beta = -0.12, ns$). The three-way interaction among effortful control, impulsivity, and age was significant. For older adolescents, low effortful control significantly predicted higher pure AAB for those at high ($B = -0.52, p = 0.001$) and mean ($B = -0.35, p = 0.01$) levels of impulsivity, but not for those at low levels of impulsivity ($B = -0.17, ns$). For younger adolescents, effortful control did not significantly predict pure AAB at any level of impulsivity (B s from -0.13 to $-0.16, ns$; see Figure 2).

Predictors of the co-occurring AAB-DEP factor—Higher baseline AAB and DEP, higher FHD, and older age predicted higher co-occurring AAB-DEP. Low effortful control ($\beta = -0.26, p < 0.001$) and low impulsivity ($\beta = -0.16, p = 0.01$) significantly predicted higher co-occurring AAB-DEP. Effortful control, impulsivity, and age interacted to predict co-occurring AAB-DEP. For older adolescents, low effortful control significantly predicted higher co-occurring AAB-DEP at high ($B = -0.50, p < 0.001$) and mean ($B = -0.36, p = 0.003$) levels of impulsivity, but only marginally at low levels of impulsivity ($B = -0.22, p = 0.08$). Note that the effect of effortful control on co-occurring AAB-DEP got progressively stronger from low to high levels of impulsivity. For younger adolescents, low effortful control marginally or significantly predicted co-occurring AAB-DEP at low ($B = -0.23, p = 0.07$), mean ($B = -0.21, p = 0.04$), and high levels of impulsivity ($B = -0.20, p = 0.08$), with the effect of effortful control remaining relatively constant across all three levels of impulsivity (see Figure 2).

Predictors of the pure DEP factor—Those with higher baseline DEP and females had significantly higher pure DEP. Low effortful control and low impulsivity predicted higher pure DEP. No interactions were significant.

Additional analyses: interactions between effortful control and impulsivity in single reporter models—Because of the high correlation between the effortful control and impulsivity factor scores, we re-estimated the models using mother-, teacher-, and father-reported temperament as predictors in separate models (rather than the multiple reporter factor scores for effortful control and impulsivity). For these single reporter models ($N = 474$), the correlations between effortful control and impulsivity were lower ($r = -0.43, r = -0.45$, and $r = -0.43$ for mother, teacher, and father reports, respectively). Interactions between effortful control and impulsivity in these models largely replicated the multiple-reporter models reported above.

Interaction results using mother-reported effortful control and impulsivity exactly replicated those from the main models except that, for younger adolescents, the marginal effect of low effortful control on co-occurring AAB-DEP at high levels of impulsivity became non-significant. Also, for older adolescents, the marginal effect of low effortful control on co-occurring AAB-DEP at low levels of impulsivity became significant, but was still smaller in magnitude than the effect of effortful control on co-occurring AAB-DEP at mean and high levels of impulsivity. Interaction results using teacher-reported effortful control and impulsivity exactly replicated those from the main models except that, for older adolescents, low effortful control only significantly predicted pure AAB at high levels of impulsivity and not *also* at mean levels of impulsivity as found in the main models. Unlike in the main models, for younger adolescents, effortful control did significantly predict pure AAB at high levels of impulsivity, and did not predict co-occurring AAB-DEP at any level of impulsivity.

Interaction results using father-reported effortful control and impulsivity somewhat replicated findings for pure AAB from the main models. However, the interaction between effortful control and impulsivity was moderated by gender, rather than by age. Specifically, low effortful control only predicted pure AAB at high levels of impulsivity for boys, not for girls. Finally, unlike the main models, there was a significant interaction among effortful

control, impulsivity and age in predicting pure DEP. For older adolescents, low effortful control predicted pure DEP only at low levels of impulsivity. For younger adolescents, low effortful control predicted pure DEP only at high levels of impulsivity. Taken together, these findings from single reporter models largely replicate the interactions found in the multiple-reporter models and suggest that the high correlation between effortful control and impulsivity did not impact those results. These results also provide greater confidence in the interpretation of these interactions (further details of single reporter models are available from the first author).

Discussion

The primary goal of the current study was to test the prediction that low effortful control is a common risk factor for AAB and DEP, but that what differentiates AAB and DEP outcomes are individual differences in impulsivity (i.e., impulsivity moderates the effects of effortful control on these outcomes). Furthermore, we tested whether the interaction between effortful control and impulsivity differed by age and gender, given age-related changes in effortful control and empirically observed gender differences (Rudolph et al., 2013). We extended existing literature by testing these hypotheses with outcomes of pure AAB, pure DEP, and co-occurring AAB-DEP, given the high co-occurrence between the two in adolescence (Zoccolillo, 1992). Thus, to characterize this co-occurrence we tested a bifactor model of AAB and DEP to yield error-free, continuous factors of pure AAB, pure DEP, and co-occurring AAB-DEP. In addition to testing these main hypotheses of interest, we also evaluated the fit of competing factor models to ensure that effortful control and impulsivity were empirically distinct constructs. To understand the unique influence of each temperamental characteristic, we examined linear main effects of effortful control and linear and quadratic main effects of impulsivity on all outcomes.

We extended previous literature by using a longitudinal study that oversampled children who were at high-risk for substance use. The pathways of interest may be more clearly explicated in such a sample because greater genetic and environmental vulnerabilities of high-risk children will likely create greater overall variability in problem behaviors and temperament. However, although we would expect elevated average levels of problem behaviors in children from high-risk compared to low-risk families, we had no hypotheses that the pathways of interest would operate differently for high- and low-risk individuals. Indeed, post-hoc analyses showed that none of the pathways of interest was moderated by family history density of substance use disorders (results available from first author).

Results showed that the bifactor model fit the data well. In addition to specific factors accounting for unique variance in pure AAB and DEP, a general factor accounted for the common variance among AAB and DEP behaviors. This suggests the utility of considering co-occurrence between AAB and DEP. The bifactor approach may be useful because it characterizes co-occurrence among behavior problems in an error-free and continuous manner. Two AAB items were deleted from the pure AAB factor because of non-significant loadings and, thus, might be unique to co-occurring AAB-DEP (runs away from home, destroys own things).

Results also indicated that the two-factor model of effortful control and impulsivity fit the data better than a one-factor model. These findings confirm and replicate previous theories and research which posited that, although effortful control and impulsivity share some conceptual overlap, they are distinct temperamental constructs (e.g., Eisenberg et al., 2013). Theoretically, effortful control is a more voluntary and flexible form of control, whereas impulsivity is a more automatic, reflexive, and relatively involuntary form of reactivity. Also, effortful control is a broader construct than impulsivity that consists of multiple dimensions, including attentional shifting and focusing. According to Rothbart's model of temperament, effortful control and impulsivity are likely correlated in our model *because* effortful control can be used to modulate and regulate behavioral expressions of impulsivity.

Main effect analyses showed that low effortful control predicted higher pure AAB, pure DEP and co-occurring AAB-DEP, over and above impulsivity and earlier levels of AAB and DEP. This suggests that deficient effortful control is a common precursor to all three problem behaviors. Results replicate previous literature showing that deficits in effortful control and related self-regulatory capacities predict higher AAB and DEP (Compas et al., 2004; Dennis & Brotman, 2003; Loukas & Roalson, 2006; Moriya & Tanno, 2008; Verstraeten et al., 2009). Children with low effortful control might be prone to developing AAB because they often have difficulty inhibiting inappropriate behaviors, willfully shifting their attention towards important tasks, and focusing attention when necessary. Similarly, children with low effortful control might be predisposed to DEP because they often have more difficulty shifting their attention away from negative thoughts and feelings and in activating their behavior. Results extend the literature by demonstrating that the longitudinal effect of low effortful control on AAB and DEP persists after accounting for co-occurrence and that low effortful control predicts co-occurring AAB-DEP.

Impulsivity did not have a unique linear or quadratic main effect on pure AAB over and above effortful control. This appears to suggest that neither high levels of impulsivity (e.g., linear) nor extremes of impulsivity (e.g., quadratic) are characteristic of those with pure AAB after controlling for effortful control. However, this main effect represents the effect of impulsivity averaged across all predictors, including age. Because research suggests that impulsivity does not uniquely predict externalizing problems over and above effortful control at older ages (Valiente et al., 2003), perhaps this lack of effect was driven by the older participants.

In contrast, low impulsivity had a unique linear (not quadratic) effect on higher pure DEP and co-occurring AAB-DEP. These effects held even after accounting for significant effects of effortful control and earlier behavior problems. This prospective relation replicates research suggesting that low impulsivity is related to high internalizing symptoms in children (Eisenberg et al., 2001, 2007, 2009). Individuals who are low in impulsivity might be at increased risk for depression because they are less motivated to approach potentially rewarding situations and might even have difficulty doing so due to inhibition (Henriques & Davidson, 2000). They might also have more difficulties rebounding from stress (Eisenberg et al., 2002). Interpreting main effects on their own might suggest that those with co-occurring AAB-DEP are also low in impulsivity and that those with pure AAB are not characterized by high impulsivity. However, interpretations of main effects must be

qualified because of three-way interactions found among effortful control, impulsivity, and age in predicting pure AAB and co-occurring AAB-DEP.

Specifically, for older participants, low childhood effortful control prospectively and significantly predicted adolescent pure AAB and co-occurring AAB-DEP only at average and high levels of impulsivity. Also, the effect of effortful control on pure AAB and co-occurring AAB-DEP was stronger for high than for average levels of impulsivity. This suggests that, for older participants, the combination of low effortful control and average-to-high impulsivity predicts change in these problem behaviors over an 18-month period. Conversely, for younger participants, the effect of low childhood effortful control on pure AAB and co-occurring AAB-DEP was similar across all levels of impulsivity (see Figure 2). Of note, separate reporter models using mother- and teacher-reported temperament largely replicated these three-way interaction effects, and models using father-reported temperament partially replicated these interaction effects. This suggests that the high correlation between effortful control and impulsivity factor scores did not appreciably impact results from our main analyses. Findings have implications for theories of effortful control and self-regulation (Carver et al., 2008), causes of AAB and DEP co-occurrence, and the role of effortful control across development. Each is discussed in turn.

Theories of Effortful Control and Self-Regulation

Our results support previous theories proposing that deficits in effortful control and self-regulation predict AAB, but only for those prone to approach- and reward-related behaviors (i.e., impulsivity; Carver et al., 2008; Eisenberg & Morris, 2002). Findings extend this literature by showing that the same pattern holds for co-occurring AAB-DEP and that this pattern might become more evident with age. Our findings reinforce the notion that the role of effortful control in AAB should be considered within the context of impulsivity. For individuals prone to reward- and approach-related behaviors, a lack of effortful control might result in the manifestation of these behaviors, such as theft, truancy, and physical aggression. Also, Nigg (2006) theorized that individuals high in surgency (the higher-order factor on which impulsivity loads) may be prone to anger because of the functional role that anger plays in overcoming obstacles when anticipating rewards. For those high in impulsivity and accordingly more prone to anger, a lack of effortful control may result in the inability to modulate their anger, a well-known precursor to AABs (Eisenberg et al., 2001). These are some of the processes that might increase risk for AAB (pure and co-occurring with DEP).

We did not find evidence that low effortful control predicted pure DEP only for those low in impulsivity, nor did we find that age or gender moderated this interaction. One explanation is that our measure of impulsivity might not have captured sufficient variability in *overcontrolled*, rigid, or constrained behavior. Although our measure had several items that tapped these types of behaviors (e.g., takes a long time approaching new situations; among the last to try out a new activity), perhaps there were not enough items or perhaps the items were not varied enough in content to detect differences in low impulsivity. A lack of items measuring low levels of impulsivity may also explain the lack of quadratic effects of impulsivity in the current data. Items to measure low impulsivity are likely important

because Rudolph et al. (2013) found that social *avoidance* (not approach) interacted with inhibitory control to predict DEP in girls. Measures that comprehensively tap both extremes of impulsivity might be used in future studies.

Gender did not moderate the interaction between effortful control and impulsivity as found in the study by Rudolph and colleagues (2013). It is possible that, in our sample, gender moderated the effortful control-by-impulsivity effect but *only for older participants*.

Rudolph et al., who found that the inhibitory control-by-social approach/avoidance interaction was moderated by gender, assessed temperament when participants were 9 years old. Because we found a significant interaction only between 8.5–10 year-olds' effortful control and impulsivity, perhaps gender moderation exists only for older participants. Our sample size did not allow a rigorous test of a four-way interaction, but future studies with larger samples might do so.

Understanding Causes of Co-occurrence

Our findings have implications for understanding causes of co-occurrence between AAB and DEP. Given that a very similar profile of temperament characteristics predicted pure AAB and co-occurring AAB-DEP (but that pure DEP and co-occurring AAB-DEP did *not* have a similar profile), co-occurring AAB-DEP might share the same or similar etiology as pure AAB. This finding is similar to others that found that pure AAB and co-occurring AAB-DEP share many of the same risk factors (Ezpeleta et al., 2005; Zoccolillo, 1992) and that both pure externalizing problems and co-occurring internalizing and externalizing problems were similarly predicted by low effortful control and high impulsivity (Eisenberg et al., 2001, 2009).

Because co-occurring AAB-DEP does not appear to share a similar etiology with pure DEP, the depressive symptoms present in co-occurring AAB-DEP might be a by-product of some other phenomenon. Perhaps for those with co-occurring problems, depressive symptoms are the result of AAB, referred to as the “failure model” (Patterson & Capaldi, 1990). This model posits that AAB may interfere with the development of critical academic and social skills, which leads to other failures, like peer rejection. These failure experiences might lead some youths with AAB to become depressed. Although we did not explicitly test this causal theory of AAB and DEP co-occurrence, our results are certainly consistent with this model.

Pure AAB and co-occurring AAB-DEP were predicted by mostly the same covariates, including baseline AAB, FHD, and older age. This provides further support for the conceptualization that co-occurring AAB-DEP and pure AAB share a similar etiology. That baseline DEP predicted co-occurring AAB-DEP, but not pure AAB, might be attributable to the stability of DEP in those with co-occurring AAB-DEP. In contrast, pure DEP had a different profile of demographic risk; those with higher baseline DEP and females were more at risk. It should be noted that the greater similarity between co-occurring AAB-DEP and pure AAB might also be explained in part by the fact that they both include observable behaviors, which might be more reliable and easier to measure than internal states such as DEP (Bem, 1972).

Moderation of Relations by Age

We found interesting age-related differences in the interactive prediction of adolescent pure AAB and co-occurring AAB-DEP from childhood effortful control and impulsivity. We found an interaction only for older participants, whose temperament and problem behaviors were assessed at 8.5–10 and 14–18 years of age, respectively. The fact that the *combination* of effortful control and impulsivity was important for predicting problem behaviors only for older participants may reflect theorized age-related differences in effortful control. Because effortful control increases with age (Murphy et al., 1999), it is likely that its *modulation* of reactive tendencies (like impulsivity) increases in effectiveness with age (Eisenberg et al., 2004). Alternatively, this finding might be due to the greater variability in problem behaviors during adolescence (see Loeber & Keenan, 1994).

Strengths and Limitations

The study has limitations to consider. First, our measure of impulsivity might not have tapped *low* impulsivity as comprehensively as needed. Second, we dichotomized each item of the bifactor model due to non-normality, potentially resulting in loss of information. Third, inclusion of observer ratings as an indicator of the effortful control factor but not of the impulsivity factor may have led to differential validity of the effortful control and impulsivity measures. Fourth, even though effortful control and impulsivity were statistically and conceptually distinct, the possibility remains that these two constructs were not fully distinguishable as measured in the current study. Indeed, questionnaire measures of effortful control and impulsivity might show less differentiation than other types of measures. Future studies might use other types of measures (e.g., behavioral measures, fMRI data) to more comprehensively tap unique aspects of these constructs (Eisenberg et al., 2013). It is important to note that, theoretically, effortful control is proposed to regulate reactive tendencies such as impulsivity, so effortful control and impulsivity are expected to be related (Valiente et al., 2003).

The study also has strengths providing confidence in findings. We used a multiple method and reporter approach to assess effortful control and impulsivity and used child reports of later problem behaviors so that results are likely not confounded by reporter bias. The longitudinal design allowed for prospective prediction. The high correlation between effortful control and impulsivity factor scores likely did not impact results because VIFs of predictors were not indicative of multicollinearity. Furthermore, very similar interaction effects were found using single-reporter models with mother- and teacher-reported temperament and partial replication was found using father-reported temperament. Because these single reporter models showed lower correlations between effortful control and impulsivity, this reduces concerns about the interpretability of the interactions between the highly correlated scores of effortful control and impulsivity from the main models. Regardless of the high correlation between effortful control and impulsivity as currently measured, they appear to provide unique information much like other highly correlated constructs such as anxiety and depression. Another strength of the study is the use of a bifactor model to characterize co-occurrence between AAB and DEP, which is more consistent with continuous conceptualizations of psychological problems and resulted in error-free factors. Moreover, a major contribution of this study was in examining

temperamental risk factors for AAB and DEP co-occurrence which, despite its high prevalence, is understudied.

In conclusion, the current results demonstrated that, for older adolescents, low effortful control significantly predicted pure AAB and co-occurring AAB-DEP only for individuals with average and high levels of impulsivity. Results suggest that co-occurring AAB-DEP and pure AAB share a similar etiology. Pure DEP was predicted by low effortful control and low impulsivity, but not the interaction between them. Thus, pure DEP appeared distinctly different from the other problem behaviors. Results highlight multiple pathways to adolescent pure DEP vs. pure AAB or co-occurring AAB-DEP. Children, despite starting out with similar vulnerabilities in effortful control, may manifest distinct adolescent outcomes as a result of individual differences in impulsivity.

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References

- Achenbach TM, Edelbrock CS. The classification of child psychopathology: A review and analysis of empirical efforts. *Psychological Bulletin*. 1978; 85:1275–1301. <http://dx.doi.org/10.1037/0033-2909.85.6.1275>. [PubMed: 366649]
- Achenbach, TM.; Rescorla, L. ASEBA School-Age Forms & Profiles. Burlington, VT: Aseba; 2001.
- Ahadi, SA.; Rothbart, MK. Temperament, development and the big five. In: Halverson, CF.; Kohnstamm, GA.; Martin, RP., editors. *The developing structure of temperament and personality from infancy to adulthood*. Hillsdale, NJ: Lawrence Erlbaum Associates; 1994. p. 189-207.
- Aiken, LS.; West, SG. *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage; 1991.
- Bem DJ. Self-perception theory. *Advances in Experimental Social Psychology*. 1972; 6:1–62.
- Caron C, Rutter M. Comorbidity in child psychopathology: Concepts, issues and research strategies. *Journal of Child Psychology and Psychiatry*. 1991; 32:1063–1080. [10.1111/j.1469-7610.1991.tb00350.x](http://dx.doi.org/10.1111/j.1469-7610.1991.tb00350.x) [PubMed: 1787137]
- Carver CS, Johnson SL, Joormann J. Serotonergic function, two-mode models of self-regulation, and vulnerability to depression: what depression has in common with impulsive aggression. *Psychological Bulletin*. 2008; 134:912–943. <http://dx.doi.org/10.1037/a0013740>. [PubMed: 18954161]
- Chassin L, Barrera M, Bech K, Kossak-Fuller J. Recruiting a community sample of adolescent children of alcoholics: A comparison of three subject sources. *Journal of Studies on Alcohol*. 1992; 53:316–319. [PubMed: 1619925]
- Cicchetti D, Rogosch FA. A developmental psychopathology perspective on adolescence. *Journal of Consulting and Clinical Psychology*. 2002; 70:6–20. <http://dx.doi.org/10.1037/0022-006X.70.1.6>. [PubMed: 11860057]
- Compas BE, Connor-Smith J, Jaser SS. Temperament, stress reactivity, and coping: Implications for depression in childhood and adolescence. *Journal of Clinical Child and Adolescent Psychology*. 2004; 33:21–31. [10.1207/S15374424JCCP3301_3](http://dx.doi.org/10.1207/S15374424JCCP3301_3) [PubMed: 15028538]
- Dennis TA, Brotman LM. Effortful control, attention, and aggressive behavior in preschoolers at risk for conduct problems. *Annals of the New York Academy of Sciences*. 2003; 1008:252–255. [10.1196/annals.1301.026](http://dx.doi.org/10.1196/annals.1301.026) [PubMed: 14998890]

- Eisenberg N, Cumberland A, Spinrad TL, Fabes RA, Shepard SA, Reiser M, Guthrie IK. The relations of regulation and emotionality to children's externalizing and internalizing problem behavior. *Child Development*. 2001; 72:1112–1134. [10.1111/1467-8624.00337](https://doi.org/10.1111/1467-8624.00337) [PubMed: 11480937]
- Eisenberg N, Edwards A, Spinrad TL, Sallquist J, Eggum ND, Reiser M. Are effortful and reactive control unique constructs in young children? *Developmental Psychology*. 2013; 49:2082–2094. <http://dx.doi.org/10.1037/a0031745>. [PubMed: 23398553]
- Eisenberg N, Ma Y, Chang L, Zhou Q, West SG, Aiken L, Zhou H. Relations of effortful control, reactive undercontrol, and anger to Chinese children's adjustment. *Development and Psychopathology*. 2007; 19:385–409. <http://dx.doi.org.ezproxy1.lib.asu.edu/10.1017/S0954579407070198>. [PubMed: 17459176]
- Eisenberg, N.; Morris, AS. Children's emotion-related regulation. In: Kail, R., editor. *Advances in child development and behavior*. Vol. 30. Academic Press; Amsterdam: 2002. p. 190-229.
- Eisenberg N, Spinrad TL, Fabes RA, Reiser M, Cumberland A, Shepard SA, Thompson M. The relations of effortful control and impulsivity to children's resiliency and adjustment. *Child Development*. 2004; 75:25–46. [10.1111/j.1467-8624.2004.00652.x](https://doi.org/10.1111/j.1467-8624.2004.00652.x) [PubMed: 15015673]
- Eisenberg N, Spinrad TL, Morris AS. Regulation, resiliency, and quality of social functioning. *Self and Identity*. 2002; 1:121–128. [10.1080/152988602317319294](https://doi.org/10.1080/152988602317319294)
- Eisenberg N, Valiente C, Spinrad TL, Cumberland A, Liew J, Reiser M, Losoya SH. Longitudinal relations of children's effortful control, impulsivity, and negative emotionality to their externalizing, internalizing, and co-occurring behavior problems. *Developmental Psychology*. 2009; 45:988–1008. <http://dx.doi.org/10.1037/a0016213>. [PubMed: 19586175]
- Endicott, J.; Andreasen, N.; Spitzer, RL. *Family History-Research Diagnostic Criteria*. New York, NY: Biometrics Research Division, New York State Psychiatric Institute; 1975.
- Ezpeleta L, Granero R, Doménech JM. Differential contextual factors of comorbid conduct and depressive disorders in Spanish children. *European Child & Adolescent Psychiatry*. 2005; 14:282–291. [10.1007/s00787-005-0476-5](https://doi.org/10.1007/s00787-005-0476-5) [PubMed: 15981141]
- Grills AE, Ollendick TH. Multiple informant agreement and the anxiety disorders interview schedule for parents and children. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2003; 42:30–40. <http://dx.doi.org/10.1097/00004583-200301000-00008>. [PubMed: 12500074]
- Henriques JB, Davidson RJ. Decreased responsiveness to reward in depression. *Cognition and Emotion*. 2000; 14:711–724. [10.1080/02699930050117684](https://doi.org/10.1080/02699930050117684)
- Holzinger KJ, Swineford F. The bi-factor method. *Psychometrika*. 1937; 2:41–54. <http://dx.doi.org/10.1007/BF02287965>.
- Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling: A Multidisciplinary Journal*. 1999; 6:1–55. [10.1080/10705519909540118](https://doi.org/10.1080/10705519909540118)
- Keiley MK, Lofthouse N, Bates JE, Dodge KA, Pettit GS. Differential risks of covarying and pure components in mother and teacher reports of externalizing and internalizing behavior across ages 5 to 14. *Journal of Abnormal Child Psychology*. 2003; 31:267–283. <http://dx.doi.org/10.1023/A:1023277413027>. [PubMed: 12774860]
- Loeber R, Keenan K. Interaction between conduct disorder and its comorbid conditions: Effects of age and gender. *Clinical Psychology Review*. 1994; 14:497–523. [http://dx.doi.org/10.1016/0272-7358\(94\)90015-9](http://dx.doi.org/10.1016/0272-7358(94)90015-9).
- Loukas A, Roalson LA. Family environment, effortful control, and adjustment among European American and Latino early adolescents. *The Journal of Early Adolescence*. 2006; 26:432–455. <http://dx.doi.org/10.1177/0272431606291939>.
- Moriya J, Tanno Y. Relationships between negative emotionality and attentional control in effortful control. *Personality and Individual Differences*. 2008; 44:1348–1355. <http://dx.doi.org/10.1016/j.paid.2007.12.003>.
- Murphy BC, Eisenberg N, Fabes RA, Shepard S, Guthrie IK. Consistency and change in children's emotionality and regulation: A longitudinal study. *Merrill-Palmer Quarterly*. 1999; 45:413–444.
- Muthén, LK.; Muthén, BO. *MPlus user's guide*. 7. Los Angeles, CA: Muthén & Muthén; 1998–2013.
- Neter, J.; Wasserman, W.; Kutner, MH. *Applied linear regression models*. 2. Homewood, IL: Irwin; 1989.

- Nigg JT. Temperament and developmental psychopathology. *Journal of Child Psychology and Psychiatry*. 2006; 47:395–422. <http://dx.doi.org/10.1111/j.1469-7610.2006.01612.x>. [PubMed: 16492265]
- Patterson, GR.; Capaldi, DM. A mediational model for boys' depressed mood. In: Rolf, JE.; Masten, AS.; Cicchetti, D.; Nuechterlein, KH.; Weintraub, S., editors. *Risk and protective factors in the development of psychopathology*. New York: Cambridge University Press; 1990. p. 141-163.
- Reise SP. The rediscovery of bifactor measurement models. *Multivariate Behavioral Research*. 2012; 47:667–696.10.1080/00273171.2012.715555 [PubMed: 24049214]
- Robins, LN.; Cottler, LB.; Bucholz, KK.; Compton, WM.; North, CS.; Rourke, KM. *Diagnostic Interview Schedule for the DSM-IV (DIS-IV)*. St. Louis, MO: Washington University; 2000.
- Rothbart MK, Ahadi SA, Hershey K, Fisher P. Investigations of temperament at three to seven years: The children's behavior questionnaire. *Child Development*. 2001; 72:1287–1604.10.1111/1467-8624.00355 [PubMed: 11699671]
- Rothbart, MK.; Bates, JE. Temperament. In: Damon, W.; Eisenberg, N., editors. *Handbook of child psychology*. Vol. 3. Social, emotional, personality development. New York: Wiley; 2006. p. 99-166.
- Rothbart, MK.; Derryberry, D. Development of individual differences in temperament. In: Lamb, ME.; Brown, AL., editors. *Advances in developmental psychology*. Vol. 1. Hillsdale, NJ: Erlbaum; 1981. p. 37-86.
- Rudolph KD, Troop-Gordon W, Llewellyn N. Interactive contributions of self-regulation deficits and social motivation to psychopathology: Unraveling divergent pathways to aggressive behavior and depressive symptoms. *Development and Psychopathology*. 2013; 25:407–418.10.1017/S0954579412001149 [PubMed: 23627953]
- Simic M, Fombonne E. Depressive conduct disorder: symptom patterns and correlates in referred children and adolescents. *Journal of Affective Disorders*. 2001; 62:175–185.10.1016/S0165-0327(99)00201-3 [PubMed: 11223105]
- Stoltenberg SF, Mudd SA, Blow FC, Hill EM. Evaluating measures of family history of alcoholism: density versus dichotomy. *Addiction*. 1998; 93:1511–1520.10.1046/j.1360-0443.1998.931015117.x [PubMed: 9926555]
- Valiente C, Eisenberg N, Smith CL, Reiser M, Fabes RA, Losoya S, Murphy BC. The relations of effortful control and reactive control to children's externalizing problems: A longitudinal assessment. *Journal of Personality*. 2003; 71:1171–1196.10.1111/1467-6494.7106011 [PubMed: 14633062]
- Verstraeten K, Vasey MW, Raes F, Bijttebier P. Temperament and risk for depressive symptoms in adolescence: Mediation by rumination and moderation by effortful control. *Journal of Abnormal Child Psychology*. 2009; 37:349–361.10.1007/s10802-008-9293-x [PubMed: 19107592]
- Widiger TA, Samuel DB. Diagnostic categories or dimensions? A question for the Diagnostic and statistical manual of mental disorders—fifth edition. *Journal of Abnormal Psychology*. 2005; 114:494–504. <http://dx.doi.org/10.1037/0021-843X.114.4.494>. [PubMed: 16351373]
- Zhou Q, Chen SH, Main A. Commonalities and differences in the research on Children's effortful control and executive function: a call for an integrated model of self-regulation. *Child Development Perspectives*. 2012; 6:112–121.10.1111/j.1750-8606.2011.00176.x
- Zoccolillo M. Co-occurrence of conduct disorder and its adult outcomes with depressive and anxiety-disorders: a review. *Journal of the American Academy of Child & Adolescent Psychiatry*. 1992; 31:547–556. <http://dx.doi.org/10.1097/00004583-199205000-00024>. [PubMed: 1592790]
- Zucker RA, Ellis DA, Fitzgerald HE. Developmental evidence for at least two alcoholisms. *Annals of the New York Academy of Sciences*. 1994; 708:134–146.10.1111/j.1749-6632.1994.tb24706.x [PubMed: 8154674]

Figure 1.

Standardized Path Coefficients for Final Models. ** $p < 0.001$, * $p < 0.05$. $N = 474$. Latent outcome factors estimated in all three models, but paths from predictors to latent factors estimated to only one factor at a time. Non-significant covariates and interaction coefficients were trimmed from final models (with the exception of T2 AAB and DEP). Bolded/Dashed lines=statistically significant/non-significant. Standard errors in parentheses. FHD: Family history density of substance use disorder. AAB: Aggressive-Antisocial Behaviors. DEP: Depressive Symptoms. EC: Effortful Control. IMP: Impulsivity. T1: 5–10 years old. T2: 11–17 years old. T3: 12–18 years old. Gender: 0=Female, 1=Male. All other variables, higher levels of construct coded as higher values. Factors are orthogonal.

Figure 2.

(a) predicting *older* (1 *SD* + mean of age) adolescent pure antisocial-aggressive behaviors (AAB) from effortful control at differing levels of impulsivity. (b) predicting *younger* (1 *SD* - mean of age) adolescent pure AAB from effortful control at differing levels of impulsivity. (c) predicting *older* adolescent co-occurring antisocial-aggressive and depressive symptoms (AAB-DEP) from effortful control at differing levels of impulsivity. (d) predicting *younger* adolescent co-occurring AAB-DEP from effortful control at differing levels of impulsivity. Individual shapes are estimated data points. Lines reflect the regions in which individuals with specific combinations of effortful control and impulsivity were actually found.

Table 1
Descriptive Statistics, t-tests, and χ^2 Analyses Comparing Included and Excluded Participants

Included			Excluded		
Variables	N	M(SD)	N	M(SD)	t
T1 age	353	6.72(1.63)	121	9.26(3.02)	8.80**
T2 age	474	12.62(1.63)	135	12.76(2.62)	0.62
T3 age	474	13.94(1.69)	106	15.55(4.55)	3.60**
FHD ^a substance use disorder	465	0.60(0.51)	288	0.49(0.47)	-2.97*
T2 Antisocial-aggressive behaviors	474	0.18(0.17)	135	0.19(0.20)	0.15
T2 Depressive symptoms	474	0.20(0.22)	135	0.22(0.22)	0.86
T1 Effortful control factor score	351	-0.02(0.46)	119	0.06(0.49)	1.59
T1 Impulsivity factor score	351	0.023(0.40)	119	-0.07(0.42)	-2.09*
N					χ ²
Gender	474	51.5% Male	135	58.5% Male	2.09
Race-ethnicity	59.2% non-Hispanic Caucasian		56.3% non-Hispanic Caucasian		0.36
	27.9% Hispanic		37.0% Hispanic		
	0.2% Asian/Pacific Islander		0% Asian/Pacific Islander		
	1.7% American Indian		0.7% American Indian		
	1.3% African American		1.5% African American		
Biological Parent Substance Use Disorder	9.7% some "other" race-ethnicity		4.4% some "other" race-ethnicity		13.82**
	470	58.5% biological parent substance use disorder	291	44.7% biological parent substance use disorder	

Note.

 $p < 0.001$,

*
 $p < 0.05$.

^aFamily History Density.

T1: 5–10 years old. T2: 11–17 years old. T3: 12–18 years old.

Table 2

Standardized Factor Loadings of Final Bifactor Model

Item	Co-occurring AAB-DEP	Pure DEP	Pure AAB	%Endorsement ^a
Enjoys little	0.59(0.08) **	0.19(0.08) *	--	7.6%
Rather be alone	0.26(0.09) *	0.51(0.10) **	--	18.1%
Won't talk	0.56(0.11) **	0.57(0.10) **	--	5.5%
Secretive	0.50(0.05) **	0.43(0.08) **	--	30.7%
Shy/timid	0.15(0.09)	0.88(0.08) **	--	29.5%
Lacks energy	0.49(0.09) **	0.51(0.08) **	--	12.3%
Sad	0.55(0.08) **	0.54(0.08) **	--	11.2%
Withdrawn	0.71 (0.07) **	0.52(0.08) **	--	12.3%
Lacks guilt	0.20(0.09) *	--	0.49(0.08) **	21.2%
Breaks rules	0.52(0.07) **	--	0.67(0.06) **	23.5%
Bad friends	0.48(0.08) **	--	0.61(0.07) **	27.8%
Lies/cheats	0.75(0.05) **	--	0.59(0.08) **	14.6%
Swears	0.55(0.07) **	--	0.56(0.07) **	30.0%
Prefers older kids	0.40(0.09) **	--	0.42(0.09) **	23.3%
Steals at home	0.77(0.06) **	--	0.46(0.17) *	2.1%
Cruel to others	0.67(0.07) **	--	0.40(0.09) **	15.3%
Threatens	0.60(0.11) **	--	0.33(0.11) *	4.0%
Gets into fights	0.43(0.15) *	--	0.53(0.13) **	5.1%
Attacks	0.59(0.13) **	--	0.56(0.16) **	2.5%
Thinks of sex too much	0.44(0.12) **	--	0.49(0.10) **	6.3%
Demands attention	0.42(0.08) **	--	0.24(0.08) **	19.5%
Sets Fires	0.69(0.09) **	--	0.40(0.12) **	3.4%
Truant	0.46(0.10) **	--	0.53(0.09) **	6.6%
Disobedient at home	0.50(0.08) **	--	0.63(0.07) **	22.2%
Disobedient at school	0.38(0.11) **	--	0.40(0.09) **	14.0%
Screams a lot	0.63(0.08) **	--	0.85(0.07) **	8.0%
Stubborn/sullen	0.63(0.06) **	--	0.37(0.08) **	34.2%
Mood changes	0.79(0.07) **	--	0.17(0.10) **	25.7%
Suspicious	0.69(0.06) **	--	0.26(0.08) **	17.1%
Teases a lot	0.46(0.07) **	--	0.46(0.08) **	19.2%
Temper	0.62(0.08) **	--	0.43(0.09) **	21.5%
Loud	0.34(0.08) **	--	0.57(0.07) **	24.4%
Destroys own things	0.78(0.07) **	--	--	5.5%

Item	Co-occurring AAB-DEP	Pure DEP	Pure AAB	%Endorsement ^a
Runs away	0.78(0.09) ^{**}	--	--	2.1%

Note.

^{**} $p < .001$,

^{*} $p < .05$,

$p > 0.10$.

$N = 474$. Parameters in parentheses are standard errors.

^a % Adolescents who endorsed occurrence of the behavior in past three months as 'somewhat true' or 'very true/often true'.

AAB: Aggressive-Antisocial Behaviors. DEP: Depressive Symptoms.

Table 3
Zero-order Correlations, t-tests and Chi-Square Analyses Testing Relations Among Manifest Variables

	Gender	Age	Race-ethnicity	FHD	T2 DEP	T2 AAB	T1 Effortful control	T1 Impulsivity
Gender	--							
Age	0.22	1.0						
Race-ethnicity	1.04	0.28	--					
FHD	0.16	0.003	-1.90	1.0				
T2 DEP	0.49	0.003	-0.75	0.07	1.0			
T2 AAB	-0.56	0.21**	0.86	0.09	0.44**	1.0		
T1 Effortful control	3.59**	0.26**	-1.51	-0.14**	-0.16**	-0.19**	1.0	
T1 Impulsivity	-2.09*	-0.25**	0.20	0.14**	0.07	0.15**	-0.72**	1.0

Note.

*** $p < 0.001$,

* $p < 0.05$.

t-tests conducted for associations between gender and race-ethnicity with all other continuous study variables. Chi-square analysis conducted for association between gender and race-ethnicity. Zero-order correlations conducted for associations between all other variables.

FHD: Family History Density of Substance Use Disorder. AAB: Aggressive-Antisocial Behaviors. DEP: Depressive Symptoms. Gender: 0=Female, 1=Male. Race-ethnicity: 0=Non-Hispanic Caucasian, 1=All other Race-ethnicities. For all other variables, higher levels of the given construct are coded as higher values. T1: 5–10 years old. T2: 11–17 years old.