



# Predictive Validity of Adolescent Callous-Unemotional Traits and Conduct Problems with Respect to Adult Outcomes: High- and Low-Risk Samples

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## Abstract

Current understanding of the predictive validity of callous-unemotional (CU) traits is limited by (a) the focus on externalizing psychopathology and antisocial behaviors, (b) a lack of long-term prospective longitudinal data, (c) samples comprised of high-risk *or* low-risk individuals. We tested whether adolescent CU traits and conduct problems were associated with theoretically relevant adult outcomes 12–18 years later. Participants were drawn from two studies: higher-risk Fast Track (FT;  $n = 754$ ) and lower-risk Child Development Project (CDP;  $n = 585$ ). FT: conduct problems positively predicted externalizing and internalizing psychopathology and partner violence, and negatively predicted health, wellbeing, and education. Three conduct problems  $\times$  CU traits interaction effects were also found. CDP: CU traits positively predicted depression and negatively predicted health and education; conduct problems positively predicted externalizing and internalizing psychopathology and substance use, and negatively predicted wellbeing. CU traits did not provide incremental predictive validity for multiple adult outcomes relative to conduct problems.

**Keywords** Callous-unemotional traits · Conduct problems · Adolescence · Adulthood · Longitudinal

## Introduction

Callous-unemotional (CU) traits are useful for understanding childhood conduct problems. Conduct problems encompass a wide range of behaviors such as aggression, destructiveness, and stealing [1]. CU traits, sometimes

associated with conduct problems, comprise deficient or dysfunctional affect, a callous lack of empathy, and reduced affiliative capacity [2]. Research has shown that individuals with elevated scores on measures of CU traits (compared to individuals without CU traits) are distinct across a range of temperamental, cognitive, emotional, and biological factors. For example, children and adolescents with elevated levels of CU traits show lower levels of fear [3], poorer emotion recognition [4–6], and reduced autonomic reactions to threat such as fear-potentiated startle [7, 8] and amygdala activation while processing facial expressions [9, 10] or vocal fear cues [11]. These impairments may be important distinguishing factors in forecasting the development and maintenance of antisocial behavior [12, 13]. Indeed, extensive evidence has linked the presence of nonnormative levels of CU traits to severe and persistent antisocial behavior [2]. For example, with a subsample of the present study, adolescent CU traits predicted delinquency, arrests, and antisocial personality disorder (ASPD) 2 years post-high school, while controlling for conduct disorder, oppositional defiant disorder, and attention-deficit/hyperactivity disorder (ADHD) symptoms [14]. Based on these and other findings, CU traits have been

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suggested to characterize an etiologically and clinically distinct group of antisocial individuals [2]. Although the predictive validity of CU traits with respect to antisocial behavior outcomes is relatively well-studied, implications of CU traits for other theoretically meaningful outcomes such as internalizing psychopathology, substance use, and indicators of health, wellbeing, and education are currently unclear. Long-term follow up of children and adolescents displaying CU traits is important for understanding developmental course and prognosis and for identifying specific intervention targets for this distinct subgroup. Further, research on CU traits is also limited by study samples of high-risk (e.g., oversampling for conduct problems, justice-involved) *or* low-risk (e.g., community recruited) participants, and findings may not generalize across diverse samples characterized as higher- and lower-risk. The importance of replication and generalizability in developmental science have been emphasized in recent calls by the scientific community [15, 16].

### CU Traits & Externalizing Psychopathology

Extensive research has established a link between the presentation of CU traits and other common childhood externalizing psychiatric diagnoses, including conduct disorder, oppositional defiant disorder, and ADHD, or other clinically relevant dimensions (e.g., aggressive behavior) (for reviews see [2, 17]). Indeed, the fifth revision of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5; [18]) added a specifier to the conduct disorder diagnostic criteria asking whether the individual also displays limited prosocial emotions. However, less research has examined whether CU traits predict specific externalizing disorders in adulthood. Although some evidence has found that CU traits are associated with ASPD in high-risk samples [19], there are few studies examining this relation perhaps, in part, because CU traits are generally measured in childhood and adolescence and ASPD is subsumed under adult diagnoses. In general, there is a lack of longitudinal CU research connecting the child/adolescent and adult developmental periods; an important limitation we discuss further below. There is some evidence to suggest that childhood CU traits may be positively associated with ADHD in low-risk and clinical samples, although studies have been cross-sectional or follow-ups have been brief [20, 21] and it is unclear whether CU traits predicts ADHD in adulthood across diverse samples.

### CU Traits & Substance Use

Research examining associations between CU traits and substance use or misuse is mixed and has predominantly comprised high-risk samples. Some research has found that CU traits are associated with broadly defined substance use in high-risk and justice-involved samples but only in

the presence of co-occurring conduct problems [22, 23], whereas other research has found that only in the absence of conduct disorder symptoms were adolescent CU traits associated with substance use 2 years post-high school in a high-risk sample [24]. Further, little research has examined whether CU traits are associated with distinct forms of substance use. CU traits are theorized to characterize a subgroup who engage in sensation-seeking behaviors [8, 25, 26], and thus, CU traits may be more strongly associated with substances with less social acceptance (i.e., illicit substances vs. decriminalized/legal substances).

### CU Traits & Internalizing Psychopathology

The relation between CU traits and internalizing psychopathology is complex. CU traits are commonly conceptualized as being underpinned by an absence of negative emotionality. Indeed, many studies have found a negative association between CU traits and broad internalizing psychopathology, anxiety, or depression symptoms [2, 17]. However, emerging evidence suggests that the link between CU traits and internalizing symptoms may be dependent on the specific manifestation of CU traits. Some researchers have identified a secondary etiological pathway to CU traits theorized to develop through an adaptive process in response to experiences of adversity (e.g., parental maltreatment; [27, 28]). In contrast to primary CU traits, which are thought to be underpinned by an affective deficit and a fearless temperament, individuals with secondary CU traits report high levels of negative emotionality [29–31]. However, the link between CU traits and internalizing psychopathology has predominantly focused on anxiety, and it is currently unclear whether CU traits predict later depression. One study found that increases in both CU traits and conduct disorder symptoms were associated with increases in anxiety and depression at 1-year intervals in a sample of low-risk community adolescents [32]. Examining internalizing psychopathology at both spectrum and categorical disorder levels may provide further clarity on this relation.

### CU Traits & Partner Violence

A key characteristic of CU traits is a difficulty to maintain close relationships or a tendency toward low affiliative reward [33, 34]. This reduced affiliative capacity may be explained by a dominant and aggressive interpersonal style [35], but it has also been conceptualized as a psychobiological construct underpinned by mesocorticolimbic brain regions related to social bonding [34]. Although extensive research has examined the link between the broader psychopathy construct (which also comprises interpersonal and impulsive-antisocial dimensions) and partner violence, very little research has tested the association between CU

traits and partner violence [19, 36]. One exemplar is a study conducted with a sample of undergraduate students ( $M_{\text{age}} = 22.93$ ; [36]). The authors found that even after controlling for antisocial behavior and delinquency, CU traits were associated with physical aggression toward a romantic partner. However, this study was cross-sectional and it is unknown whether CU traits in adolescence predict partner violence in adulthood across both high- and low-risk samples.

### CU Traits & Health, Wellbeing, & Education

Indicators of health and wellbeing are rarely examined in relation to CU traits. Although biological indices implicated in physical health (e.g., dysregulation of physiological systems, inflammatory markers) have been examined among individuals reporting high levels of CU traits [30, 37, 38], these may be more strongly associated with secondary CU traits and it is unclear whether broader indicators of health and wellbeing are negatively associated with CU traits in the same capacity as childhood conduct problems [39, 40]. Finally, a central feature of CU traits is a lack of concern with regard to school or work performance [2]. Several explanations have been proposed to account for this association, including an insensitivity to discipline [41], negative reciprocal teacher–child interactions [42], and emotional and cognitive deficits [43]. However, current understanding of CU traits and academic engagement is predominantly founded on cross-sectional or short-term longitudinal studies with lower-risk samples [44, 45].

### CU Traits vs. Conduct Problems

An ongoing debate in the field is whether CU traits in childhood and adolescence provide incremental predictive validity over and above child conduct problems. Etiological models of CU traits propose that in comparison to children with conduct problems-only, children with elevated levels of CU traits have a temperament characterized by fearlessness and deficient emotional responsiveness [2, 12]. It is this fearless temperament that may disrupt emotional and autonomic arousal in the face of distress or punishment, thereby hindering normative conscience (i.e., guilt and empathy) development and placing children at risk for aggressive and antisocial behavior [46–48]. However, not all children with a fearless temperament show deficits in emotional arousal, and thus, other theories of conscience development also consider environmental influences such as the role of parenting [49, 50]. Specifically, fearless children may be more likely to develop guilt and empathy when they experience a relationship of shared warmth and positive affect with their parent. By contrast, children with conduct problems-only are more commonly characterized by a defiant or difficult temperament. Patterson's theory suggests that parents negatively

reinforce coercive child behavior, in addition to parental harsh punishment being episodically used as a tool to control defiant behavior, which, in turn, socializes children to aggressive behavior perpetuating further aggressive tendencies [51]. These theories highlight how aggressive and antisocial behavior can develop among children with CU traits and conduct problems. However, very little research has examined the predictive validity of CU traits with respect to outcomes such as internalizing psychopathology, substance use, and indicators of health, wellbeing, and education.

CU traits may also moderate the association between childhood conduct problems and adult outcomes [52]. Whereas some children and adolescents with conduct problems also exhibit CU traits, many individuals with elevated levels of CU traits present with conduct problems, and some evidence has found CU traits in the absence of conduct problems [53–55]. Longitudinal studies have shown that childhood conduct problems predict later poor social, emotional, and cognitive outcomes that persist throughout the life-course [39, 56, 57]; however, these studies have not examined conduct problems in the context of CU traits. In addition, as highlighted in the previous paragraphs, the association of CU traits and several outcomes, including externalizing and internalizing psychopathology and substance use, can be dependent on the presence of conduct problems (e.g., [22, 23, 32]), pointing to a possible moderating role of CU traits. Thus, to accurately understand the developmental consequences of childhood CU traits, it is important to evaluate CU traits in the context of conduct problems.

### The Present Study

Current understanding of the predictive validity of CU traits is limited by (a) the focus on externalizing psychopathology and other antisocial behaviors; (b) a lack of long-term prospective longitudinal data; and (c) samples comprised of high-risk *or* low-risk individuals. Thus, we tested whether CU traits and conduct problems in adolescence were associated with a broad range of theoretically relevant outcomes 12–18 years later through emerging and established adulthood. We examined externalizing psychopathology and endorsement of clinical levels of ASPD and ADHD; internalizing psychopathology and endorsement of clinical levels of anxiety, depression, avoidant personality, and somatic problems; substance use including binge drinking, heavy cannabis use, and other substances; partner violence; and a range of health, wellbeing, and education indicators including a general health index, happiness, personal strength, and completion of high school and college [58]. It was hypothesized that CU traits would be associated with externalizing psychopathology and clinical levels of ASPD symptoms to a greater extent (as indicated by significance with a greater number of outcomes and/or greater effect sizes), relative

to conduct problems. Given the lack of research or mixed findings across our other domains, we did not have directional *a priori* hypotheses for internalizing psychopathology, substance use, and indicators of health, wellbeing, and education. We also explored whether CU traits moderated the association between conduct problems and adult outcomes. Finally, we tested whether findings generalize across diverse independent samples characterized as higher- and lower-risk populations. Participants were drawn from two longitudinal multisite studies: the higher-risk Fast Track project (FT; [59]) and the lower-risk Child Development Project (CDP; [60]).

## Method

### Participants and Procedure

Participants were drawn from two longitudinal studies. FT is a longitudinal, multisite (Durham, NC; Nashville, TN; Seattle, WA; and rural Pennsylvania) investigation of the development and prevention of child conduct problems [59]. In 1991–1993, 9,594 kindergarteners across three cohorts were screened for classroom conduct problems by teachers using the Teacher Observation of Classroom Adaptation-Revised [61], and a subset were screened for home behavior problems by parents using a 22-item instrument based on the Child Behavior Checklist (CBCL; [62]). Teacher and parent screening scores were standardized within site and summed to yield a total severity-of-risk screen score. Children were selected for inclusion into the high-risk sample based on this screen score, moving from the highest score downward until desired sample sizes were reached within sites, cohorts, and groups. This multi-stage screening procedure resulted in 891 children divided into control ( $n=446$ ) and intervention ( $n=445$ ) samples. In addition to the high-risk sample of 891, a stratified normative sample of 387 children was identified to represent the population normative range of risk scores and was followed over time. The present study used data from the high-risk control (65% male; 44% Black, 51% white, 5% other race/ethnicity) and normative (51% male; 42% Black, 51% white, 7% other race/ethnicity) samples; the intervention sample was not included in the present analyses. Seventy-nine of the participants recruited for the high-risk control group were included as part of the normative sample; thus, the total final sample included 754 participants.

CDP is an investigation of children's social development and adjustment [60]. In 1987 and 1988, a sample of children was identified at the time of kindergarten registration and then followed over time. Participants were recruited in each of two annual cohorts at each of three geographic sites (Nashville, TN; Knoxville, TN; and Bloomington, IN). Within each site, federally subsidized lunch rates and

neighborhood housing patterns were used to identify schools that served a full demographic range of the communities. Parents registering their children were approached at random by research staff and asked to participate in a longitudinal study of child development. About 75% agreed. Interested parents were then visited by research staff who explained the project in detail and obtained parents' informed consent. Overall, 585 children participated (52% male; 81% white, 17% Black, 2% other race/ethnicity).

At the time of recruitment, FT participants were rated as higher in conduct problems than CDP participants based on parent-reports (FT,  $M=14.89$ ,  $SD=8.69$ ; CDP,  $M=10.25$ ,  $SD=7.01$ ;  $t(1248)=9.98$ ,  $p<0.001$ ) on the CBCL externalizing broadband scale [62]. At the first adult time points considered in the present study (i.e., age 25 for FT and age 28 for CDP), both FT and CDP participants also nominated a peer (e.g., spouse, friend) for an independent interview, who was subsequently contacted by the research team. For both studies, parents or legal guardians provided initial consent and children assented to procedures. Participants were provided monetary compensation. All procedures were approved by the Institutional Review Boards of participating universities.

### Measures

The present study included data collected from the following periods: covariates in kindergarten, CU traits and conduct problems at age 13 for FT and 16 for CDP, and adult outcomes combined at ages 25 and 32 for FT and 28 and 34 for CDP.

### Covariates

Covariates included sex (FT, male = 58%; CDP, male = 52%), urban/race status (FT, urban Black = 45.5%, urban white = 24.5%, rural white = 25.5%; CDP, urban Black = 16.2%, urban white = 51.1%, rural white = 30.4%), socioeconomic status as measured by the Hollingshead Index (FT,  $M=25.66$ ;  $SD=12.90$ ; CDP,  $M=39.53$ ;  $SD=14.011$ ; [63]), and parent-reported problem behavior (outlined below). Urban/rural definitions were based on site at the beginning of each study, and thus, represent approximations. The urban/race status variable was created to account for the multisite sampling. Parents reported on the frequency of 10 child problem behaviors derived from the CBCL [62] and the Revised Behavior Problem Checklist [64]. Items include behaviors such as 'child breaks house rules', 'child has temper tantrums', 'child hits other children', and were scored on a 3-point scale (1 'never', 2.5 'a little', 4 'a lot'). Internal consistency was acceptable in the present study (FT,  $\alpha=0.74$ ; CDP,  $\alpha=0.72$ ).

## Adolescent Predictors

**Callous-Unemotional Traits** CU traits were measured with parent-report (for FT) and self-report (for CDP) on the Antisocial Process Screening Device [65, 66]. The Antisocial Process Screening Device is a 20-item measure that assesses CU traits, narcissism, and impulse control/conduct problems on a 3-point scale (0 ‘not at all true’, 1 ‘sometimes true’, 2 ‘definitely true’). Continuous mean scores of the 6-item CU traits subscale (e.g., ‘is concerned about the feelings of others,’ reverse scored) was used in the present study. Internal consistency was marginal to acceptable in the present study (FT,  $\alpha=0.66$ ,  $\omega=0.78$ ; CDP,  $\alpha=0.44$ ,  $\omega=0.55$ ).<sup>1</sup>

**Conduct Problems** Conduct problems were assessed using parent-report (for FT) on the CBCL [61] and self-report (for CDP) on the Youth Self-Report [67].<sup>2</sup> The present study used sum scores from the continuous externalizing broadband scale comprising items from the aggression and delinquency narrowband scales. Items are scored on a 3-point scale (0 ‘not true’, 1 ‘somewhat or sometimes true’, 2 ‘very or often true’). Internal consistency was good to excellent in the present study (FT,  $\alpha=0.93$ ,  $\omega=0.94$ ; CDP,  $\alpha=0.88$ ,  $\omega=0.91$ ).

Only 1 item from the Antisocial Process Screening Device [65] and CBCL [62] had content overlap, so we decided not to alter the original scales.<sup>3</sup>

## Adult Outcomes

**Psychopathology** Self- and peer-reports of internalizing and externalizing problems were assessed with the 132-item Adult Self-Report and Adult Behavior Checklist-Friend [68]. The continuous externalizing broadband scale is comprised of items from the delinquent and aggressive

behavior problem narrowband scales, and the continuous internalizing broadband scale is comprised of items from the anxious/depressed, withdrawn, and somatic problem narrowband scales. Items are scored on a 3-point scale (0 ‘not true’, 1 ‘somewhat or sometimes true’, 2 ‘very or often true’) and were summed. Internal consistency was excellent for the broadband externalizing (FT,  $\alpha=0.92$ , 0.95; CDP,  $\alpha=0.89$ , 0.93) and internalizing (FT,  $\alpha=0.94$ , 0.95; CDP,  $\alpha=0.94$ , 0.94) scales. These measures also assessed psychiatric symptoms for anxiety, depression, avoidant personality, somatic problems, ASPD, and ADHD. Indicators were dichotomously scored (1 ‘yes’, 0 ‘no’) using DSM-IV criteria. Across disorders, internal consistency was good in the present study (FT,  $\alpha=0.77$ -0.90, 0.78-0.87; CDP,  $\alpha=0.81$ -0.89, 0.79-0.87).<sup>4</sup>

**Substance Use** Self- and peer-reports of substance use were assessed with the 57-item Tobacco, Alcohol, and Drugs Survey-Version 3 adapted from the National Longitudinal Study of Adolescent Health [69]. The present study included three dichotomous indices: binge drinking (defined as 5 or more drinks on one or more occasion in the last month and 5 or more drinks on 12 or more occasions in the last year); heavy cannabis use (defined as 27 or more days of use in the past month); and other substance use (defined as use of cocaine, crack, inhalants, heroin, LSD, phencyclidine, ecstasy, mushrooms, speed, or other pills not prescribed by a physician in the past month).

**Partner Violence** Self- and peer-reports of partner violence were measured with the 47-item General Violence Questionnaire [70]. Violent acts (e.g., threatened with a knife or gun; pushed, shoved, grabbed, slapped, or threw something; beat up or choked, strangled, burned, or scalded on purpose) over the past 12 months perpetrated by participants toward partners were summed as a continuous score. Internal consistency was acceptable in the present study (FT,  $\alpha=0.75$ , 0.59; CDP,  $\alpha=0.81$ , 0.68).

**Health and Wellbeing** The 36-item Short-Form Health Survey [71] was used to create a general health index that comprised a mean continuous score across items capturing overall health status, presence of chronic conditions, magnitude of bodily pain, and presence of physical health issues

<sup>1</sup> In the present study, we used mean scores on the Antisocial Process Screening Device [64] to be consistent with other studies using these samples. However, most other research using this measure reports sum scores. When we convert our mean scores into sum scores, we find the following for each of our samples: FT:  $M=3.74$ ,  $SD=2.20$ ; CDP:  $M=2.99$ ,  $SD=1.75$ , which are consistent with other studies. For example, in a sample of community adolescents ( $M=13.40$  years), Muñoz and Frick [85] found similar sum scores to the CDP sample and lower than the FT sample across three time points approximately 1 year apart ( $M=2.41$ -2.70;  $SD=1.94$ -2.05). Comparably, in another sample of community adolescents (aged 12-14 years), Shaffer et al. [86] found similar self-reported sum scores ( $M=2.95$ ,  $SD=1.74$ ).

<sup>2</sup> Although CDP also has parent-report information for conduct problems, we elected to use self-report to align with our measure of CU traits (i.e., CDP only has self-report information for CU traits).

<sup>3</sup> Items with content overlap include Antisocial Process Screening Device [65] ‘feel bad when do something wrong’, reverse coded, for CU traits, and CBCL [62] ‘doesn’t feel guilty about misbehavior’ for conduct problems.

<sup>4</sup> We also repeated analyses with Adult Self-Report [68] continuous aggressive behavior, delinquency/rule-breaking, attention problems, anxious/depressed, withdrawn, and somatic complaints narrowband scales (see Supplementary Table S7). Without Bonferroni correction, for FT, CU traits did not predict any outcome and conduct problems predicted every outcome. For CDP, CU traits predicted aggressive behavior, attention problems, anxious/depressed, and withdrawn scores. Conduct problems predicted every outcome.

for self- and peer-report. Self- and peer-reports on the Adult Self-Report were also used to compute personal strength (e.g., ‘*lifting or carrying groceries*’) and happiness (e.g., ‘*have you been a happy person*’) continuous sum scores. Internal consistency was acceptable to good for these subscales (FT,  $\alpha=0.68$ – $0.88$ ,  $0.67$ – $0.86$ ; CDP,  $\alpha=0.74$ – $0.90$ ,  $0.44$ – $0.87$ ).

**Education** Two dichotomous scores indicating whether the participant (a) graduated from high school; and (b) completed a 4-year college degree or more were created from the National Longitudinal Survey [72].

## Analytic Approach

At the first adult time points (i.e., age 25 for FT and age 28 for CDP) both participants and peers reported; a self- and peer-reported mean was used for continuous, and if self- or peer-ratings indicated that participants met criteria a ‘1’ was allocated for dichotomous variables. In order to increase power and stability, we combined the last two time points from each study (i.e., age 25 and 32 for FT and 28 and 34 for CDP) such that we created mean scores for continuous variables, and participants who met criteria for either time point a ‘1’ was allocated for dichotomous variables.<sup>5</sup> Analyses were conducted using Mplus 8 [73] to examine whether adolescent CU traits and conduct problems were associated with distinct adult outcomes. Missing data were estimated using full-information maximum likelihood (FIML; [74]). Continuous variables were assessed with linear regression and standardized coefficients are reported, and dichotomous variables were assessed with binary logistic regression and odds ratios (*OR*) and confidence intervals are reported. CU

<sup>5</sup> We also repeated analyses with just the final time points, i.e., age 32 for FT and 34 for CDP. Without Bonferroni correction, many significant effects remained the same. For FT, CU traits negatively predicted high school graduation ( $OR=0.43$ ). There were no other significant effects for CU traits. Conduct problems positively predicted externalizing ( $\beta=0.22$ ) and internalizing ( $\beta=0.14$ ) psychopathology, as well as endorsement of clinical levels of ASPD ( $OR=1.38$ ), depression ( $OR=1.43$ ), and avoidant personality ( $OR=1.48$ ); and negatively predicted the general health index ( $\beta=-0.13$ ), happiness ( $\beta=-0.12$ ), high school graduation ( $OR=0.74$ ), and college completion ( $OR=0.45$ ). For CDP, CU traits positively predicted internalizing psychopathology ( $\beta=0.16$ ) and endorsement of clinical levels of depression ( $OR=5.80$ ), and negatively predicted happiness ( $\beta=-0.13$ ), strength ( $\beta=-0.12$ ) and college completion ( $OR=0.23$ ). Conduct problems positively predicted externalizing ( $\beta=0.42$ ) and internalizing ( $\beta=0.21$ ) psychopathology; endorsement of clinical levels of ASPD ( $OR=2.40$ ), ADHD ( $OR=3.18$ ), anxiety ( $OR=1.93$ ), depression ( $OR=1.79$ ), avoidant personality ( $OR=2.02$ ), binge drinking ( $OR=2.04$ ), and partner violence ( $\beta=0.17$ ). Conduct problems negatively predicted the general health index ( $\beta=-0.13$ ) and happiness ( $\beta=-0.20$ ).

traits and conduct problems were specified to covary, and predictors and outcomes were regressed onto covariates. To determine whether CU traits moderated the effect of conduct problems on adult outcomes, we repeated analyses with the inclusion of a conduct problems  $\times$  CU traits interaction term and we plotted significant effects using interActive [75]. Individual plots depict interactive effects at 2 *SD* and 1 *SD* below the mean, the mean, and 1 *SD* and 2 *SD* above the mean, in addition to 95% confidence intervals, observed data, and minimum and maximum values. Given multiple comparisons, we applied a Bonferroni corrected alpha of 0.01.

## Results

### Descriptives

Descriptive statistics and correlations of main study variables are presented in Supplementary Table S1 for FT and Supplementary Table S2 for CDP. Correlations of covariates are reported in Supplementary Tables S3 for FT and Table S4 for CDP. In brief, for FT, CU traits were positively associated with all forms of psychopathology (with the exception of ADHD and avoidant personality), heavy cannabis use, and partner violence; and negatively associated with general health index, happiness, strength, graduated high school, and completed college. Conduct problems were positively associated with all forms of psychopathology, substance use (with the exception of binge drinking), and partner violence; and negatively associated with general health index, happiness, strength, high school graduation, and college completion.

For CDP, CU traits were positively associated with all forms of psychopathology (with the exception of ADHD and anxiety), and negatively associated with happiness, strength, high school graduation, and college completion. Conduct problems were positively associated with all forms of psychopathology, substance use, and partner violence; and negatively associated with general health index, happiness, and college completion.

### Regression Models

In these models, CU traits and conduct problems were specified to covary and covariates were included. As shown in Table 1 (all covariate effects are reported in Supplementary Table S5), for FT, CU traits negatively predicted high school graduation ( $OR=0.20$ ). There were no other significant effects for CU traits. Conduct problems positively predicted externalizing ( $\beta=0.20$ ) and internalizing ( $\beta=0.16$ ) psychopathology; endorsement of clinical levels of ASPD ( $OR=1.85$ ), ADHD ( $OR=1.75$ ), and depression

( $OR=1.56$ ); and partner violence ( $\beta=0.16$ ). Conduct problems also negatively predicted the general health index ( $\beta=-0.18$ ), happiness ( $\beta=-0.20$ ), and college completion ( $OR=0.42$ ).

For CDP, CU traits positively predicted endorsement of clinical levels of depression ( $OR=4.05$ ) and avoidant personality ( $OR=5.11$ ); and negatively predicted strength ( $\beta=-0.14$ ) and college completion ( $OR=0.22$ ). Conduct problems positively predicted externalizing ( $\beta=0.26$ ) and internalizing ( $\beta=0.17$ ) psychopathology; endorsement of clinical levels of ASPD ( $OR=3.43$ ), ADHD ( $OR=2.17$ ), and somatic problems ( $OR=1.74$ ); and binge drinking ( $OR=1.85$ ), heavy cannabis use ( $OR=2.08$ ), and other substance use ( $OR=2.08$ ). Conduct problems also negatively predicted happiness ( $\beta=-0.19$ ).

### Interaction Effects

Analyses were repeated including a conduct problems  $\times$  CU traits interaction term (all interaction effects are reported in Supplementary Table S6). For FT, three interaction terms were significant, including with adult externalizing ( $\beta=-0.43$ ), internalizing ( $\beta=-0.44$ ), and happiness ( $\beta=0.30$ ). As shown in Fig. 1, at 2  $SD$  ( $\beta=0.69$ ) and 1  $SD$  ( $\beta=0.52$ ) below the mean of CU traits, lower levels of adolescent conduct problems predicted moderate levels of adult externalizing psychopathology. In addition, at the mean ( $\beta=0.35$ ) and 1  $SD$  above the mean ( $\beta=0.18$ ) of CU traits, lower conduct problems also predicted externalizing psychopathology. Similarly, as shown in Fig. 2, at 2  $SD$  ( $\beta=0.69$ ) and 1  $SD$  ( $\beta=0.51$ ) below the mean, the mean ( $\beta=0.33$ ), and 1  $SD$  above the mean ( $\beta=0.15$ ) of CU traits, lower levels of adolescent conduct problems predicted moderate levels of adult internalizing psychopathology. Conversely, as shown in Fig. 3, at 2  $SD$  ( $\beta=-0.17$ ) and 1  $SD$  ( $\beta=-0.14$ ) below the mean, the mean ( $\beta=-0.11$ ), and 1  $SD$  above the mean ( $\beta=-0.08$ ) of CU traits, lower levels of adolescent conduct problems predicted greater adult happiness.

For CDP, there were no significant interaction effects.

### Discussion

We tested the predictive validity of adolescent CU traits and conduct problems with respect to a broad range of theoretically relevant adult outcomes over 12–18 years later. These tests were conducted in two distinct samples: one higher risk and the other lower risk. Multivariate models included CU traits, conduct problems, and relevant covariates. In the higher-risk FT sample, adolescent CU traits positively predicted high school graduation; there were no further significant effects for CU traits in this sample. Conduct problems positively predicted externalizing and internalizing

psychopathology and partner violence, and negatively predicted health, wellbeing, and education. In the lower-risk CDP sample, CU traits positively predicted depression and negatively predicted health and education. Conduct problems positively predicted externalizing and internalizing psychopathology and substance use, and negatively predicted wellbeing. Testing conduct problems  $\times$  CU traits interaction terms, we identified three significant interaction effects in our higher-risk FT sample with respect to externalizing and internalizing psychopathology, and happiness. Specifically, lower levels of conduct problems predicted moderate levels of externalizing and internalizing psychopathology at low (2 and 1  $SD$  below the mean) and moderate (mean and 1  $SD$  above the mean) levels of CU traits, and lower levels of conduct problems predicted higher levels of happiness at low and moderate levels of CU traits. Our findings fill several gaps in knowledge on the predictive validity of CU traits across diverse samples.

### CU Traits & Externalizing Psychopathology

Across both samples, adolescent CU traits did not, independently from their overlap with conduct problems, predict any adult externalizing outcome. Our findings are in contrast to hypotheses and past research finding significant associations with CU traits and several forms of externalizing problems [2, 17]. For example, one systematic review identified 118 studies examining associations between CU traits and conduct problems, aggression, and delinquency [2]. Of these studies, 105 found evidence of significant positive associations between childhood CU traits and forms of antisocial behavior. In other research using the FT sample, McMahon et al. [14] found that adolescent CU traits were predictive of several antisocial outcomes 2 years post-high school, including ASPD symptoms, even after controlling for conduct disorder, oppositional defiant disorder, and ADHD symptoms. Thus, CU traits have shown independent prediction of future antisocial problems in our FT sample; however, this finding concerns prediction to late adolescence/early adulthood as opposed to established adulthood as in the present study. Developmental theorists have emphasized adolescence as a prominent period of antisocial behavior relative to other life stages [76, 77]. Our study builds on the work of McMahon et al. [14] by extending the follow-up period into emerging adulthood through established adulthood. Whereas emerging adulthood refers to the developmental transition from adolescence into early adulthood [78], established adulthood is the period from ages 30–45 [79]. Established adulthood has been largely overlooked in developmental research, but this period represents a distinct stage characterized by some of the most demanding years due to a “career-and-care crunch” ([79, p. 436]). In contrast to late adolescence/early adulthood, established adulthood represents a developmental

**Table 1** FT and CDP estimates between study variables

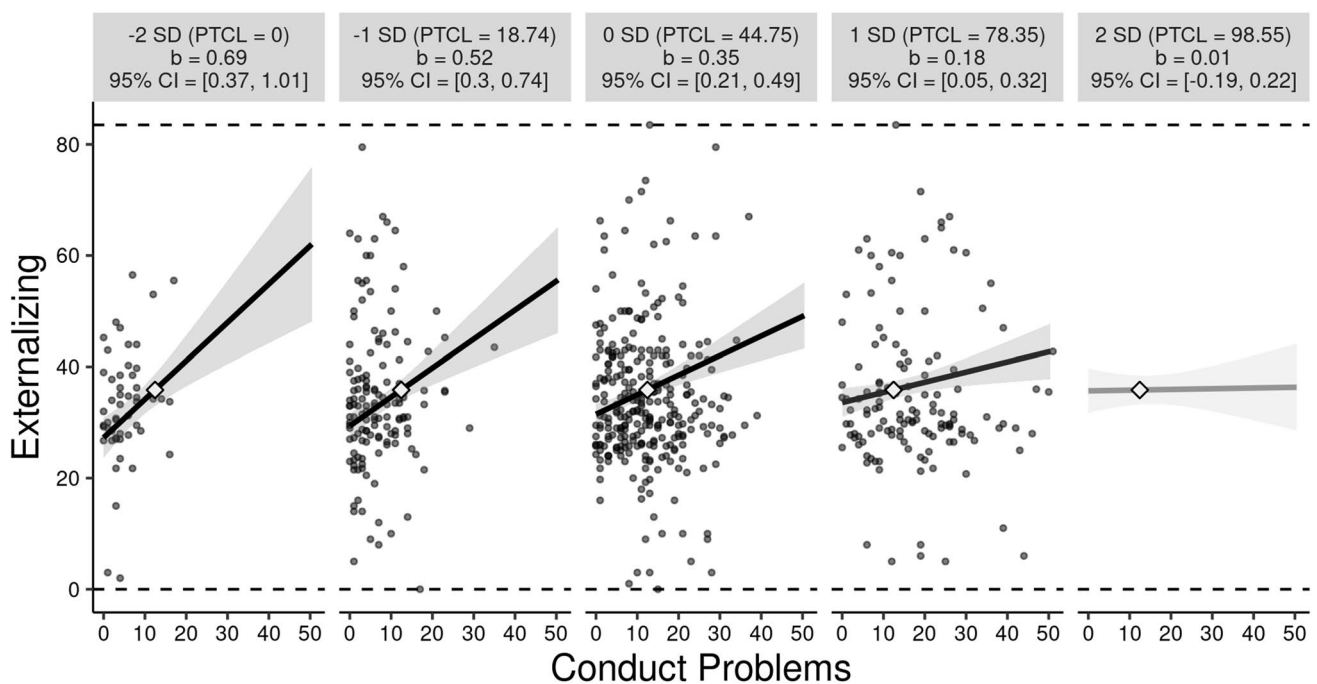
Variable	FT sample				CDP sample			
	<i>B (SE)</i>	$\beta/OR$	95% CI	<i>p</i>	<i>B (SE)</i>	$\beta/OR$	95% CI	<i>p</i>
<i>Psychopathology</i>								
Externalizing								
CU traits	0.13 (0.18)	0.03		0.479	0.30 (0.22)	0.07		0.170
Conduct problems	0.29 (0.08)	0.20		<0.001	0.42 (0.09)	0.26		<0.001
ASPD								
CU traits	0.22 (0.39)	1.25	0.59, 2.66	0.563	1.62 (0.99)	5.03	0.72, 35.32	0.104
Conduct problems	0.62 (0.14)	1.85	1.42, 2.43	<0.001	1.23 (0.32)	3.43	1.82, 6.45	<0.001
ADHD								
CU traits	-0.13 (0.44)	0.88	0.37, 2.07	0.762	1.13 (0.82)	3.08	0.61, 15.52	0.172
Conduct problems	0.56 (0.14)	1.75	1.34, 2.28	<0.001	0.78 (0.30)	2.17	1.21, 3.91	0.010
Internalizing								
CU traits	0.25 (0.21)	0.06		0.230	0.53 (0.26)	0.12		0.040
Conduct problems	0.25 (0.09)	0.16		0.003	0.31 (0.10)	0.17		0.002
Anxiety								
CU traits	0.27 (0.44)	1.31	0.55, 3.09	0.544	-0.15 (0.63)	0.86	0.25, 2.96	0.808
Conduct problems	0.26 (0.17)	1.29	0.93, 1.79	0.130	0.51 (0.23)	1.66	1.05, 2.61	0.029
Depression								
CU traits	0.22 (0.37)	1.25	0.61, 2.55	0.544	1.40 (0.54)	4.05	1.42, 11.55	0.009
Conduct problems	0.45 (0.13)	1.56	1.22, 2.00	<0.001	0.43 (0.21)	1.53	1.02, 2.30	0.040
Avoidant person- ality								
CU traits	0.34 (0.41)	1.40	0.62, 3.15	0.413	1.63 (0.54)	5.11	1.77, 14.74	0.003
Conduct problems	0.34 (0.14)	1.40	1.06, 1.85	0.017	0.31 (0.23)	1.36	0.86, 2.16	0.184
Somatic problems								
CU traits	0.47 (0.33)	1.59	0.84, 3.04	0.156	0.83 (0.56)	2.29	0.76, 6.91	0.141
Conduct problems	0.27 (0.12)	1.31	1.04, 1.65	0.022	0.56 (0.19)	1.74	1.20, 2.53	0.003
<i>Substance use</i>								
Binge drinking								
CU traits	0.19 (0.34)	1.21	0.62, 2.35	0.577	-0.40 (0.49)	0.67	0.25, 1.76	0.415
Conduct problems	0.07 (0.12)	1.08	0.85, 1.37	0.552	0.62 (0.17)	1.85	1.32, 2.59	<0.001
Heavy cannabis use								
CU traits	0.25 (0.40)	1.28	0.59, 2.81	0.535	0.38 (0.84)	1.46	0.28, 7.51	0.654
Conduct problems	0.20 (0.13)	1.23	0.95, 1.58	0.116	0.73 (0.28)	2.08	1.20, 3.60	0.009
Other substance use								
CU traits	-0.06 (0.37)	0.94	0.46, 1.96	0.877	0.38 (0.50)	1.47	0.55, 3.92	0.443
Conduct problems	0.15 (0.13)	1.16	0.90, 1.51	0.249	0.73(0.17)	2.08	1.49, 2.92	<0.001
<i>Partner violence</i>								
CU traits	0.06 (0.16)	0.02		0.722	0.19 (0.13)	0.08		0.132
Conduct problems	0.19 (0.07)	0.16		0.007	0.08 (0.06)	0.09		0.137
<i>Health and wellbeing</i>								
General health index								
CU traits	-0.02 (0.02)	-0.04		0.488	0.01 (0.03)	0.01		0.829
Conduct problems	-0.03 (0.01)	-0.18		<0.001	-0.04 (0.02)	-0.15		0.020
Happiness								
CU traits	-0.09 (0.07)	-0.07		0.202	-0.24 (0.10)	-0.15		0.014
Conduct problems	-0.10 (0.03)	-0.20		<0.001	-0.12 (0.03)	-0.19		<0.001
Strength								
CU traits	-0.07 (0.04)	-0.09		0.059	-0.12 (0.05)	-0.14		0.010



**Table 1** (continued)

Variable	FT sample				CDP sample			
	<i>B</i> ( <i>SE</i> )	$\beta/OR$	95% CI	<i>p</i>	<i>B</i> ( <i>SE</i> )	$\beta/OR$	95% CI	<i>p</i>
Conduct problems	-0.02 (0.01)	-0.07		0.180	0.01 (0.02)	0.03		0.529
<i>Education</i>								
High school graduation								
CU traits	-1.63 (0.39)	0.20	0.09, 0.42	<0.001	-1.17 (0.96)	0.31	0.05, 2.04	0.223
Conduct problems	-0.28 (0.14)	0.76	0.57, 0.99	0.044	0.02 (0.32)	1.02	0.55, 1.89	0.958
College completion								
CU traits	-0.53 (0.51)	0.59	0.22, 1.59	0.298	-1.53 (0.52)	0.22	0.08, 0.61	0.003
Conduct problems	-0.88 (0.29)	0.42	0.24, 0.73	0.002	-0.13 (0.17)	0.88	0.64, 1.22	0.444

*ADHD* attention-deficit/hyperactivity disorder, *ASPD* antisocial personality disorder, *CU* callous-unemotional



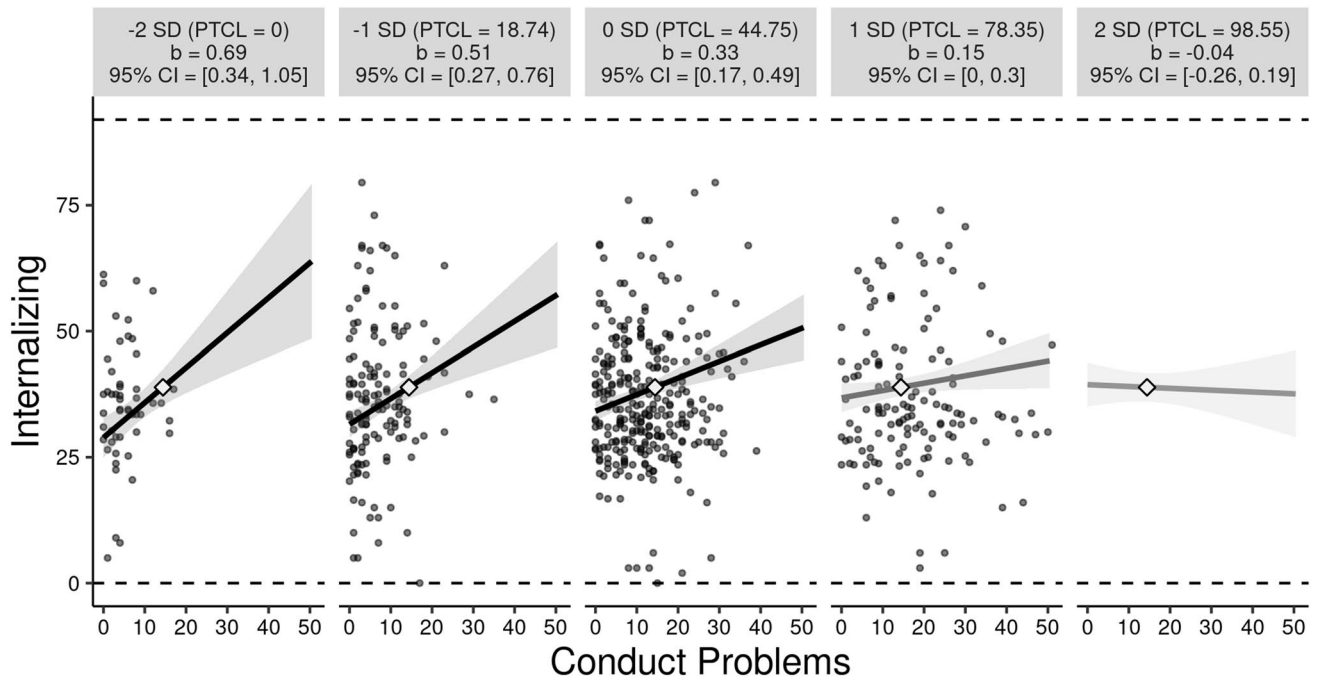
**Fig. 1** Interactive effect of adolescent conduct problems and CU traits (from 2 SD below to 2 SD above the mean) on adult externalizing psychopathology depicting 95% confidence region (shaded), observed

data (circles), and minimum and maximum values (dashed lines). *CI* confidence intervals, *PTCL* percentile

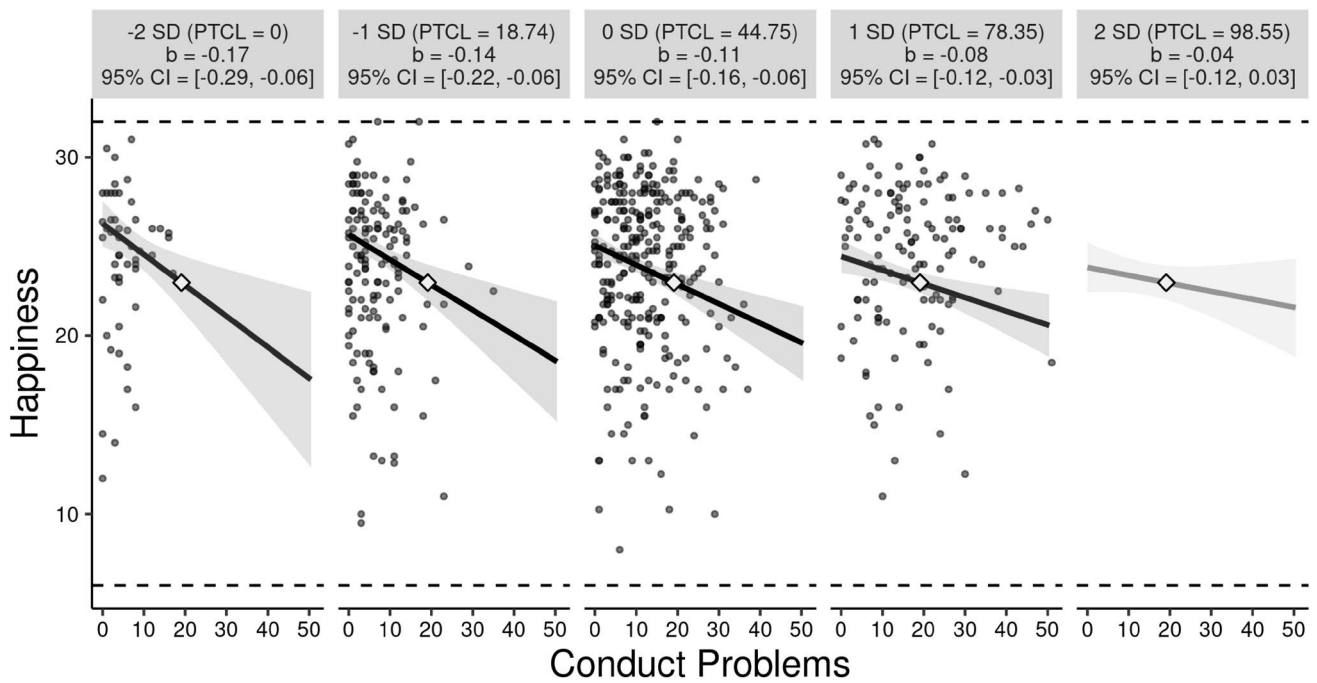
period marked by greater responsibilities across family and work domains [79]. This increase in obligations may buffer against continued externalizing psychopathology and antisocial behavior.

In addition, although the present study aimed to examine the unique associations and incremental predictive validity of CU traits, some research has found that it is those individuals with *both* CU traits and conduct problems that show greater externalizing symptoms and other antisocial behavior relative to individuals with only CU traits *or* conduct problems [22, 23, 32]. In the aforementioned systematic review

[2], 30 studies established a significant association between CU traits and antisocial behavior after controlling for early conduct problems or aggression, and 25 studies showed a significant association after controlling for other childhood externalizing psychiatric diagnoses, leaving several studies that only found significant effects without controlling for the presence of externalizing psychopathology. Without controlling for externalizing psychopathology, significant associations established in these studies may be attributable to concurrent externalizing psychopathology (i.e., the presence of *both* CU traits and conduct problems). Thus, we also



**Fig. 2** Interactive effect of adolescent conduct problems and CU traits (from 2 SD below to 2 SD above the mean) on adult internalizing psychopathology depicting 95% confidence region (shaded), observed data (circles), and minimum and maximum values (dashed lines). *CI* confidence intervals, *PTCL* percentile



**Fig. 3** Interactive effect of adolescent conduct problems and CU traits (from 2 SD below to 2 SD above the mean) on adult happiness depicting 95% confidence region (shaded), observed data (circles), and minimum and maximum values (dashed lines). *CI* confidence intervals, *PTCL* percentile

examined conduct problems  $\times$  CU traits interaction effects. We found that lower conduct problems predicted externalizing psychopathology at low and moderate levels, but not high levels, of CU traits in the higher-risk FT sample.

### CU Traits & Internalizing Psychopathology

In the lower-risk CDP sample, adolescent CU traits independently predicted adult endorsement of clinical levels of depression. Although, theoretically, CU traits would not necessarily be associated with depression, emerging evidence has identified a positive association between CU traits and depression symptoms [32]. One explanation for these findings may be that deficient affect represents a transdiagnostic marker of both CU traits and depression. Whereas anxiety is distinguished by hyperarousal, CU traits and depression are both characterized by hypoarousal. Thus, a more nuanced syndrome or symptoms approach may be needed to inform the CU-internalizing debate. Further research is also needed to understand how CU traits may promote depression by examining potential mediators (e.g., unresolved conflicts, threats of loss [e.g., incarceration]). In addition, adolescent CU traits also predicted endorsement of clinical levels of adult avoidant personality. Whereas the DSM-5 operationalizes avoidant personality disorder as feelings of inadequacy and hypersensitivity to negative evaluation in social situations [18], the avoidant personality scale of the Adult Self-Report [68] includes items such as *‘doesn’t get along with others’*, *‘would rather be alone’*, and *‘trouble keeping friends’*. These items may also be characteristic of CU traits, and thus, it could be the case that this association is a reflection of commonality between items on the CU traits and avoidant personality scales.

Similar to our externalizing findings, when we examined lower conduct problems  $\times$  CU traits interaction effects, we also found that conduct problems predicted internalizing psychopathology at low and moderate levels of CU traits in the FT sample more so than at higher levels of CU traits. Individuals with CU traits have traditionally been characterized as shallow in affective response, and although the aforementioned findings on depression scores suggest that there may be greater nuance to the affective component of CU traits, our measure of internalizing psychopathology comprised items across depression, anxiety, withdrawn, and somatic problems, thereby potentially masking depression effects. Again, we argue, there is a need for further research on CU traits and internalizing psychopathology across a hierarchy of levels (e.g., spectra, factor, disorder, and symptom levels [80]).

### CU Traits & Health, Wellbeing, & Education

Among CDP participants, adolescent CU traits also negatively predicted adult personal strength and college completion, controlling for conduct problems. CU traits only negatively predicted high school graduation in the FT sample. However, we also found that lower levels of conduct problems were associated with happiness at low and moderate levels of CU traits in the FT sample. These findings add to a very limited literature attempting to understand the implications of CU traits in health, wellbeing, and education domains. Past research has also predominantly been cross-sectional or follow-ups have been brief [44, 45]; our findings inform current understanding on the longer-term developmental course across these domains. We identified distinct CU associations across our independent samples. These differences may be explained by sample differences in the initial level of risk or a number of sociodemographic factors. In contrast to CDP, FT was oversampled for high levels of conduct problems in kindergarten. It may be that this targeted childhood conduct problem sampling strategy has contributed to our diverse findings; however, other sociodemographic characteristics may also be contributing to effects [81]. The present study’s use of both higher- and lower-risk samples contributes to our understanding of developmental processes across diverse samples. This design helped to highlight possible moderating factors as well as converging, generalizable associations.

### Conduct Problems & Outcomes

Across both higher- and lower-risk samples, conduct problems independently positively predicted externalizing and internalizing psychopathology and multiple clinical diagnoses, and negatively predicted health and wellbeing. Where the two samples diverged was on partner violence, education, and substance use, with conduct problems predicting the former two in the higher-risk FT sample and the latter in the lower-risk CDP sample. The link between adolescent conduct problems and adult externalizing psychopathology and diagnoses may reflect the shared variance of these measures (i.e., measured by the CBCL/Youth Self-Report and the Adult Self-Report). Significant associations with internalizing psychopathology, partner violence, substance use, and other indicators of health, wellbeing, and education, support extensive research (including long-term longitudinal studies) on the negative consequences of childhood conduct problems [39, 56, 57], and we extend these findings by showing that these effects obtain even when holding constant CU traits. We also extend these findings by demonstrating replicability across multiple outcomes in higher- and lower-risk samples. Given some

theoretical accounts suggest that CU traits may underlie or promote conduct problems [46–48], future research should also examine conduct problems as a mediator in the relation between CU traits and adult outcomes.

## Strengths & Limitations

Strengths of our study include the examination of understudied but theoretically meaningful outcomes, the multisite longitudinal design with prospective data, and the testing of associations across diverse samples distinguished on level of risk. Despite these strengths, interpretation of findings must be considered within the context of some limitations. First, we used the CU subscale from the Antisocial Process Screening Device [65]. Although this measure has been established as a strong instrument for assessing multidimensional psychopathic traits in child and adolescent samples, there is some debate with regard to the CU subscale due to poorer internal reliability and inconsistencies in prior factor analytic studies. In the present study, the CU subscale showed marginal internal consistency in the lower-risk CDP sample, which may have impacted findings. More comprehensive measures of CU traits have since been developed, such as the Inventory of Callous Unemotional Traits [82]. Future research might consider using such second-generation CU measures providing a more comprehensive and reliable assessment. In addition, although some research uses the full Antisocial Process Screening Device to assess psychopathy in youth samples, the downward extension of the adult psychopathy construct to children and adolescents is still actively debated [83], and thus, we focused on CU traits. However, future research should examine long-term outcomes of juvenile psychopathy. Second, in the FT sample, parents reported on adolescent CU traits and participants self-reported adult outcomes, whereas in the CDP sample, participants self-reported on adolescent CU traits and adult outcomes. Thus, although we would assume some convergence between parent and self-reports of adolescents' CU traits, we would also assume differences in the meanings of the measure. In the CDP sample, shared method variance cannot be ruled out as a source of the associations between constructs. Future research should draw on multi-informant reports and further consider the importance of how different informants may contribute distinct information. Third, it is important to note that although the time periods between the adolescent CU traits and adult outcomes were equivalent across the two samples (i.e., approximately 12 years to the first adult time point, and 18 years to the second adult time point), CU traits were assessed early in adolescence for FT (i.e., 13 years) and later in adolescence for CDP (i.e., 16 years). Because of this, we focused on relative, rather than absolute, differences in findings to make conclusions with regards to replicability across samples. To further inform

developmental processes related to CU traits and conduct problems, future tests are needed of the predictive validity of these constructs across childhood and adolescence. Finally, although a key strength of this study is the use of two samples and our samples included some representation of sociodemographic diversity, further replication research is needed with samples characterized by other diversities.

## Implications & Conclusions

A major limitation in developmental science is the generalizability and replication of research findings across diverse samples. Relative to conduct problems, we found greater differences in associations with CU traits across our independent samples. We emphasize the importance for future CU research to test associations across samples represented by higher and lower levels of risk and other diversities. Testing the predictive validity of adolescent CU traits with respect to multiple adult outcomes also has important theoretical and clinical implications. Theoretical perspectives and empirical evidence have emphasized that children and adolescents with nonnormative levels of CU traits differ on a number of environmental, biological, cognitive, social, and emotional factors, relative to individuals without these traits [2, 17]. Our findings add to this body of work by revealing long-term associations with constructs not commonly assessed but theoretically important. For example, in our lower-risk CDP sample, we found that adolescent CU traits positively predicted adult endorsement of clinical levels of depression. Individuals with CU traits have been less successfully served by prevention and treatment efforts [52, 84]. Our findings suggest that research is needed to investigate whether individuals with elevated levels of CU traits benefit from CU-focused interventions that also target symptoms of depression. Although the current study does not have measures of CU traits in adulthood, our lack of significant effects with externalizing psychopathology may also suggest that CU and externalizing traits are not immutable over time [2].

## Summary

Nonnormative levels of CU traits distinguish an etiologically and clinically distinct group of antisocial individuals [2]. However, relative to antisocial behavior, the predictive validity of CU traits with respect to impairment across other theoretically meaningful outcomes such as internalizing psychopathology, substance use, and indicators of health, wellbeing, and education is currently unclear. Past research is also limited by a lack of long-term prospective longitudinal data, and samples have comprised high-risk or low-risk individuals. Using data from the higher-risk Fast Track (FT;  $n = 754$ ) and lower-risk Child Development Project (CDP;

$n = 585$ ) studies, we tested whether adolescent CU traits and conduct problems were associated with theoretically relevant adult outcomes 12–18 years later. We also explored whether CU traits moderated the association between conduct problems and adult outcomes. In the higher-risk FT sample, CU traits only negatively predicted education; conduct problems positively predicted externalizing and internalizing psychopathology and partner violence, and negatively predicted health, wellbeing, and education. We identified three conduct problems  $\times$  CU traits interaction effects with respect to externalizing and internalizing psychopathology, and happiness. Specifically, lower levels of conduct problems predicted moderate levels of externalizing and internalizing psychopathology at low and moderate levels of CU traits, and lower levels of conduct problems predicted higher levels of happiness at low and moderate levels of CU traits. In the lower-risk CDP sample, CU traits positively predicted depression and negatively predicted health and education; conduct problems positively predicted externalizing and internalizing psychopathology and substance use, and negatively predicted wellbeing. There were no significant interaction effects for the CDP sample. Our study design extends current understanding of generalizable developmental processes across diverse samples. Present findings also suggest that CU traits may not provide incremental predictive validity for several adult outcomes relative to conduct problems. However, we contribute knowledge on significant CU effects with understudied but theoretically relevant variables. Our findings also have important clinical implications.

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Drug Abuse. Data Availability Data and code for this study are available by emailing the corresponding author.

**Code Availability** Data and code for this study are available by emailing the corresponding author.

## Declarations

**Conflict of interest** The authors declare they have no conflicts of interest.

**Ethical Approval** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee with the 1964 Helsinki Declaration and its later amendment or comparable ethical standards.

**Informed Consent** Informed consent was obtained from all individual participants included in the study.

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