Early starting, aggressive, and/or callous-unemotional? Examining the overlap and predictive utility of antisocial behavior subtypes

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Abstract

Antisocial behavior (AB) in adolescence predicts problematic outcomes in adulthood. However, researchers have noted marked heterogeneity within the broad group of youth engaging in these destructive behaviors and have attempted to identify those with distinct etiologies and different trajectories of symptoms. In the present study, we evaluate three prominent AB subtyping approaches: age of onset, presence of callous-unemotional (CU) traits, and aggressive versus rule breaking symptoms. We examined the overlap of these subtypes and their predictive validity in a diverse sample of 268 low-income young men followed prospectively from adolescence into emerging adulthood. We found that those with early starting AB were uniquely high on aggressive symptoms but not on CU traits. Early starting AB and both aggression and rule breaking measured during adolescence predicted most subsequent psychiatric and AB outcomes in early adulthood in univariate models, whereas CU traits were only predictive of adolescent arrests, later substance dependence diagnosis, and later CU traits. Finally, after accounting for shared variance among predictor variables, we found that aggressive symptoms explained the most unique variance in predicting several later outcomes (e.g., antisocial personality disorder) over and above other subtyping approaches. Results are discussed in relation to of the utility of existing subtyping approaches to AB, noting that aggression and age of onset, but not CU traits, appear to be the best at predicting later negative outcome.

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Keywords

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Antisocial behavior (AB) is a prevalent and pervasive problem in youth (Nock, Kazdin, Hiripi, & Kessler, 2006), with dramatic consequences for perpetrators, victims, their families, and society more generally (Foster & Jones, 2005). This heterogeneous group of behaviors includes physical and sexual aggression, destruction of property, theft, and violation of rules. It is diagnosed in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) and Fifth Edition (DSM-5) as Conduct Disorder (CD) in youth and Antisocial Personality Disorder (APD) in adults (American Psychiatric Association, 1994, 2013). However, over the last several decades there has been increasing evidence that both AB clinical diagnoses encompass a notably heterogeneous group of behaviors and individuals, likely with a variety of distinct etiologies (Frick & Ellis, 1999; Loeber & Hay, 1997; Moffitt et al., 2008).

Although many schemes for parsing this heterogeneity have been proposed over the years (e.g., Frick & Nigg, 2012; Lahey et al., 1998), researchers have largely focused on three schemes to subtyping AB: age of onset of AB (Moffitt, 1993), presence or absence of callous-unemotional (CU) traits (Frick & White, 2008), and a predominance of overt/aggressive versus covert/non-aggressive rule-breaking behaviors (Burt, 2012; Loeber & Stouthamer-Loeber, 1998). Each of these approaches has generated large empirical literatures that have been useful in identifying youth with different risk profiles and likely distinct etiologies (e.g., Frick & White, 2008). Critically, however, comparatively little research has simultaneously examined the overlap of these schemes or clarified differences in their predictive utility, particularly from adolescence into emerging adulthood in samples at high risk for serious AB, such as low-income, urban males (Farrington & Loeber, 2000; Murray, Irving, Farrington, Colman, & Bloxsom, 2010). Exploring these issues is critical, not only for integrating these disparate research traditions but also for refining our understanding of the best approach for predicting specific outcomes from adolescence into emerging adulthood. For example, are most youth high on CU traits also early starters? Are aggressive youth higher on CU traits than are those with non-aggressive AB? Moreover, does each subtyping scheme measure unique sets of behaviors and youth with different trajectories and outcomes in emerging adulthood? The degree of overlap between these schemes and differential prediction of future outcomes has key implications for the integration of the various research findings and their clinical implications (i.e., do the various lines of research inform one another?).

Age of onset

Building on Moffitt's seminal taxonomy (Moffitt, 1993), DSM-IV and DSM-5 both subdivide youth by age of AB onset: "early starters" (before age 10) and "late starters" (Aguilar, Sroufe, Egeland, & Carlson, 2000; American Psychiatric Association, 1994, 2013; Moffitt, 1993). Early starting problems have been linked to a larger set of child and family risk factors, including neurocognitive deficits, harsher parenting, more difficult temperament and higher comorbidity (Moffitt, Caspi, Harrington, & Milne, 2002; Patterson, Reid, &

Dishion, 1992). Early starters are also known to have a more chronic and escalating trajectory of behavior (Shaw & Gross, 2008), as well as worse outcomes in adulthood, such as higher rates of antisocial personality disorder and depression, greater time spent unemployed, and greater continued involvement in crime (Moffitt et al., 2002). Late starting AB, by contrast, has been linked to deviant peer affiliation (Dishion, Patterson, Stoolmiller, & Skinner, 1991), fewer proximal family risks, and a less elevated and less chronic trajectory of AB (Moffitt, Caspi, Dickson, Silva, & Stanton, 1996). Late starters appear to have less problematic outcomes in adulthood *compared to early starters*; however, recent studies have demonstrated that the late starting group is elevated when *compared to low AB* groups on drug and property offenses, and self-reported mental health and drug problems (Moffitt et al., 2002; Nagin, Farrington, & Moffitt, 1995; Roisman, Monahan, Campbell, Steinberg, & Cauffman, 2010).

CU Traits

A second major subtyping scheme in the study of AB has focused on the presence or absence of CU traits (Frick, Cornell, Bodin, et al., 2003). The presence of CU traits has recently been added as a specifier (subgrouping scheme) in the diagnosis of AB disorders in the DSM-5 (American Psychiatric Association, 2013), categorized as "limited prosocial emotions" (Frick & Moffitt, 2010; Moffitt et al., 2008), and thus is now an especially important subgrouping approach to consider. Theoretically, CU traits are a downward extension of the shallow affect and lack of empathy seen in the affective and interpersonal components of adult psychopathy (Burke, Loeber, & Lahey, 2007). Beginning as early as the preschool period (e.g., Hyde et al., 2013), when compared to AB without CU traits, AB in the presence of these traits have been shown to predict a more severe course of AB that, is more stable, more highly heritable, and linked to a distinct set of emotional, cognitive and personality characteristics (Frick, Ray, Thornton, & Kahn, 2014; Frick & White, 2008). Finally, CU traits have been associated with earlier starting AB (Dandreaux & Frick, 2009; Silverthorn, Frick, & Reynolds, 2001) and higher levels of aggression, particularly proactive aggression (Cornell et al., 1996; Frick, Cornell, Barry, Bodin, & Dane, 2003).

Aggression versus rule breaking

A third major approach to understanding the heterogeneity within antisocial behavior relates to the specific behaviors that characterize the manifestation of AB within each individual – namely, the tendency to preferentially engage in physically aggressive or overt (e.g., fighting, bullying) as compared to non-aggressive rule-breaking or covert (e.g., theft, vandalism) antisocial behaviors (Quay, 1986). Qualitative literature reviews and factor analyses have consistently supported this distinction (Burt, 2012; Frick et al., 1993; Loeber & Schmaling, 1985; Loeber & Stouthamer-Loeber, 1998), despite the fact that the two dimensions are typically correlated in the 0.4 to 0.6 range (see Burt, 2012 for a discussion of their overlap). For instance, separate but correlated aggressive and rule breaking dimensions have been observed in factor analyses of CD symptoms (Burt, Donnellan, McGue, & Iacono, 2011; Tackett, Krueger, Iacono, & McGue, 2005), behavioral rating scales (Achenbach & Rescorla, 2001), and naturalistic observations and observer-ratings (Hinshaw, Simmel, & Heller, 1995). Other work has highlighted the presence of substantive

etiologic, cognitive, and personological distinctions between aggression and rule breaking (see Burt, 2012 for a review). For example, aggression is more heritable, emerges in early childhood, and is linked to emotion dysregulation/negative emotionality and executive dysfunction than rule-breaking. Although the frequency of aggressive behaviors decreases over the course of development, those who are most aggressive early in life commit the majority of aggressive acts as adults. Conversely rule breaking appears to be less heritable and less stable over time, is specifically tied to impulsivity, and is most frequent during adolescence (Burt, 2012).

Overlap of schemes

Each of these approaches appears to identify a "highest risk" group – early starters, those high on CU traits, and those high on aggression – and one intriguing possibility is that these schemes may in fact be identifying a common subset of youth (e.g., early starters are also those who are high on CU traits and highly aggressive). Indeed, some have argued that youth high on aggression represent the same youth categorized as early starters (Burt, 2012; Lahey et al., 1998). Similarly, many early starters have been shown to be high on callousness compared to late and never starting youth during both adolescence (Dandreaux & Frick, 2009) and early adulthood (Moffitt et al., 2002), leading to the assertion that CU traits are most prominent within early starting AB (Frick & Viding, 2009). Moreover, some studies argue that CU traits are more highly correlated with aggressive behavior than rule breaking (Poythress, Dembo, Wareham, & Greenbaum, 2006).

However, these results are far from consistent across studies and evidence of high levels of overlap between aggression/early-starting AB and CU traits is far from conclusive. For instance, although some studies report that CU traits are correlated more strongly with aggression, other studies have found that CU traits are not differentially associated with aggression versus rule breaking (Edens, Marcus, & Vaughn, 2011; Kimonis et al., 2008). Moreover, available factor analyses (Frick, Cornell, Bodin, et al., 2003; Patrick, 2007) and twin studies (Larsson et al., 2007; Taylor, Loney, Bobadilla, Iacono, & McGue, 2003) have highlighted critical differences between CU traits and early aggressive behaviors (Burt, 2012), and in some studies the overlap between CU traits and early starting AB has been modest at best (e.g., Edens et al., 2011). Moreover, sample sizes for many of the studies in this area have been small (i.e., *N*s of less than 80) and in some cases, the studies are retrospective in nature (e.g., Dandreaux & Frick, 2009; Silverthorn et al., 2001). Additionally, few studies have compared rule breaking versus aggression in early starting youth (Burt, 2012), and most have focused specifically on proactive versus reactive aggression rather than aggression versus rule breaking (Frick & Ellis, 1999), leading to a murky picture in regard to the overlap among all of these constructs. Given this lack of clarity, more research is needed to examine the extent to which all these approaches to sub-typing identify the same at-risk youth, particularly during late adolescence when crime begins to peak and we have the ability to identify early versus late starters.

Prediction of adult outcomes

In addition to clarifying these issues of overlap in adolescence, it is also critically important to evaluate whether and how the different subtyping schemes predict criminal and mental health outcomes in emerging adulthood. For example, early starting AB has been linked to later antisocial personality disorder (APD) and depression in early adulthood, whereas late starting has been more consistently linked to substance use than APD (Moffitt et al., 2002). Those with CU traits are also at higher risk for substance use (Poythress et al., 2006) and antisocial personality disorder (Loeber, Burke, & Lahey, 2002), but appear protected from depression (Patrick, 2007; Poythress et al., 2006). However, very few studies have directly compared the predictive utilities and specificity of prediction of each subtyping scheme, especially the unique variance each scheme may contribute over and above the predictive power of another scheme to a variety of AB and mental health outcomes. In one of the few such studies available, Burt and Hopwood (2010) examined a cross-sectional sample of 1,726 adults in treatment for alcoholism. As expected, those with early starting AB evidenced far higher rates of aggressive and non-aggressive AB (particularly aggressive AB), as well as higher rates of anger and alcohol dependency, than those with late starting AB or those without AB. However, when aggression, rule-breaking, and age-of-onset were examined simultaneously, age of onset did not contribute unique variance to the prediction of anger and alcohol dependence (see also Burt, Donnellan, McGue, et al., 2011), indicating that aggression and rule breaking may capture much of the predictive variance explained by age of onset.

Research comparing CU traits to conduct disorder symptoms (e.g., encompassing aggression and rule breaking) has suggested that CU traits contribute unique variance to a variety of antisocial outcomes (Frick et al., 2014; McMahon, Witkiewitz, Kotler, & Conduct Problems Prevention Research Group, 2010). However, no study has compared the predictive utility of all three subtyping schemes. Research that compares these approaches can help identify which subtypes (e.g., early starters versus those high on CU traits) are most predictive of which outcomes (e.g., antisocial personality disorder versus substance use disorders), and which of these links are unique to specific subtypes while accounting for the overlapping variance explained by other subtypes.

One final, if sometimes overlooked, issue is the extent to which these subtyping constructs are used in a categorical versus dimensional way in actual research. Although all of these variables could be examined from either perspective (e.g., by treating age of onset as a continuous variable), the approach used to test these constructs has grown increasingly important because diagnostic manuals focus on categories, whereas most recent research focuses on the dimensional nature of psychopathology (Edens, Marcus, Lilienfeld, & Poythress, 2006; Krueger & Markon, 2011). Whereas age of onset approaches are typically measured categorically in research and practice, CU traits have been examined both dimensionally and categorically, and aggression versus rule breaking approaches have largely been examined dimensionally in research and in practice (e.g., via the Child Behavior Checklist, symptoms on diagnostic interviews). An advantage to the categorical nature of the age of onset approach is that it is most easily applicable to clinical diagnoses by virtue of the ease at identifying age, particularly within two categories (i.e., before age 10

or after age 10). This highlights one of the values of using a person-centered approach in research that can inform translational goals. However, conceptualizations of psychopathology have moved to more dimensional accounts that better capture the distribution of normative and psychopathological behaviors (Krueger & Markon, 2011) and much research in this area has increasingly focused on dimensional conceptions of these constructs. Hence, it would be important to compare schemes that are categorical versus dimensional, using both person-centered and variable-centered analyses, especially in assessing how these approaches best capture youth at highest risk and best predict adult outcomes.

Goals of the current study

The current study aims to address gaps in the literature concerning subtypes of AB by a) examining the overlap of different subtyping schemes using dimensional and person-centered approaches and b) examining the prediction of key adult outcomes, including criminal and antisocial behavior, as well as relevant psychiatric diagnoses such as depression and substance use. First, we examined the overlap of these subtypes using a person-centered approach with the hypothesis that most youth classified as having CU traits would also be early starters and engage in high levels of aggression during adolescence. Second, we examined the overlap of these subtypes using a variable-centered approach where we hypothesized that early onset, CU traits, and aggression (versus rule breaking) would be most highly correlated with each other and predict the highest likelihood of arrest across adolescence. Third, we examined the prediction of later outcomes in emerging adulthood with the hypothesis that early onset, CU traits, and aggressive behaviors would all predict diagnoses of APD and self-reported delinquency. In terms of specificity, we hypothesized that rule breaking, late starting AB, and CU traits would more strongly predict drug abuse and dependence than aggression and early starting. Further, we expected CU traits to specifically positively predict later measures of CU traits but negatively predict depression, which we hypothesized would be predicted by early starting and aggressive behavior. We evaluated these hypotheses using a longitudinal study of 310 low-income urban males followed from early childhood through early adulthood. This sample is well characterized by standard diagnostic interviews, self-report, and court records so that we can use multi-method data to test hypotheses. We focused specifically on two key age periods: late adolescence when early and late starters can be separated and when both aggression and rule breaking are expected, and early adulthood when we could assess the persistence and growth of these subtypes into adult behaviors and diagnoses.

Method

Participants

Participants in this study are part of the Pitt Mother and Child Project (PMCP), an ongoing longitudinal study of child vulnerability and resiliency in low-income families. In 1991 and 1992, 310 infant boys and their mothers were recruited from Allegheny County Women, Infant, and Children Nutrition Supplement Clinics when the boys were between 6 and 17 months old (Shaw, Gilliom, Ingoldsby, & Nagin, 2003). At the time of recruitment, 53% of the target children in the sample were European-American, 36% were African-American,

5% were biracial, and 6% were of other races (e.g., Hispanic-American or Asian-American). Two-thirds of mothers in the sample had 12 years of education or less. The mean per capita income was $241 per month ($2,892 per year) indicative of a working class to impoverished and economically distressed sample. Thus, a large proportion of the participants could be considered at high risk for antisocial outcomes because of their socioeconomic standing.

Retention rates have generally been high at each of the time points from age 1.5- to 20-years old, with sufficient data from age 10–17 for trajectory analyses on 268 participants (86%) (see Shaw, Hyde, & Brennan, 2012), and some data available on 248 participants (80%) at age 17 and 256 participants (83%) at age 20. When compared with those who dropped out at earlier time points, participants who remained in the study at ages 17 or 20 or had trajectory analysis data did not differ on the CBCL externalizing scores at ages 2, 3.5, or 5, maternal age, income, or educational attainment (most $ps= 0.20-.93$, except that those missing data at age 17 had younger mothers and greater early maternal depression scores; $ps = .07$).

Visit procedures

Target children and their mothers were seen for two- to three-hour visits almost every year from age 1.5–20. Data were collected in the laboratory (ages 1.5, 2, 3.5, 6, 11, 20), on the phone (age 16) and/or at home (ages 2, 5, 5.5, 8, 10, 12, 15, 17). Target children (now adults) also participated in a lab assessment at age 20 alone. During home and lab assessments, parents and adolescents completed questionnaires regarding sociodemographic characteristics, family issues, and child behavior, as well as diagnostic interviews. Participants were reimbursed for their time at the end of each assessment. All assessments and measures have been approved by the IRB of the University of Pittsburgh.

Measures

Note that many of the variables computed for this study have overlapping content because of the wide variability in subtypes of youth with disruptive and antisocial behavior (e.g., there are several measures focusing on overlapping but different dimensions of externalizing problem behavior). Thus great care was taken to use both diagnostic and self-report measurement and to construct dimensions or categories that are consistent with previous work in this area and current clinical practice (e.g., DSM-5 approaches), as well as the use different types of measurement (e.g., self-report versus interview).

Demographics (age 1.5)—Demographics were collected at the beginning of each visit with the family and included asking families about the target child's race/ethnicity (coded 0=white, 1=non-white in the current study) and the family SES measured via Hollingshead scores (Hollingshead, 1975).

Aggressive and Rule Breaking Symptoms (age 17)—Primary caregivers and their sons were administered the K-SADS-P (Kaufman et al., 1997) by a trained examiner. The K-SADS is a semi-structured diagnostic interview assessing DSM-IV psychiatric disorders and symptoms over the last year in which an examiner privately interviewed the primary caregiver and then the adolescent about symptoms psychiatric disorders, and reports were combined via using a clinical decision making process to determine when symptoms met

DSM thresholds via discussion in regular clinical supervision meetings (see Shaw et al., 2012 for more details on the extensive procedures for training, reliablity and oversight of examiners). For the current study, five aggressive items (i.e., bullies, initiates physical fights, uses weapon, physically cruel to people, stolen while confronting victim) and seven rule breaking items (i.e., vandalism, breaking and entering, lies, stolen non-trivial items without confrontation, stays out late at night, runs away overnight, truant) were identified within the symptoms of Conduct Disorder (CD) in the DSM-IV. These items are consistent with past research on aggressive versus rule breaking behaviors (Burt, 2012; Burt, Donnellan, Iacono, & McGue, 2011) and were found in the present sample to have high specific loadings to one factor (e.g., AGG; >.6) and relatively low loadings on the other factor (e.g., rule breaking) using an exploratory and then confirmatory factor analysis with WLSMV estimation in Mplus 5. The two factor model fit the data well (χ^2 = 64.9, df= 53, p = .13; CFI = .98, RMSEA = .03) and better than a one factor model (χ^2 difference = 10.1, df = 1, p < .005), thus attesting to the utility of these two dimensions. These items (0 = not present; 1 = present) were therefore summed within each factor to create composite symptom counts of aggressive and rule breaking behaviors, respectively.

Structured Clinical Interview for DSM-IV (SCID-I & II) (age 20)—Lifetime clinical diagnoses of major depression, substance abuse, and substance dependence were made at age 20 through interview of the young men by a trained examiner using the SCID-I Research Version (First, Spitzer, Gibbon, & Williams, 1996). Symptoms and diagnosis of antisocial personality disorder (APD) were made using the SCID-II (First & Gibbon, 1997). The SCID-I and SCID-II are structured interviews that assess DSM-IV adult psychiatric symptoms at present (during the past month) and across the lifetime (lifetime scores were used in the present report given low rates of current diagnoses and because APD diagnoses require a longer history). Training, reliability and oversight of interviewers was similar to the K-SADS. Of the 254 participants with diagnostic data available, 26 (10%) met current or lifetime criteria for major depression, 66 (26%) for substance abuse (mostly cannabis), 39 (15%) for substance dependence (mostly cannabis), and 34 (13%) for APD.

Self-reported Delinquency (ages 10–17, 20)—Delinquency was assessed based on boys' self-report using the Self-report of Delinquency Questionnaire (Elliott, Huizinga, & Ageton, 1985) at age 10,11, 12, 15, 16, 17, and 20. The SRD is a semi-structured interview that contains 33 items (at age 10, 11, 12) or 62 items (at age 15, 16, 17, 18) and assess the frequency with which an individual has engaged in aggressive and delinquent behavior, alcohol and drug use, and related offenses. Using a 3-point rating scale (1=never, 2=once/twice, 3=more often), youth rate the extent to which they engaged in different types of antisocial activities (e.g., stealing, throwing rocks at people, drug use). These item responses were summed to create a composite reflecting variety (i.e., number of different acts endorsed) and severity (i.e., whether the act was once/twice versus more often) of AB. Across ages 10–17, internal consistency was high (α=.79–.92) (Shaw et al., 2012). At age 20, the measure was reduced to 53 items by removing content that was inappropriate for adults (e.g., have you smoked a cigarette?) with continued high internal consistency (α=.90).

Trajectories of delinquency/Age of Onset **(age 10–17)—**using the above described self-report of delinquency, trajectories were generated across adolescence (ages 10-17) using Nagin's semiparametric group based Proc TRAJ in SAS 9.2 (Nagin, 2005). We selected the best model using Bayesian Information Criteria (BIC), considering posterior probabilities for group membership, and the overall size of the groups (i.e., we avoided groups smaller than 4% of the sample). These trajectory groups were based on the Self-Report of Delinquency from age 10 – 17 (described above), although a mean score at each age was used in these analyses to address the smaller item pool measured at age 10 – 12 (33 items) versus age 15 – 17 (62 items) (for more details on group creation and estimation see Shaw et al., 2012). The trajectory analyses yielded 4 distinct groups: a low group with very little AB across adolescence (*n*=171; 63%), a late-starting moderate group with initially low levels of AB, increasing from age 15 – 17 (*n*=54; 20%), a desisting group with very high levels at age 10 and decreasing across adolescence (*n*=15; 6%), and an early/high group with initially high levels of AB that increased dramatically across adolescence (*n*=28; 10%). These trajectory groups have previously been shown to be valid in this sample as they discriminated both court involvement and behavior disorder diagnosis at age 17 (Shaw et al., 2012). In univariate analyses, these groups were treated as categorical and used in ANOVAs as the grouping variable. To test for age-of-onset group differences in a meaningful way (and avoid assumptions of linearity) in regressions with multiple predictors, it was necessary to use contrast codes for the regression analyses (Cohen, Cohen, West, & Aiken, 2003). For the first contrast code, to compare those in AB versus non-AB trajectories, the low group was coded as a −3 and each of the AB groups (late starting, desisting, early/high) were coded 1. For the second contrast code, to specifically compare early versus late starting groups consistent with past research (Burt & Hopwood, 2010; Moffitt et al., 2002), the low and desisting groups were coded a 0, the late starting group was coded −1, and the early/ high group was coded as 1.

Callous/Unemotional Traits **(age 17 and 20)—**CU traits were measured via self-report at age 17 and age 20 using five items from the six-item CU factor from the Antisocial Process Screening Device (APSD) (Frick, Bodin, & Barry, 2000). These 5 items from the APSD assess lack of empathy and affect, and callousness (e.g., you are concerned about the feelings of others) on a 3-point rating scale (1=not at all true, 2=sometimes true, 3=definitely true). At age 17 and 20, exploratory and confirmatory factor analyses with WLSMV estimation in Mplus 5 (as described above) supported the 6 original CU items loading on one factor. However, one item ('you hide your emotions from others') had poor loadings, particularly at age 20 (age 17= −.48; age 20= −.11), and was excluded from consideration, leading to a consistent 5 item factor at both ages with moderately acceptable internal consistency at age 17 (α=.73) and age 20 (α=.60) consistent with internal consistency of this measure in past studies (see Dillard, Salekin, Barker, & Grimes, 2013).

Although this scale formed a dimensional measure of CU traits at both ages, we were also interested in examining diagnostic categories and thus created a measure of DSM-5 Conduct Disorder (CD) diagnosis with the "limited prosocial emotions" specifier, which is based on measures of CU traits (Frick & Moffitt, 2010). To create these categories, consistent with research done on the DSM-5 specifier (Kahn, Frick, Youngstrom, Findling, & Youngstrom,

2012), we used the four items from the APSD that most closely overlap with 4 DSM-5 items within the limited prosocial emotions specifier (i.e., lack of remorse/guilt, callousness/lack of empathy, unconcerned about school performance, shallow/deficient affect). We recoded these items into present (1 = "definitely true") or absent (0 = "not true at all" or "sometimes true"). Consistent with the DSM-5 scheme, we classified CD+CU+ participants as those who endorsed 2 or more of these items in addition to a diagnosis of CD on the K-SADS at age 17. 35 of 250 (14%) individuals within the sample with K-SADS data were diagnosed with CD. Of those with CD, 14 (40%; 6% of the total sample) met criteria for the CU specifier, whereas the other 21 boys were diagnosed with CD but did not meet the CU specifier (60%; 8% of the total sample). Whereas the rates of CU trait diagnosis within CD diagnoses may appear high, they are consistent with previous studies using this same methodology (Frick et al., 2014; Kahn et al., 2012).

Court records (ages 15-18 & 18-22)—To assess each boy's involvement with the legal system during adolescence and then during adulthood as an outcome of interest, with written permission from primary caregivers, juvenile court records were obtained annually from the primary county where the participants resided (Allegheny, PA) and, when available, other counties where participants lived. Petitions were coded dichotomously into whether the boy had ever had a petition against him. Of the boys included in these analyses, 241 had court data available during the juvenile period, and of these boys, 84 (35%) had at least one petition against him. For arrest records in the adult years, we used the Pennsylvania state public court records website to search for the child's (now young man's) name and date of birth. These records were last checked in February of 2014 when almost all boys were at least 21 years old (and up to 24 years old). Of the full cohort that was searched, 91 young men (29%) had at least one arrest and the probabilities of arrest during adolescence and adulthood were moderately correlated (r=.22). As the juvenile and adult records were obtained through different methods and are adjudicated in different ways, we report separately on petitions during the adolescent years and adult years, which also allows for analysis of relatively concurrent records during adolescence and prospective outcomes via adult records.

Data analytic plan

Primary analyses were computed in SPSS v.20. As there was missing data across ages, multiple imputation using a Markov Chain Monte Carlo approach was used to create five data sets (Rubin, 1996). All variables were imputed except trajectory group membership which was taken from Shaw et al., 2012, leading to an effective sample size of 289 participants that had some data at either time point (age 17 and 20), and 267 for analyses involving trajectory group consistent with Shaw et al. (2012). Statistics presented throughout the manuscript are the pooled estimates across the five datasets unless otherwise specified. In the case of ANOVA, χ^2, and Fisher exact tests, pooled estimates were not available in SPSS, thus the estimates from the first imputed dataset are presented. Note that for all results presented, outcomes and patterns of results were almost identical across each imputed dataset and when using listwise deletion with the original dataset. Finally, for variables with (expected) high levels of skew (i.e., self-reported delinquency, aggressive and rule breaking

symptoms, antisocial personality disorder symptoms), the variables were transformed using a natural log transformation when they were used as dependent variables.

Results

Zero order correlations and descriptive statistics are presented in Table 1. Tables 2 and 3 present analyses based on age of onset and CD/CU groups respectively. Note that for clarity the tables present data by *analysis type* (i.e., ANOVA vs. regression) and the following sections present results by *specific hypothesis/research question* (i.e. by construct and question).

What is the overlap between subtyping schemes at age 17?

Are early starters high on CU traits and more likely to be diagnosed with CD/CU?—Youth who met criteria for CD were over-represented in the early starting trajectory group (Fisher exact test=51.2, *df*=6, *p*<.001); however, those with CD+CU+ were not more common in the early starting group: 44% (11 out of 25) of the early starting group met for CD+CU− and 16% (4 out of 25) of the early starting group met for CD+CU+. Instead, those with CD+CU+ appeared to be over-represented in the late starting group: 6% (3 out of 52) of the late starting group met for CD+CU− and 10% (5/52) of the late starting group met for CD+CU+. An ANOVA examining dimensional measures of CU traits separated by trajectory group was also consistent with this conclusion (Table 2); none of the groups were statically different in their levels of CU traits (though the mean of the desisting group was the highest). In sum, there was little evidence of overlap between those high on CU traits and those who are classified as early starting youth using either dimensional or person-centered measures of CU traits.

Are early starters higher on aggression versus rule breaking symptoms?—As shown in Table 2, when examining aggression and rule breaking as outcomes by trajectory group using ANOVAs and pairwise comparisons, early starters were particularly high on aggressive symptoms – higher than late starters and the low AB group. Desisters, late starting and early starting youth were all elevated on rule breaking compared to the low AB youth, with early starters being significantly higher than late starters. Thus, consistent with past research (Moffit, 2003), aggressive symptoms appear to represent a distinguishing feature of early starters (and perhaps the desisting group as well). Rule breaking, by contrast, was high among all 3 AB groups, although early starters were significantly higher than late starters on this dimension.

Are those high on CU traits higher on aggressive versus rule breaking symptoms?—As shown in Table 1, when examined dimensionally, CU traits were modestly correlated with CD diagnosis (*r*=.20) and CD symptoms (*r*=.21), with similar correlations between CU traits and the aggressive (*r*=.20) and rule breaking symptom dimensions (*r*=.16; all *p* values <.05 unless otherwise specified). When aggressive and rule breaking symptoms were entered into a regression predicting age 17 CU traits, neither variables predicted unique variance in CU traits (Aggressive Symptoms: *B*=.43, *SE*=.27, *β*=.13, *p*=.13; Rule Breaking Symptoms: *B*=.28, *SE*=.16, *β*=.15, *p*=.09). When examined using a

person centered approach of ANOVAs and pairwise comparisons (Table 3), both aggressive and rule breaking symptoms were higher in CD+CU− and CD+CU+ groups than the CD-CU- group, but these groups (CD+CU+, CD+CU−) did not differ statistically from each other. These results suggest that CU traits are correlated similarly with aggressive and rule breaking symptoms, but that this relationship may not hold when accounting for CD diagnosis. To explore this issue further, we conducted two regression analyses in which CU traits predicted aggressive and then rule breaking behaviors (results not shown). In these regressions, when CD diagnosis was partialled out, the association between CU traits and these outcomes became non-significant (both p's>.19), indicating that much of the relationship between these dimensions and CU traits may have to do with the overlap between CU traits and CD diagnosis/severity.

Which outcomes does each subtyping scheme predict at age 20?

Does the early starting group have the highest later delinquency, rate of antisocial personality, and depression diagnoses? Does late starting preferentially predict substance use?—When analyzed using ANOVAs with pairwise comparisons, trajectory group membership significantly discriminated each adult outcome. The low AB group was protected from all negative outcomes at age 20 (Table 2). Early and late starters demonstrated the highest level of self-reported delinquency and percentage of depression diagnoses but, importantly, did not differ statistically from one another. Desisting and early starting groups demonstrated the highest levels of APD symptoms and diagnoses but did not differ from each other for either outcome. For substance abuse and dependence, early starters were higher than the later starting and low AB groups. In sum, the low AB group demonstrated the lowest levels of all maladaptive outcomes, and early starters generally demonstrated the highest levels of symptoms and diagnoses, except for CU traits. However, for some outcomes (APD symptoms, substance abuse and dependence) early starters (and "desisters") were higher than late starters, whereas for others (self-reported delinquency, depression, CU traits) early and late starters did not differ statistically.

Do CU traits predict Age 20 outcomes?—In zero-order correlations, dimensions of CU traits at age 17 predicted adult self-reports of CU traits (r= .41), the probability of being diagnosed with substance dependence (r = .14), and abuse (marginally: r = .12, p=.11), and predicted the chances of arrest during adolescence (r =. 17), but not adulthood (r = .09, p = .18; Table 1). However, in contrast to our hypotheses, CU traits did not predict APD symptoms or diagnosis, nor were CU traits significantly associated with later depression diagnosis (r = −.05, p = .47). The person-centered results presented in Table 3 analyzed using ANOVAs and pairwise comparisons further indicate that though CD diagnosis significantly predicted all outcomes, in contrast with our hypotheses, the CD+CU− versus CD+CU+ groups did not differ significantly across any outcome variable. For APD symptoms and diagnosis, as well as substance abuse and dependence diagnosis, both CD groups were significantly higher than the group not diagnosed with CD, but they did not differ from each other. For depression diagnosis at age 20 the CD+CU+ group was *intermediate* to the CD+CU− group and the non-CD group. The only exception to the overall pattern was in examining CU traits at age 20, in which, not surprisingly, the CD+CU

+ group was the highest on CU traits, albeit did not differ statistically from the CD+CU−
group (see Table 3).

Do aggression and rule breaking differentially predict Age 20 outcomes?—As
shown in Table 1, aggression and rule breaking symptoms predicted all concurrent (e.g.,
adolescent arrest) and prospective outcomes based on zero-order correlations, including
APD symptoms, APD diagnosis, substance abuse and dependence diagnosis, and CU traits
at age 20. The exception was depression diagnosis, which was uniquely predicted by
aggressive symptoms. In contrast to the hypothesis that aggression would be a stronger
predictor of some outcomes, aggressive and rule breaking symptoms had similar-magnitude
associations with outcomes, with none of the correlations differing statistically from each
other. The exception was that for APD diagnosis, aggressive behaviors demonstrated a
statistically larger correlation with APD diagnosis than rule breaking when comparing the
magnitude of correlations between APD and each predictor ($Z = 2.53$, $p < .01$) using the
Steiger (1980) test for comparison of correlations sharing one variable in common (Lee &
Preacher, 2013).

Which subtyping scheme uniquely predicts outcomes over and above other subtyping schemes?

**Does the early starting category predict later outcomes over and above other
subtyping approaches?**—Table 4 presents results from linear and logistic regressions
using subgrouping schemes to predict adolescent arrest records and prospectively predict
age 20 outcomes. In this series of regressions, all subtyping schemes were examined
dimensionally as predictors whereas trajectory group was examined using the contrast codes
described above. Those in any partially or persistently high AB trajectory (i.e., early/high,
late, or desisting groups versus those in the "low/never starting group) were at greatest risk
for all outcomes, even when controlling for other subgrouping dimensions (except for the
outcome of adolescent arrests). Thus, the most robust predictor of adult outcomes was
simply being in a trajectory group that involved AB during adolescence. Beyond this
contrast, early starters demonstrated higher risk than late starters for adolescent and adult
arrests, APD symptoms and diagnosis, as well as substance abuse and dependence.
Importantly, however, the strength of these coefficients was reduced in the second step of
the regression analyses when controlling for aggressive symptoms, rule-breaking symptoms,
and CU traits. In particular, only the early starting contrast code (i.e. early starters vs. later
starters) continued to account for unique variance in predicting APD symptoms and adult
arrest records.

Do CU traits add unique variance to the prediction of later outcomes?—CU
traits at age 17 predicted CU traits at age 20 but did not significantly predict other age 20
outcomes in regressions when accounting for aggressive symptoms, rule breaking symptoms
and trajectory group.

**Does the aggression/rule breaking approach add unique variance to the
prediction of later outcomes?**—The number of aggressive symptoms was a robust
predictor of adolescent (but not adult) arrest, APD symptoms and diagnosis, and depression

and substance use diagnosis after accounting for other subtyping dimensions in multiple regressions (though relationships with APD and substance dependence diagnosis were trend level). The number of rule breaking symptoms, by contrast, predicted adolescent arrest and marginally predicted APD symptoms ($p = .05$).

Overall, the presence or absence of AB across adolescence was the most robust predictor of deleterious outcomes in early adulthood. A dimension of aggressive behaviors added explanatory power to predicting APD diagnosis and symptoms, depression diagnosis, as well as the presence or absence of an adolescent arrest record, whereas early starting AB added explanatory power only when predicting APD symptoms and adult arrest record. CU traits only added explanatory variance when predicting concurrent court arrest records and later CU traits.

Discussion

Overall, this study tested important and novel questions regarding the overlap and predictive utility of the 3 most common subtyping approaches for understanding heterogeneity in youth AB in a sample of low-income males followed prospectively. The results indicated high overlap between aggression and early starting AB, but much less overlap between these schemes and CU traits. Being in an AB trajectory group (i.e., desisting, late, early) across adolescence robustly predicted adult outcomes, with early starters being at particular risk for APD symptoms and adult arrest. Aggressive symptoms appeared to capture the most unique variance in most of the adult outcomes when controlling for the overlap of all schemes. CU traits showed stability from adolescence to adulthood but these traits were not a robust predictor of adult outcomes over and above other subtypes approaches. Given the complexity of the results, we organize the discussion by subtyping scheme.

Age of onset

Consistent with the literature, early starting AB was associated with a more malignant course, despite having similarly high levels of AB with late starters in late adolescence. Our results indicated that all AB groups were relatively high on rule breaking but early starters were particularly high on rule breaking and were the only group high on aggression. This result emphasizes that though early and late starters may both have higher AB in late adolescence, early starters' trajectories appear to be higher in terms of severity of rule breaking symptoms and be marked by an additional set of aggression symptoms not seen in other groups, even during adolescence when both early and late starters demonstrate a peak in AB.

Early starters were highest on likelihood of adolescent and adult arrest, APD symptoms and diagnosis, and substance abuse diagnosis but not self-reported delinquency or CU traits. This result was consistent with seminal work demonstrating that early starters to appear to be highest on many, but not all, maladaptive outcomes in early adulthood (Moffitt et al., 2002). Also consistent with Moffitt's work, although late starters were not higher than early starters on any outcome, late starters were nonetheless impaired *compared to the non-AB group* on adult AB, APD symptoms, depression diagnosis, and CU traits. Thus, although this later onset trajectory may not end in as severe outcomes as early starters, this group is

still associated with multiple negative outcomes in early adulthood. However, it should be noted that our follow-up was in emerging adulthood and thus differences between these groups may narrow or widen later in adulthood.

Interestingly, being in an AB trajectory group (i.e., early, late, or desisting) added unique explanatory power above other subtyping groups to the prediction of adult outcomes; however, being an early starter only uniquely predicted APD symptoms and adult arrest record in a multiple regression framework. In fact, as discussed below, in a multivariate framework the addition of aggressive and rule breaking symptoms attenuated the magnitude of associations for the early starting group in predicting later outcomes. This is consistent with the small amount of literature in this area (Burt, Donnellan, Iacono, et al., 2011; Burt & Hopwood, 2010) and demonstrates that examining aggressive and rule breaking symptoms may be more helpful in predicting later outcomes than age of onset alone. Overall, early starting was not as powerful of a predictor in multivariate models as we had expected or one might expect given the major focus on this subgroup in the literature. On the other hand, early starting was the best unique predictor of adult arrest record which is a very important outcome.

In interpreting results examining age of onset, two important points should be considered. First, age of onset was assessed via trajectory analyses of self-reported delinquency from age 10 – 17. This method differs substantially from the way that clinicians using the DSM-5 are able to make this diagnosis (i.e., by asking for self-report retrospective recall of when symptoms began). Whereas our approach uses more data and therefore may contain greater accuracy, it is also less clinically meaningful and thus may not be comparable to many previous studies in this area. Second, our trajectory method identified a fourth group of "desisting" youth, which could mark youth who are improving in their AB during adolescence. However, as we have discussed in a recent related paper examining these trajectory groups in this sample (Shaw et al., 2012), this "desisting" group may actually represent a group of youth who begin under-reporting their AB as they get older and thus may be misclassified (i.e., they should be in the early/high group based on their 60% record of arrest as juveniles). This issue may explain why ANOVAs using trajectory group to predict later outcomes show less predictive power of the early starting group than contrast codes that only compare early to late starters (rather than early starters to all other groups).

CU traits

Counter to our hypotheses, CU traits were not more common in early starters, nor were those high on CU traits more likely to be early starters. CU traits were similarly correlated with both rule breaking and aggressive symptoms and neither set of symptoms appeared to be unique to CU traits. Whereas it is surprising that CU traits were not more highly overlapping with age of onset and aggression, there have only been a few prior prospective studies to examine this question and some of the existing studies have found relatively even distributions of those with CU traits between early and late starters (e.g., Dandreaux & Frick, 2009; Silverthorn et al., 2001). A caveat is that CU traits in this study were measured in late adolescence and it is possible that this construct or measure taps a different process than CU traits measured earlier in adolescence/childhood. Our measure of CU traits was also

fairly short, and thus more extensive measurement of this construct (i.e., with the Inventory of Callous-Unemotional traits, the Clinical Assessment of Prosocial Emotions) may yield different results.

Consistent with previous research (Frick & Dickens, 1996), CU traits did predict important outcomes such as adolescent arrests, later CU traits, and substance dependence. Interestingly, the dimensional measure of CU traits was a much better predictor of outcomes than the group based approach that is now used in DSM-5. As many studies involving CU traits have examined this construct dimensionally, it will be important for research to examine this construct as it is defined in the DSM-5 to assess whether a dichotomous measure (that also requires CD diagnosis) will capture the same predictive power as studies using dimensional measures.

In contrast to previous longitudinal work (e.g., Loeber et al., 2002), CU traits did not predict adult APD diagnosis or symptoms. Additionally, CU traits did not contribute unique variance to the prediction of later outcomes other than later CU traits over and above aggression/rule breaking dimensions and trajectory class membership. Although this outcome was surprising, it is important to consider how these findings differ from other studies showing the power of CU traits in predicting worse AB outcomes. First, many of these studies used clinical or forensic samples with individuals already high on CD symptoms, and thus CU traits may be most predictive in the most extreme samples. Second, it is important to consider the base rates of CU traits in this sample. Although this sample is high risk and has a substantial number of youth with significant AB, only 35 boys in the sample met criteria for CD and only 14 of those boys met for the CU specifier. Therefore, even in a high risk community sample with fairly high rates of adolescent arrests (35% had court records), highly elevated CU traits were relatively rare. Overall, these findings emphasize the need to specify what outcomes researchers expect CU traits to be especially predictive of, and whether this prediction is unique to CU traits above and beyond the severity of CD symptoms. Finally, it is important to note that much recent research has focused on how those with and without CU traits may have similar ABs, but a different underlying etiology to those behaviors (Frick et al., 2014; Frick & White, 2008). As this study only examines overlap of subgroups and prediction of outcomes, it cannot address the extent to which these groups share or differ in earlier risk or underlying etiology.

Aggression versus rule breaking

Aggressive and rule breaking symptoms were robust correlates of all outcomes. Surprisingly, both dimensions appeared to correlate at similar levels with most outcomes in univariate models. When controlling for their overlap and other subtyping schemes, aggressive behaviors alone predicted unique variance in probability of adolescent arrest, APD symptoms and diagnosis and depression diagnosis but not substance use or dependence. Beyond simply knowing if a youth was classified as having any AB or not, aggressive symptoms appeared to explain the most unique variance in a majority of outcomes which is consistent with a small set of recent studies (Burt, Donnellan, McGue, et al., 2011; Burt & Hopwood, 2010).

Comparison of subtyping approaches

Consistent with our hypotheses, aggression and early starting appeared to have a high overlap and account for similar variance. However, aggressive symptoms were a better predictor of most outcomes than age of onset. Albeit intriguing, this result could be considered in terms of measurement issues. As age of onset is a categorical measure, it may provide less explanatory power than dimensional approaches, though it may be more clinically useful. As aggression and rule breaking appeared to have similar relationships with many variables (which is not surprising given their moderate correlation in this sample), it may be that examining aggression and rule breaking, especially within the same regression, ends up tapping the *severity* of AB, as these dimensions are essentially symptom counts of CD. Thus, our results could simply reflect the continuity of severe AB across the life span. To address this potential confounding of aggression and rule breaking as simply measures of severity, we conducted additional analyses (Supplemental Table 1) in which we estimated a similar set of regressions predicting outcomes shown in Table 4 in which we dichotomized aggression and rule breaking (0=no aggression symptoms or no rule breaking symptoms, 1=any aggression symptoms or any rule breaking symptoms). In these regressions, the dichotomized measures performed similarly in prediction of later outcomes, and in some cases, were *better* predictors than the dimensional versions. Moreover, the dichotomized variables showed more specificity in that having any aggressive symptoms predicted APD diagnosis more strongly than previously, and having any rule breaking symptoms emerged as a unique predictor of substance use and dependence, as we had hypothesized. Thus, it appears that there is something unique about the presence of these particular symptoms in terms of predicting outcomes, over and above their implications for severity of CD symptoms. Thus, clinically, it may be most useful, beyond age of onset, for clinicians to consider the severity of symptoms by symptom count, and the *presence of an aggressive symptom*, which according to our results, may uniquely predict the most maladaptive outcomes in early adulthood. In short, we suspect the *type* of AB youth engage is an important consideration when thinking about the longer-term ramifications of early AB.

Beyond these two subtypes, CU traits appeared to have the least unique predictive validity above and beyond the other variables. A wealth of studies have shown that CU traits predict worse AB outcomes (Frick et al., 2014), yet studies in this area have not been consistent in controlling for the severity of AB or other aspects of AB such as age of onset, so it is important for studies to begin assessing the unique predictive nature of CU traits, over and above the severity of AB and age of onset. It is also worth noting that CU traits were self-reported, which has been an issue of controversy in the field of adult psychopathy (Hare, 1985). Moreover, as all adult outcomes relied to some extent on self-report, those higher on CU traits may have under-reported their adult outcomes, lessening the predictive power of CU traits.

Limitations and Future Directions

This study contained several strengths including the use of longitudinal data on a relatively large, diverse sample of urban males, the use of multiple reporters and validated clinical assessments, and the comparison of multiple subtyping approaches. However, there are

several limitations worth noting in interpreting the results. First, this is a sample of urban, predominantly low-income males recruited from the community and thus cannot be directly compared to broader epidemiological or higher-severity clinical samples (or samples of girls) that have been the basis of many of the studies cited throughout the introduction. Nor can the current results necessarily be generalized to studies of middle-class populations from suburban or rural communities. Second, we did not have a measure of psychopathy in adulthood and thus we could only examine if CU traits predicted a later measure of CU traits and not adult psychopathy. Very few studies have demonstrated this link between adolescent CU traits and adult psychopathy (e.g., Lynam, Caspi, Moffitt, Loeber, & Stouthamer-Loeber, 2007), and it would have been helpful to examine if CU traits have specificity in predicting psychopathy versus APD. Third, although we attempted to measure each construct in a way consistent with past research and clinical practice, there are some limitations in our measures. For example, measures of aggression (versus rule breaking) may confound the type of act (i.e., aggression) with the severity and frequency of the act (i.e., aggressive behaviors are often less frequent but more severe than rule breaking). Our analyses would benefit from the creation of a scale that matches aggressive and rule breaking items based on their frequency. Unfortunately, such a measure needs to be developed and validated for diverse samples and does not exist in this study (for a further discussion of this issue see Burt, 2012).

Two other limitations bear discussion in the context of the need for future research. First, we did not focus on the potential *interaction* between subgrouping approaches. For example, CU traits may be most predictive only when they are in the context of early onset AB (i.e., an interaction between age of onset and CU traits). However, based on sample size we were unable to test this question with sufficient power. As noted in the footnote to Table 4, we did explore these interactions but did not find any significant results. We were likely under-powered given the small amount of overlap between those qualifying as early starters and also high on CU traits. Second, our results may have been dependent on the way in which we created each measure. For example, our measure of self-reported delinquency indexes both severity and variety, likely with a greater weight on variety (i.e., the total number of different antisocial acts), which may lead to an over-emphasis on frequent but less severe acts (though see Bendixen, Endresen, & Olweus, 2003). The trajectory groups that were based on the self-report of delinquency and used to assess age of onset also contained information both about age and severity, which may confound the effect of age of onset and overall severity. Finally, and most importantly, our measures of aggression and rule breaking came from the K-SADS, which contains both parent and child reports (as well as clinician judgment). Thus, aggression and rule breaking may have been strongest in prediction of later outcomes based on the better measurement of this construct. To address these limitations, we present three alternate ways of creating the subtyping constructs and present the methods and a discussion of the results in the Supplemental Materials (with statistical results presented in Supplemental Tables 2 – 5). These analyses indicate that the way in which we constructed each measure has a bearing on its predictive power and overlap. Clearly, more work is needed to identify the "ideal" way of identifying those who are early starting or high on aggression or high on CU traits, as measurement (and measurement error) may play a large role in later predictive power. Future studies are

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needed that explicitly examine the role of measurement in each of these constructs, particularly as they relate to their relative predictive power.

Summary

In conclusion, we found moderate overlap between aggressive symptoms and early starting AB, but low overlap between these constructs and CU traits. Consistent with past research, we found that any AB in adolescence portends poorer outcomes in early adulthood, but that early starting AB and those with more aggressive symptoms had the worst outcomes. This work underscores the importance of understanding the overlap of these subtyping approaches and their potential clinical utility, including more evidence that dimensional measures such as examining severity of AB, may be helpful in predicting outcomes. Overall, aggressive symptoms and age of onset were highly overlapping and good predictors of poor outcomes in emerging adulthood. CU traits appear to identify a different group of youth than age of onset or aggressive symptoms. However, CU traits at diagnosable levels were relatively rare in this sample and did not appear to be as good a predictor of adult outcomes as expected. Ultimately, this research underscores the complexity of comparing these approaches and emphasizes that, though each subtyping approach identifies a more severe group, the youth identified by each are not necessarily entirely overlapping.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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Table 1

Correlations of study variables

	Mean (SD)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Early SES	23.3 (9.2)														
2. Race (0=white; =non-white)	.49 (.5)	−.13*													
Adolescent variables															
3. CD diagnosis	.14 (.35)	−.15*	−.04												
4. CU traits (age 17)	3.9 (2.5)	−.16*	.06	.21											
5. Aggressive symptoms	.31 (.83)	−.13+	.05	.60**	.20**										
6. Rule Breaking symptoms	.75 (1.2)	−.11+	.07	.35**	.16*	.37**									
7. Any adolescent arrest record?	.34 (.48)	−.23**	.17**	.34*	.17**	.33**	.31**								
Adult outcomes															
8. APD symptoms	.77 (1.6)	−.09	.10+	.31**	.09	.40**	.31**	.27*							
9. APD diagnosis	.13 (.34)	−.10	.05	.24*	.06	.33**	.17+	.19+	.74**						
10. Depression diagnosis	.10 (.30)	.01	.03	.17*	−.05	.20**	.12	.07	.20**	.09					
11. Substance abuse diagnosis	.26 (.44)	−.02	−.01	.10	.12	.23**	.26**	.15+	.40**	.27**	.11				
12. Substance dependence diagnosis	.15 (.36)	.01	−.03	.23**	.14*	.29**	.23**	.16	.33**	.29**	.15+	.64**			
13. CU traits (Age 20)	2.6 (1.7)	−.18**	.18**	.15*	.41**	.14*	.23*	.18*	.13*	.13+	−.01	.15*	.18**		
14. Self-reported delinquency	10.5 (8.8)	.11	−.02	.18+	.05	.19**	.24**	.15+	.41**	.37**	.10	.37**	.33**	.14*	
15. Any adult arrest record?	.29 (.46)	−.02	.22**	.12+	.09	.17**	.20**	.22**	.22**	.12+	.09	.26**	.14*	.17**	.25**

Note: N=289.

Variables with high skew (aggression, rule breaking, self-reported delinquency, APD symptoms) were transformed with a natural log transformation prior to computing correlations. Means and *SD* are presented on non-transformed variables and on original data before imputation.

** p<.01

* p<.05

+ p<.10.

Table 2

Concurrent and prospective relationships between age of onset and outcomes

	Omnibus test	1. Low AB Mean (SD) n=170	2. Desisting Mean (SD) n=15	3. Late Starting moderate Mean (SD) n=54	4. Early Starting/ High Mean (SD) n=28	Significant group differences
Concurrent relationships (age 17)						
Aggressive symptoms	F=20.17 p<.001	.18 (.52)	.69 (.81)	.28 (.64)	1.4 (1.6)	1<2,4 3<4
Rule Breaking Symptoms	F=31.48 p<.001	.34 (.87)	1.2 (1.3)	1.1 (1.2)	2.0 (1.6)	1< 2,3,4 3<4
CU Traits (age 17)	F=2.0 p=.12	3.7 (2.5)	5.2 (2.8)	3.8 (2.5)	4.4 (1.8)	
Arrest record (adolescent)	χ^2=24.5 p<.001	22% (.42)	60% (.51)	42% (.50)	71% (.46)	1<2,3,4 3<4
Prospective relationships (age 20)						
Self-reported delinquency	F=24.04 p<.001	8.1 (7.4)	14.0 (11.9)	16.3 (8.9)	20.7 (9.8)	1<3,4 2<4
APD symptoms	F=41.0 p<.001	.37 (1.0)	2.7 (2.1)	1.2 (1.6)	2.5 (1.8)	1<2,3,4 3<2,4
% APD diagnosis	χ^2=26.9 p<.001	11% (.31)	47% (.51)	20% (.41)	43% (.50)	1<2,3,4 3<4
% Depression diagnosis	χ^2=20.1 p=.001	4% (.20)	13% (.35)	20% (.41)	25% (.44)	1<3,4
% Substance Abuse diagnosis	χ^2=30.1 p<.001	18% (.39)	47% (.52)	33% (.48)	64% (.49)	1<2,3,4 3<4
% Substance Dependence diagnosis	χ^2=31.0 p<.001	11% (.32)	33% (.49)	22% (.42)	54% (.5 1)	1<2,3,4 3<4
CU traits (age 20)	F=5.42 p=.001	2.2 (1.6)	2.8 (2.3)	3.1 (1.9)	3.5 (1.6)	1<3,4
Arrest record (adult)	χ^2=33.1 p<.001	20% (.41)	60% (.50)	33% (.48)	68% (.48)	1<2,4 3<4

Note. N=268 for all analyses. Statistical comparisons of the means were conducted using ANOVA on the log-transformed data (for aggressive, rule breaking and self-reported delinquency), as they better approximate normality. However, the corresponding raw symptom counts are presented in here and discussed in the text to promote ease of understanding. Post-hoc group differences were tested using a Tukey test (for ANOVAs with continuous outcomes) and individual χ^2 tests (for binary outcomes) and are marked if p<.05. Results with binary outcomes are presented with χ^2 tests but were similar in terms of significance when using Fisher exact tests or ANOVAs.

Table 3

Concurrent and prospective relationships between CD/CU groups and outcomes

	Omnibus test	1. No CD diagnosis mean n=215	2. CD – CU mean n=21	3. CD + CU mean n=14	Significant group differences
Concurrent relationships (age 17)					
Aggressive symptoms	F=146.4 p<.001	.07 (.28)	1.8 (1.5)	1.8 (1.3)	1<2, 3
Rule Breaking Symptoms	F=99.1 p<.001	.40 (.71)	2.9 (1.3)	3.0 (1.8)	1<2, 3
Arrest record (adolescent)	χ²=46.5 p<.001	24% (.43)	89% (.31)	92% (.29)	1<2,3
Prospective relationships (age 20)					
Self-reported delinquency	F=6.41 p<.01	10.6 (8.8)	19.6 (12.8)	11.1 (5.7)	1, 3<2
APD symptoms	F=16.3 p<.001	.68 (1.4)	2.0 (1.5)	2.0 (1.9)	1<2,3
% APD diagnosis	χ²=18.8 p<.001	13% (.34)	43% (.51)	43% (.51)	1<2,3
% Depression diagnosis	χ²=11.1 p<.01	7% (.26)	29% (.46)	14% (.36)	1<2
% Substance Abuse diagnosis	χ²=8.52 p<.05	25% (.44)	52% (.51)	43% (.51)	1<2,3
% Substance Dependence diagnosis	χ²=17.8 p<.001	15% (.36)	52% (.51)	29% (.47)	1<2,3
CU traits (age 20)	F=6.92 p=.001	2.4 (1.7)	2.9 (1.9)	4.2 (1.7)	1<3
Arrest record (adult)	χ²=18.3 p<.001	26% (.44)	71% (.46)	29% (.47)	1,3<2

N=250 for all analyses and the data from the first imputed dataset are presented though note that results were equivalent across 5 imputed datasets. Statistical comparisons of the means were conducted on the log-transformed data (for aggressive, rule breaking and self-reported delinquency), as they better approximate normality. However, the corresponding raw symptom counts are presented in here and discussed in the text to promote ease of understanding. Post-hoc group differences were tested using a Tukey test (for ANOVAs with continuous outcomes) and individual χ^2 tests (for binary outcomes) and are marked if p<.05. Results with binary outcomes are presented with χ^2 tests but were similar in terms of significance when using Fisher exact tests or ANOVAs.

Table 4

Predicting emerging adult outcomes from adolescent subtypes of youth antisocial behavior

Outcome	Contrast Code 1: Presence of AB	Contrast code 2: age of onset of AB	Contrast Code 1: Presence of AB	Contrast code 2: age of onset of AB	Aggressive symptoms	Rule Breaking Symptoms	CU traits (age 17)
	Step 1			Step 2			
Any arrest/petition? (adolescence)	.33 (.07)**	.62 (.26)*	.14 (.09)	.21 (.29)	.75 (.30)*	.47 (.16)**	.09 (.06)
Self-reported delinquency	.24 (.04)**	.11(13)	.22 (.04)**	.07 (.13)	.04 (.10)	.03 (.07)	.001 (.03)
APD symptoms	.17 (.02)**	.31 (.06)**	.14 (.02)**	.22 (.07)**	.13 (.05)**	.04 (.03)+	-.005 (.01)
APD diagnosis	.35 (.11)**	.56 (.26)*	.26 (.11)*	.25 (.31)	.63 (.31)+	.03 (.17)	-.03 (.10)
Depression	.34 (.16)*	.16 (.30)	.24 (.18)+	-.23 (.37)	.65 (.27)*	.03 (.21)	-.15 (.11)
Substance Abuse	.33 (.08)**	.49 (.29)+	.26 (.09)**	.29 (.29)	.33 (.22)	.07 (.14)	.07 (.08)
Substance Dependence	.37 (.10)**	.56 (.28)+	.27 (.12)*	.28 (.30)	.46 (.25)+	.11 (.15)	.09 (.09)
CU traits (age 20)	.24 (.06)**	.17 (.22)	.19 (.07)*	.01 (.21)	.03 (.16)	.08 (.11)	.28 (.05)**
Any arrest/petition? (adult)	.36 (.07)**	.74 (.25)**	.33 (.08)**	.67 (.27)*	.05 (.20)	.08 (.14)	.07 (.06)

N=266

All tests two-tailed. Each box represents unstandardized regression coefficients with (SE). Patterns for Alcohol abuse and dependence were identical to substance abuse and dependence finding. Self-reported delinquency and APD symptoms were log transformed to account for their skew. Logistic regression was used for all binary outcomes and linear regression for all continuous outcomes. Similar regressions were explored using dummy-coded trajectory groups and interactions with CU traits at age 17 to predict adult outcomes. None of these interactions were statistically significant and are thus not reported but are available upon request.

+ p<.10

* p<.05

** p<.01.