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Which matters most? Demographic, Neuropsychological, Personality, and Situational Factors in Long-Term Marijuana and Alcohol Trajectories for Justice-Involved Male Youth

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Abstract

Justice-involved youth have high rates of alcohol and marijuana use. However, little is known about what may drive these rates over time. Using a large-scale (N=1,056; 41.4% African-American, 33.5% Hispanic) longitudinal study with strong retention (M retention = 90% over Years 1–7), we utilized random-effects regression to determine the comparative contribution of four sets of factors in justice-involved males' patterns of marijuana and heavy alcohol use (number of times drunk) over the seven years of follow-up: demographic, personality, situational, and neuropsychological factors. Across both marijuana and heavy alcohol use models, three factors were particularly strong contributors to lower rates of substance use: (1) Hispanic ethnicity, (2) less exposure (street) time, and (3) better impulse control. Similarly, two factors were strong contributors to increased rates of marijuana and heavy alcohol use: (1) delinquent peers and (2) family member arrest. Together, these findings indicate the relative superiority of these independent variables over other categories (i.e., neuropsychological factors) in predicting high-risk youths' long term (seven year) rates of substance use. These findings also suggest the importance of evaluating the connection of these areas for high-risk, adjudicated youth.

Keywords

marijuana; alcohol; trajectories; adolescents; juvenile justice

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Introduction

Throughout the past two decades, many American youth have moved towards alcohol and marijuana as their preferred substances of use (SAMHSA, 2014). Within the United States, recent surveys indicate that by age 14, 55.6% of American youth have consumed alcohol and 30.1% have used marijuana at least once, proportions that increase to 75.6% (alcohol) and 48.6% (marijuana) by age 18 (CDC, 2014). With rates surpassing mainstream youth, alcohol and marijuana have emerged as the primary substances of abuse among justice-involved youth (e.g., D'Amico et al., 2014; Feldstein Ewing, Venner, Mead, & Bryan, 2011), with many meeting criteria for substance use disorders (SUDs) (Aarons, Brown, Hough, Garland, & Wood, 2001). This is concerning, as adolescent alcohol and marijuana use are strongly connected with numerous health risk behaviors, protracted use, and poorer longer-term outcomes during adulthood (Abram et al., 2015; Boden, Fergusson, & Horwood, 2012; Elkington et al., 2008).

Despite the ubiquity of alcohol and marijuana use among adolescent populations, little is known about what factors drive and sustain use, particularly among justice-involved youth. While preliminary work has begun to examine use trajectories (e.g., Mauricio et al., 2009), many have relied upon piecemeal approaches. At the same time, these studies have yielded important information regarding potential salient variables related to long-term patterns of substance use.

To that end, studies have supported the relevance of demographic factors in high-risk youths' progression of alcohol and marijuana use over time (e.g., race/ethnicity; socioeconomic status; family factors; time in monitored settings) (e.g., Feldstein Ewing, Schmiege, & Bryan, 2014; Haberstick et al., 2014; Prado et al., 2012). Whereas others have shown the contribution of personality-level factors in youth substance use rates over time (e.g., externalizing disorders, impulsivity) (e.g., Abram et al., 2015; Mauricio et al., 2009; Prince van Leeuwen, Creemers, Verhulst, Ormel, & Huizink, 2011). Additional studies have indicated the role of situational factors in youths' continuity of alcohol and marijuana use (e.g., neighborhood problems; peer behavior; parent/guardian supervision) (e.g., de Looze, Janssen, Elgar, Craig, & Pickett, 2014; Fallu, Briere, & Janosz, 2014; Mauricio et al., 2009). In addition, an emerging body of research has suggested the impact of alcohol and marijuana use on the developing brain (e.g., Feldstein Ewing, Blakemore, & Sakhardande, 2014; Lubman, Cheetham, & Yucel, 2014; Volkow, Baler, Compton, & Weiss, 2014) and related neuropsychological functioning (e.g., lower attention switching, as measured by Trail Making Test B) (e.g., Day, Celio, Lisman, Johansen, & Spear, 2013; Day, Metrik, Spillane, & Kahler, 2013; Tahaney, Kantner, & Palfai, 2014).

While many of these studies have indicated the importance of each of these variables, existing designs have precluded the ability to cluster these variables into *groups* of potential contributors. Further, within the current literature, it is difficult to discern which set of factors may be *most* important as youth transition into emerging adulthood. Thus, we used the Pathways to Desistance study, a large-scale, multi-site, longitudinal study that followed serious youth offenders from adolescence into early adulthood. This is a highly-unique and

exceptional dataset that facilitates investigations of large, meta-level questions regarding the *relative* weight of each set of factors in the progression of youth marijuana and heavy alcohol use. Evaluating these questions with adjudicated youth is particularly important, as the larger body of youth addiction research has been primarily conducted with non-justice samples (Cohen & Piquero, 2009).

Although our work was broadly informed by the developmental psychopathology of SUDs (Chassin, Sher, Hussong, & Curran, 2013; Chassin, Sher, Hussong, Curran, & Colder, 2015), in the present study we used an atheoretical approach to disentangle the relative weights of each set of contributors in high-risk adolescents' marijuana and heavy alcohol use over time. Based on the substantive literature on situational factors (Wallace, 1999), we projected that this set of factors would be the strongest contributor to the progression of adolescent substance use (marijuana and heavy alcohol) from baseline to the seven year follow-up. Further, based on recent neurodevelopmental studies (Feldstein Ewing, Blakemore, et al., 2014; Filbey et al., 2014; Houck, Bryan, & Feldstein Ewing, 2013), we predicted that neuropsychological factors would weigh heavily in youths' substance use patterns.

Methods

We used data from Pathways to Desistance, a longitudinal study of serious youth offenders. Locations for this project (Maricopa County, AZ and Philadelphia County, PA) were selected based on feasibility criteria, including sufficient serious offending youth (including females), detailed processing information, racial/ethnic diversity, system cooperation, presence of established researchers, and distinct systems [e.g., one with more treatment available (PA) and one with less (AZ)]. Data regarding study rationale and design can be found in Mulvey et al. (2004), with more methodological details in Schubert et al. (2004).

Potential participants were identified for enrollment via court file review at each locale. To be included, youth had to be adjudicated delinquent or found guilty of a serious (felony) offense. Offenses for this sample included violent crimes against persons (41%), property crimes (26%), weapons (10%), sex crimes (4%), and others (4%). All eligible youth were invited to participate. All juveniles and their parents/guardians completed informed consent. Baseline interviews occurred immediately post-consent.

All participants were age 14–17 years at baseline. A total of 1,354 adolescents were enrolled. The full sample was predominantly racial/ethnic minority (41.4% African-American, 33.5% Hispanic) and male (86.4%). Every effort was made to follow-up youth every 6 months for the first 3 years of the study and annually thereafter through year 7, covering youth, on average from age 16 to 25. Over the 7 years, 86% of the sample completed >8 of 10 possible follow-ups with an average retention rate of 90% at each wave. In addition, 91 youth died (n=48; 3.5%) or discontinued participation (n=43; 3%).

For this paper, we evaluated the extent to which demographic, neuropsychological, personality, and situational variables obtained at the baseline interview predicted marijuana

and heavy alcohol use (times drunk) over time. Because of the small female sample (*n*=184), we focused all analyses on the male sub-sample only (N=1,056).

Dependent Variables

We assessed longitudinal marijuana use and heavy alcohol use using a modified substance use measure (Sher, 1991) from prior Pathways investigations (e.g., Chassin et al., 2010). We focused on these two outcomes because they are the most prevalent forms of substance use in this sample. For the first 6 waves, youth self-reported their frequency of heavy alcohol use (number of times drunk) and marijuana use over the past 6 months. Response options ranged from: 0 (*Not at all*), 1 (*1–2 times*), 2 (*3–5 times*), 3 (*1 time per month*), 4 (*2–3 times per month*), 5 (*1 time per week*), 6 (*2–3 times per week*), 7 (*4–5 times per week*), and 8 (*everyday*). At Year 4, funding changes led to yearly (rather than semi-annual) follow-ups. Thus, we standardized measures from the first 6 waves (first 3 years) into yearly observations by averaging waves 1 and 2, waves 3 and 4, and waves 5 and 6 to make them comparable to later waves. For validation, we also included a baseline evaluation of lifetime **DSM-IV/ICD-10 substance use disorder criteria** via the Composite International Diagnostic Interview (CIDI) (WHO, 1990), and an estimate of each adolescent's **number of criminal acts** during each follow-up period through the Self-Reporting Offending (SRO) instrument (Huizinga, Esbensen, & Weihar, 1991).

Independent Variables

Our longitudinal investigation of youth substance use was distinguished by factors which have gained previous theoretical and empirical research support (Loeber & Farrington, 1998).

Demographic Variables—Race/ethnicity was measured using 4 dichotomous variables: African-American (41.29%), Hispanic (34.56%), other race/ethnicity (4.55%), and White (19.60%; serving as the reference group throughout the analysis). Parents' baseline SES was calculated with the **Parental Index of Social Position** score ("ISP", Hollingshead, 1971) via formula [(Occupation score × 7)+(Education score × 4)]. Education values ranged from 1 = *Professional degree* to 7 = *<7 years of school*. Occupation values ranged from 1 to 7, with 1 = *Higher executives to major professionals* to 7 = *Unskilled*. When both parents provided data, the mean was used in the formula. In this system, lower scores indicate "higher" social position (e.g., score of 11–17 = *upper*; 18–31 = *upper-middle*; 32–47 = *middle*; 48–63 = *lower-middle*; 64–67 = *lower*). **Family arrest** dichotomously measured whether anyone in the youth's family had ever been arrested (77.97%). **Exposure time** reflected proportion of time spent in a secure facility at each time point (e.g., jails, prisons, detention centers, and residential treatment facilities). This variable was calculated by the youth's total number of days in a controlled environment divided by total days in the recall period (generating proportion scores from 0 to 1). Exposure time was included, as it operates as an opportunity variable either limiting or expanding the amount of time available for antisocial behavior (see Piquero et al., 2001).

Neuropsychological Variables—Cognitive dysfunction related to impairment in the prefrontal cortex of the brain was assessed through two widely-utilized neuropsychological

tests, the Stroop Color-Word Test (Golden, 1978) and the Trail Making Test (Reitan, 1979). Specifically, the Stroop was used to examine interference on reading ability. Time scores generated a marker for "Diagnosed Prefrontal Disorders" based on scoring algorithms within the manual (Golden & Freshwater, 2002). Using established algorithms, 3.7% (n=50) of the sample met criteria for a prefrontal cortex disorder. The Trail-making test was used to examine ability to switch attention. In the current analyses, we used the score reflecting ability to **shift cognitive sets** (Part B). The study participant's score was compared to age-appropriate standardization data provided in the manual (Reitan, 1992) to establish level of impairment. Based on the provided time range, 26.6% (n=356) of the sample had "mild/moderate impairment" and 11.4% (n=153) had "moderate/severe impairment." We also included the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999), an interviewer-administered measure which produces an estimate of **Full-Scale IQ** based on two subtests: Vocabulary and Matrix Reasoning; higher scores indicate greater intellectual ability.

Personality—We used **the impulse control** subscale from the Weinberger Adjustment Inventory (WAI; Weinberger & Schwartz, 1990) (e.g., *"I say the first thing that comes into my mind without thinking enough about it*"; e.g., 1= False to 5= True). Higher scores indicate greater impulse control (α = .76). The Emotionality, Activity, Sociability, and Impulsivity (EASI) inventory measures **internal emotionality** (Buss & Plomin, 1984) ("*I tend to be nervous in new situations*."; e.g. 1 = "Strongly disagree" to 5 = "Strongly agree"). Higher scores indicate greater emotionality (α = .61).

Situational—Neighborhood problems around the participant's home was assessed via a modified version of the Neighborhood Conditions measure (Sampson & Raudenbush, 1999). Items tap physical (e.g., "*graffiti or tags*") and social disorder (e.g., "*adults fighting or arguing loudly")* with higher mean values indicating more problems (α = .94). **Peer delinquency** was derived within the antisocial behavior scale (e.g., "*During the last six months how many of your friends have sold drugs?*"; e.g., 1 = "None of them" to 5 = "All of them") from the Rochester Youth Study (Thornberry, Lizotte, Krohn, Farnworth, & Jang, 1994) (α = .92). **Unsupervised routine activities** was a 4-item Likert scale drawn from the Monitoring the Future questionnaire (Osgood, Wilson, O'Malley, Bachman, & Johnston, 1996), assessing activities done without an authority figure (e.g., "*How often do you go to parties or other social gatherings*?"; e.g., 1 = "Never" to 5 = "Almost every day"). Higher scores reflected greater involvement in unstructured activities (α = .62). **Gang involvement** reflected whether the youth was a gang member prior to study entry (17.28%). **Gun carrying** reflected if youth ever carried a gun (50.86%).

Table 1 contains summary statistics, while Figure 1 shows the 7-year average for each outcome variables, marijuana use and heavy alcohol use (times drunk).[1]

[1]Multicollinearity was not a problem among the independent variables, as no correlation was > .6.

Analytic Plan

For these longitudinal analyses, we used random-effects regression (Greene, 2012). The random-effects model assumes that the unobserved individual-specific effect over time is uncorrelated with the independent variables. The model intercept has a random component equivalent to a multilevel model where level 1 observations are the longitudinal heavy alcohol or marijuana scores, and the level 2 predictors represent our baseline measures along with the time-varying exposure measure. To examine how each set of variables related to longitudinal marijuana and heavy alcohol use, we present five models: (1) demographics-only, (2) neuropsychological-only, (3) personality-only, (4) situational-only, with a final (5) full model containing all four sets of variables. Thus, resulting models provide estimates of the variability in the mean levels (intercepts) between persons (rates of use), rather than substance use growth.

Results

Overall Substance Use

At baseline, within the overall sample, 44.9% of youth met DSM diagnostic criteria for a lifetime substance use disorder (SUD). In terms of what percent of youth were using within this sample, just under half reported heavy alcohol use (times drunk) (41.7%–46.1%; waves 1–7) and marijuana use at each wave (36.0%–48.4%; waves 1–7; see Figure 1). Average rates of substance use for the full sample ranged from 0.8–1.35 (heavy alcohol) and 1.46–2.11 (marijuana; Figure 1) over the course of 7 years. Yet, importantly, within the substance-using sub-sample, means were much higher (M's =1.91–2.97 for heavy alcohol use; M's=3.11–5.18 for marijuana). In addition, in terms of predictive validity, there were strong relationships between both types of substance use and offending throughout the 7 years (r's = .28–.44 for heavy alcohol use; and r's =.40–.50 for marijuana use; data available upon request). Finally, youth showed an increased slope in use for both substances over the 7 years of follow-up.

Predicting 7-Year Marijuana Use

The demographic-only model (Model 1) results show that compared to Whites, Hispanic youth reported less marijuana use over time (see Table 2). In addition, youth with an arrested family member were more likely to use marijuana. In contrast, youth who had less exposure time were less likely to use marijuana. Model 2 shows that no neuropsychological variables were related to longitudinal patterns of marijuana use. However, of the personality variables, only greater impulse control (Model 3) was related to marijuana use. Of the situational variables (Model 4), neighborhood problems, peer delinquency, and unsupervised routine activities were positively related to marijuana use. Model 5 contains the fully specified model. Here, both Hispanic and other race/ethnic youth were less likely than White youth to use marijuana over time. Higher impulse control and less exposure time were associated with less marijuana use, while youth with a family member arrest were more likely to use marijuana. Finally, longitudinal patterns of marijuana use were strongly predicted by baseline situational variables, with more neighborhood problems, peer delinquency, and gun carrying all positively related to use.

Predicting 7-year Heavy Alcohol Use (Number of Times Drunk)

Table 3 presents the results for heavy alcohol use (number of times drunk). In the demographic-only model (Model 1), five variables were significant. African-American and Hispanic youth were less likely than Whites to report heavy alcohol use over time. Further, youth with parents of lower social position and less exposure time reported less heavy alcohol use. However, youth who had a family member arrest were more likely report heavy alcohol use. Unlike the marijuana results, two neuropsychological variables were related to heavy alcohol use, but in different directions (Model 2). Specifically, youth with higher IQ were more likely to report heavy alcohol use, while youth who had greater impairment on cognitive set switching were less likely to report heavy alcohol use.[2] The personality variables (impulse control; internal emotionality; Model 3) were both negatively related to heavy alcohol use. As seen in Model 4, in terms of situational variables, youth with greater neighborhood problems were less likely to show heavy alcohol use, while youth with more delinquent peers and more time in unsupervised activities were more likely to report heavy alcohol use. Finally, in the full model (Model 5) nine variables attained significance; compared to Whites, African-American and Hispanic youth were less likely to report heavy alcohol use over time. Youth with less exposure time were less likely to report heavy alcohol use, while youth with a family member arrest were more likely to report heavy alcohol use. Further, youth who had greater impairment on cognitive set switching, greater impulse control and higher internal emotionality reported less heavy alcohol use. Finally, youth with more delinquent peers and more time in unsupervised activities were more likely to report heavy alcohol use throughout the 7-year follow-up.

Discussion

At this time, many dispositional decisions in the juvenile justice system rely exclusively on data generated within the initial intake meeting. Thus, we utilized an atheoretical approach to take an unconstrained look at the comparative contribution of four sets of predictors evaluated within the baseline assessment on high-risk male youths' marijuana and heavy alcohol use over the course of seven years. To yield the most ecologically-valid data for this important policy area, we utilized data from a unique longitudinal study of serious, adjudicated youth offenders to see how these initially assessed factors related to rates of use over time. Based on seminal reviews (Wallace, 1999), we anticipated that situational factors would outperform other variables in predicting youths' long-term rates of marijuana and heavy alcohol use. Further, following recent data on the developmental neuroscience of addiction (Feldstein Ewing, Blakemore, et al., 2014; Filbey et al., 2014), we posited that neuropsychological factors would be highly relevant youths' marijuana and heavy alcohol use patterns.

Just about half of the sample met DSM diagnostic criteria for SUDs (44.9%) at baseline. Further, within the full sample, almost the same percentage reported substance use at each follow-up period throughout the course of the seven years (M=44.21% for heavy alcohol; 42.5% for marijuana), with the slope of youths' use increasing throughout this longitudinal

[2]It is important to note that youth who scored higher on the IQ test were less likely to have greater impairment as judged by the Trail-Making test ($r = -.391$, $p<.05$).

period. Of the sub-sample who were using, youth reported using fairly heavily (up to weekly use). Importantly, these rates of DSM diagnoses are much higher than those observed in across both the general adolescent population (Kilpatrick et al., 2000), as well as within other justice-involved youth samples (Wasserman, McReynolds, Lucas, Fisher, & Santos, 2003). Moreover, adolescents' substance use within this sample was strongly connected to other problem behaviors (rates offending) throughout the 7-year follow-up, providing an additional indicator of interference in functioning, a signature feature of DSM diagnoses. Consistent with other studies (Abram, Choe, Washburn, Romero, & Teplin, 2009; Abram et al., 2015), the protracted nature of their substance use behavior over time, and its strong connection to other problem behaviors (offending) suggests the need to interrupt this pattern of use to help transition youth to abstinence post-arrest. Additionally, these values reflect the nature of this sample, many of whom were incarcerated or in supervised care at several time points throughout the follow-up, which is likely to have impacted substance use access and/or related reporting at different follow-up points.

In terms of the comparative contribution, we did not find evidence that one set of factors (demographic, personality, situational, neuropsychological) outperformed others in terms of youths' marijuana and heavy alcohol use (times drunk) over the seven-year follow-up. Rather, a handful of smaller variables showed the strongest relationships to rates of both marijuana and heavy alcohol use. To this end, across both substances, three factors strongly predicted less marijuana and alcohol use: (1) Hispanic ethnicity, such that Hispanic youth (and to some degree African-American and other race/ethnic youth) showed less substance use than White youth; (2) exposure time, such that youth in supervised facilities showed less substance use, and (3) impulse control, wherein greater impulse control was related to less use of marijuana and alcohol. In addition, for both substances, two factors emerged as the strongest predictors of increases in marijuana and alcohol use: (1) delinquent peers and (2) family member arrest.

The lower rates of substance use for Hispanic and African American youth is in line with numerous studies that have indicated that despite greater rates of substance-related consequences (e.g., arrests, STI/HIV infection), youth of color show less substance use than justice-involved White youth (Braithwaite, Conerly, Robillard, Woodring, & Stephens, 2003; Feldstein Ewing et al., 2011). Interestingly, while protective effects for African American youth went away in the full marijuana model, Hispanic ethnicity continued to show protective effect against both substances of abuse. The next critical step is to evaluate how and by which mechanisms race/ethnicity exert their protective effects.

In line with others (e.g., Dougherty et al., 2013), impulse control also emerged as a protective factor for this sample. As suggested in the neuroimaging literature (Behan et al., 2014; Gruber, Silveri, Dahlgren, & Yurgelun-Todd, 2011), our findings indicate a potential link between executive control systems and the persistence of marijuana and heavy alcohol use for this group of youth. As suggested by our findings regarding the influence of delinquent peers, another compelling question is whether and how impulse control may interact, and/or be exacerbated in contexts with delinquent peers.

Congruent with prior work (Feldstein Ewing, Schmiege, et al., 2014), we also found that youth who spent more time in a facility or other supervised setting showed less marijuana and heavy alcohol use. While supervised settings do not always ensure treatment or rehabilitation, the findings here suggest the value of continuing to examine the connection between time off of the street and in protective settings for this population and decreasing rates of use.

In terms of risk factors, while situational factors were not collectively the strongest risk factor (Wallace, 1999), following research in this area (e.g., Chassin, Pitts, & Prost, 2002; Horner, Tarter, Kirisci, & Clark, 2013; McAdams, Salekin, Marti, Lester, & Barker, 2014), this study affirms that delinquent peer behavior is a potent risk factor in high-risk youths' substance use patterns as they move into emerging adulthood. While often discussed, few have identified how to steer youth away from delinquent peers in order to nurture youths' development of pro-social peer networks. This study underscores the need to evaluate whether and how to insulate high-risk youth from this weighty and persistent substance use risk variable.

The second risk factor that emerged was family arrest history. This builds upon a line of research on the relationship between parent/guardian arrest and youths' substance use over time (Hayatbakhsh, Kinner, Jamrozik, Najman, & Mamun, 2007; Kinner, Alati, Najman, & Williams, 2007). An important next step is to determine how to mitigate the potential negative impact of family arrest on youth in this developmental period (Skeer & Ballard, 2013).

The evaluated neuropsychological factors were not strongly connected to youths' marijuana use progressions. Yet, following emerging work on the neurocognitive correlates of adolescent alcohol use (Feldstein Ewing, Blakemore, et al., 2014; Lisdahl, Gilbart, Wright, & Shollenbarger, 2013), this study indicated that neuropsychological factors were related to youths' *heavy alcohol* use progressions. In the neuropsychological only model, greater full-scale IQ predicted greater alcohol use, and greater impairment in cognitive set switching was associated with less alcohol use. Interestingly, in line with others (Day, Metrik, et al., 2013), only cognitive set switching survived within the full model. While this finding is somewhat muddled, there are a few potential interpretations. One is that neurocognitive differences in youth marijuana use might not be detectable until an older age (Becker, Collins, & Luciana, 2014). Another is that there might not be strong neurocognitive differences that discriminate youth who are using marijuana from those who are not (Cousijn et al., 2014). A third is that engagement of compensatory cognitive strategies may mask adolescent marijuana-based neurocognitive differences. A fourth is that these findings may reflect an underlying interaction between race/ethnicity and the included neuropsychological measures. Ultimately, more sensitive measures (e.g., neuroimaging) may help accurately deconstruct predictors and sequelae of substance use in developing brains (Filbey et al., 2014; Filbey & Dunlop, 2014).

In terms of implications, these findings suggest that there is more overlap than dissonance between risk and protective variables in high-risk youths' patterns of marijuana and heavy alcohol use through seven years post-arrest. In addition, this study suggests that it is not

simply one set of factors that drive youths' marijuana and heavy alcohol use, but rather salient variables within these sets that best indicate who is at greatest risk for continued use. Compellingly, the factors that emerged as most important were consistent between the two types of substance use (Hispanic ethnicity, exposure time, impulse control, peer delinquency and family arrest), with a few unique variables for each substance (e.g., marijuana = neighborhood problems, gun carrying; heavy alcohol = cognitive set switching, internal emotionality, unsupervised activities). While this study does not shed light on how, the exciting next step and challenge of the larger body of work is to evaluate whether incorporation of these factors benefit prevention programming.

While there are many strengths of this study, including the large sample size, the comprehensive breadth of assessment instruments, and the 7 year follow-up period, results should be interpreted in light of the following limitations. First, due to the small sample of female youth within this sample, all analyses were restricted to adolescent males. Given gender differences within adjudicated youth (Abram et al., 2015), replication with a female sample is requisite prior to generalizing results to justice-involved females. Second, there are several aspects of our design that may depress the observed rates of substance use, such as the high level of incarceration and supervision within this sample, which may interfere with patterns of and/or reporting of use. Third, heavy alcohol and marijuana use were queried with an item-based approach. While recent adolescent studies support the validity of adolescent self-report in reporting substance use behavior (Clark & Winters, 2002; Marlatt et al., 1998), additional work highlights the benefit of employing interview approaches (e.g., the Timeline FollowBack; Sobell & Sobell, 1992) to gather greater detail regarding prior 30–90 day patterns of use (Donohue et al., 2004). Fourth, these data underscore that we need to know more about the context in which adolescents are using alcohol and marijuana. Fifth, although these analyses were longitudinal, conclusions must be interpreted in light of the correlational nature of this analytic approach; thus, causation cannot be determined within this study. Finally, future research should examine the settings in which youth live, and the more real-time nature of peer interactions, to determine how they may play into youths' marijuana and alcohol use decision-making (Danielsson, Wennberg, Tengstrom, & Romelsjo, 2010; Epstein, Botvin, & Doyle, 2009; Gardner & Steinberg, 2005).

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References

Aarons GA, Brown SA, Hough RL, Garland AF, Wood PA. Prevalence of adolescent substance use disorders across five sectors of care. Journal of the American Academy of Child & Adolescent Psychiatry. 2001; 40(4):419–426. [PubMed: 11314567]

Abram KM, Choe JY, Washburn JJ, Romero EG, Teplin LA. Functional impairment in youth three years after detention. Journal of Adolescent Health. 2009; 44(6):528–535. [PubMed: 19465316]

Abram KM, Zwecker NA, Welty LJ, Hershfield JA, Dulcan MK, Teplin LA. Comorbidity and continuity of psychiatric disorders in youth after detention: A prospective longitudinal study. JAMA Psychiatry. 2015; (72):84–93. [PubMed: 25426584]

Becker MP, Collins PF, Luciana M. Neurocognition in college-aged daily marijuana users. J Clin Exp Neuropsychol. 2014; 36:379–398. [PubMed: 24620756]

Behan B, Connolly CG, Datwani S, Doucet M, Ivanovic J, Morioka R, Stone A, Watts R, Smyth B, Garavan H. Response inhibition and elevated parietal-cerebellar correlations in chronic adolescent cannabis users. Neuropharmacology. 2014; 84:131–137. [PubMed: 23791961]

Boden JM, Fergusson DM, Horwood LJ. Alcohol misuse and violent behavior: Findings from a 30-year longitudinal study. Drug and Alcohol Dependence. 2012; 122:135–141. [PubMed: 22015176]

Braithwaite RL, Conerly RC, Robillard AG, Woodring T, Stephens TT. Alcohol and other drug use among adolescent detainees. Journal of Substance Use. 2003; 8(2):126–131.

Buss, AH.; Plomin, R. Temperament: Early developing personality traits. Hillsdale, NJ: Erlbaum; 1984.

CDC. Youth Risk Behavior Surveillance Survey (2013). 2014.

Chassin L, Dmitrieva J, Modecki K, Steinberg L, Cauffman E, Piquero AR, Knight GP, Losoya S. Does adolescent alcohol and marijuana use predict suppressed growth in psychosocial maturity among male juvenile offenders? Psychology of Addictive Behaviors. 2010; 24:48–60. [PubMed: 20307112]

Chassin L, Pitts SC, Prost J. Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: Predictors and substance abuse outcomes. Journal of Consulting and Clinical Psychology. 2002; 70(1):67–78. [PubMed: 11860058]

Chassin L, Sher KJ, Hussong A, Curran P. The developmental psychopathology of substance use disorders: 25 years of progress and future directions. Development and Psychopathology. 2013; 25:1567–1584. [PubMed: 24342856]

Chassin, L.; Sher, KJ.; Hussong, A.; Curran, P.; Colder, C. The developmental psychopatholgy of substance use disorders. In: Cicchetti, D., editor. Developmental Psychopathology. 3. 2015.

Clark DB, Winters KC. Measuring risks and outcomes in substance use disorders prevention research. Journal of Consulting and Clinical Psychology. 2002; 70(6):1207–1223. [PubMed: 12472298]

Cohen MA, Piquero AR. New evidence on the monetary value of saving a high risk youth. Journal of Quantitative Criminology. 2009; 25(1):25–49.

Cousijn J, Vingerhoets WA, Koenders L, de Haan L, van den Brink W, Wiers RW, Goudriaan AE. Relationship between working-memory network function and substance use: a 3-year longitudinal fMRI study in heavy cannabis users and controls. Addiction Biology. 2014; 19:282–293. [PubMed: 24589297]

D'Amico EJ, Houck JM, Hunter SB, Miles JN, Osilla KC, Ewing BA. Group motivational interviewing for adolescents: Change talk and alcohol and marijuana outcomes. Journal of Consulting and Clinical Psychology. 2014

Danielsson AK, Wennberg P, Tengstrom A, Romelsjo A. Adolescent alcohol use trajectories: Predictors and subsequent problems. 2010; 35(9):848–852.

Day AM, Celio MA, Lisman SA, Johansen GE, Spear LP. Acute and chronic effects of alcohol on trail making test performance among underage drinkers in a field setting. Journal of Studies on Alcohol and Drugs. 2013; 74:635–641. [PubMed: 23739029]

Day AM, Metrik J, Spillane NS, Kahler CW. Working memory and impulsivity predict marijuana-related problems among frequent users. Drug and Alcohol Dependence. 2013; 131:171–174. [PubMed: 23312340]

de Looze M, Janssen I, Elgar FJ, Craig W, Pickett W. Neighborhood crime and adolescent cannabis use in Canadian adolescents. Drug and Alcohol Dependence. 2014

Donohue B, Azrin NH, Strada MJ, Silver NC, Teichner G, Murphy H. Psychometric evaluation of self- and collateral timeline follow-back reports of drug and alcohol use in a sample of drug-abusing and conduct-disordered adolescents and their parents. Psychology of Addictive Behaviors. 2004; 18(2):184–189. [PubMed: 15238061]

Dougherty DM, Mathias CW, Dawes MA, Furr RM, Charles NE, Liguori A, Shannon EE, Acheson A. Impulsivity, attention, memory, and decision-making among adolescent marijuana users. Psychopharmacology (Berl). 2013; 226:307–319. [PubMed: 23138434]

Elkington KS, Teplin LA, Mericle AA, Welty LJ, Romero EG, Abram KM. HIV/sexually transmitted infection risk behaviors in delinquent youth with psychiatric disorders: A longitudinal study. Journal of the American Academy of Child and Adolescent Psychiatry. 2008; 47:901–911. [PubMed: 18645421]

Epstein JA, Botvin GJ, Doyle M. Gender-specific effects of social influences and competence on lifetime poly-drug use among inner-city adolescents. Journal of Child & Adolescent Substance Abuse. 2009; 18(3):243–256.

Fallu, Js; Briere, FN.; Janosz, M. Latent classes of substance use in adolescent cannabis users: predictors and subsequent substance-related harm. Front Psychiatry. 2014; 5:9. [PubMed: 24570663]

Feldstein Ewing SW, Blakemore S-J, Sakhardande A. The effect of alcohol consumption on the adolescent brain: A systematic review of MRI and fMRI studies of alcohol-using youth. Neuroimage: Clinical. 2014

Feldstein Ewing SW, Schmiege S, Bryan AD. Continued detention involvement and adolescent marijuana use trajectories. Journal of Correctional Health Care. 2014; 20:31–44. [PubMed: 24272742]

Feldstein Ewing SW, Venner KL, Mead HM, Bryan AD. Exploring racial/ethnic differences in substance use: A preliminary theory-based investigation with juvenile justice-involved youth. BMC Pediatrics. 2011; 11(71)

Filbey FM, Aslan S, Calhoun VD, Spence JS, Damaraju E, Caprihan A, Segall J. Long-term effects of marijuana use on the brain. Proc Natl Acad Sci USA. 2014; 25:16913–16918. [PubMed: 25385625]

Filbey FM, Dunlop J. Differential reward network functional connectivity in cannabis dependent and non-dependent users. Drug and Alcohol Dependence. 2014

Gardner M, Steinberg L. Peer influence on risk taking, risk preference, and risky decision making in adolescence and adulthood. Developmental Psychology. 2005; 41(4):625–635. [PubMed: 16060809]

Golden, C. Stroop color and word test. Illinois: Stoelting Company; 1978.

Golden, C.; Freshwater, SM. Stroop Color and Word Test: Revised examiners manual. Illinois: Stoelting Company; 2002.

Greene, WH. Econometric analysis. 7. Prentice Hall; 2012.

Gruber SA, Silveri MM, Dahlgren MK, Yurgelun-Todd D. Why so impulsive? White matter alterations are associated with impulsivity in chronic marijuana smokers. Exp Clin Psychopharmacol. 2011; 19:231–242. [PubMed: 21480730]

Haberstick BC, Young SE, Zeiger JS, Lessem JM, Hewitt JK, Hopfer CJ. Prevalence and correlates of alcohol and cannabis use disorders in the United States: results from the national longitudinal study of adolescent health. Drug and Alcohol Dependence. 2014; 136:158–161. [PubMed: 24440049]

Hayatbakhsh MR, Kinner SA, Jamrozik K, Najman JM, Mamun AA. Maternal partner criminality and cannabis use in young adulthood: Prospective study. Aust N Z J Psychiatry. 2007; 41:546–553. [PubMed: 17508325]

Horner MS, Tarter R, Kirisci L, Clark DB. Modeling the association between sexual maturation, transmissible risk, and peer relationships during childhood and adolescence on development of substance use disorder in young adulthood. Am J Addict. 2013; 22:474–480. [PubMed: 23952893]

Houck J, Bryan AD, Feldstein Ewing SW. Functional connectivity and adolescent cannabis dependence. The American Journal of Drug and Alcohol Abuse. 2013; 39:414–423. [PubMed: 24200211]

Huizinga D, Esbensen F, Weihar A. Are there multiple paths to delinquency? Journal of Criminal Law and Criminology. 1991; 82:83–118.

Kilpatrick DG, Acierno R, Saunders BE, Resnick HS, Best CL, Schnurr PP. Risk factors for adolescent substance abuse and dependence: Data from a national sample. Journal of Consulting and Clinical Psychology. 2000; 68(1):19–30. [PubMed: 10710837]

Kinner SA, Alati R, Najman JM, Williams GM. Do paternal arrest and imprisonment lead to child behaviour problems and substance use? A longitudinal analysis. Journal of Child Psychology and Psychiatry. 2007; 48:1148–1156. [PubMed: 17995491]

Lisdahl KM, Gilbart ER, Wright NE, Shollenbarger S. Dare to Delay? The Impacts of Adolescent Alcohol and Marijuana Use Onset on Cognition, Brain Structure, and Function. Front Psychiatry. 2013; 4:53. [PubMed: 23847550]

Loeber, R.; Farrington, DP., editors. Serious and violent juvenile offenders: Risk factors and successful interventions. Thousand Oaks, CA: Sage PUblications, Inc; 1998.

Lubman DI, Cheetham A, Yucel M. Cannabis and adolescent brain development. Pharmacology & Therapeutics. 2014

Marlatt GA, Baer JS, Kivlahan DR, Dimeff LA, Larimer ME, Quigley LA. Screening and brief intervention for high-risk college student drinkers: Results from a 2-year follow-up assessment. Journal of Consulting and Clinical Psychology. 1998; 66(4):604–615. [PubMed: 9735576]

Mauricio AM, Little M, Chassin L, Knight GP, Piquero AR, Losoya SH, Vargas-Chanes D. Juvenile offenders' alcohol and marijuana trajectories: Risk and protective factor effects in the context of time in a supervised facility. Journal of Youth and Adolescence. 2009; 38(3):440–453. [PubMed: 19636756]

McAdams TA, Salekin RT, Marti CN, Lester WS, Barker ED. Co-occurrence of antisocial behavior and substance use: testing for sex differences in the impact of older male friends, low parental knowledge and friends' delinquency. J Adolesc. 2014; 37:247–256. [PubMed: 24636685]

Mulvey EP, Steinberg L, Fagan J, Cauffman E, Piquero AR, Chassin L, et al. Theory and research on desistance from antisocial activity among serious adolescent offenders. Youth Violence and Juvenile Justice. 2004; 2:213–236. [PubMed: 20119505]

Osgood DW, Wilson JK, O'Malley PM, Bachman JG, Johnston LD. Routine activities and individual deviant behavior. American Sociological Review. 1996; 61:635–655.

Prado G, Cordova D, Huang S, Estrada Y, Rosen A, Bacio GA, Leon-Jimenez G, Pantin H, Brown CH, Velazquez MR, Villamar J, Freitas D, Tapia MI, McCollister K. The efficacy of Familias Unidas on drug and alcohol outcomes for Hispanic delinquent youth: Main effects and interaction effects by parent stress and social support. Drug and Alcohol Dependence. 2012; 125:S18–S25. [PubMed: 22776441]

Prince van Leeuwen A, Creemers HE, Verhulst FC, Ormel J, Huizink AC. Are adolescents gambling with cannabis use? A longitudinal study of impulsivity measures and adolescent substance use: The TRAILS study. Journal of Studies on Alcohol and Drugs. 2011; 72:70–78. [PubMed: 21138713]

Reitan, R. Trail-making test. Arizona: Reitan Neuropsychology Laboratory; 1979.

Reitan, R. Trail Making Test: Manual for administration and scoring. Arizona: Reitan Neuropsychology Laboratory; 1992.

SAMHSA. Results from the 2013 National Survey on Drug Use and Health: Summary of National Findings NSDUH Series H-48. Rockville, MD: 2014.

Sampson R, Raudenbush S. Systematic social observation on public spaces: A new look at disorder in urban neighborhoods. American Journal of Sociology. 1999; 105:603–651.

Sher, KJ. Alcohol, Health, and Behavior Study. University of Missouri; Columbia, MO: 1991.

Skeer MR, Ballard EL. Are family meals as good for youth as we think they are? A review of the literature on family meals as they pertain to adolescent risk prevention. J Youth Adolesc. 2013; 42:943–963. [PubMed: 23712661]

Sobell, LC.; Sobell, MB. Time-line follow-back: A technique for assessing self-reported alcohol consumption. In: Litten, RZ.; Allen, JP., editors. Measuring alcohol consumption. Totowa, N.J: Humana Press; 1992. p. 73-98.

Tahaney KD, Kantner CW, Palfai T. Executive function and appetitve processes in the self-control of alcohol use: the moderational role of drinking restraint. Drug and Alcohol Dependence. 2014; 138:251–254. [PubMed: 24661391]

Thornberry TP, Lizotte AJ, Krohn MD, Farnworth M, Jang SJ. Delinquent peers, beliefs, and delinquent behavior: A longitudinal test of interaction theory. Criminology. 1994; 32:47–83.

Volkow ND, Baler RD, Compton WM, Weiss SRB. Adverse health effects of marijuana use. New England Journal of Medicine. 2014; 370:2219–2227. [PubMed: 24897085]

Wallace JMJ. The social ecology of addiction: Race, risk, and resilience. Pediatrics. 1999; 103:1122–1127. [PubMed: 10224199]

Wasserman GA, McReynolds LS, Lucas CP, Fisher P, Santos L. The voice DISC-IV with incarcerated male youths: prevalence of disorder. J Am Acad Child Adolesc Psychiatry. 2003; 41:314–321. [PubMed: 11886026]

Wechsler, D. Wechsler Abbreviated Scale of Intelligence. San Antonio, TX: The Psychological Corporation; 1999.

Weinberger DA, Schwartz GE. Distress and restraint as superordinate dimensions of self-reported adjustment: A typological perspective. Journal of Personality. 1990; 58:381–417. [PubMed: 2213473]

WHO. Composite International Diagnostic Interview. Geneva, Switzerland: World Health Organization; 1990.

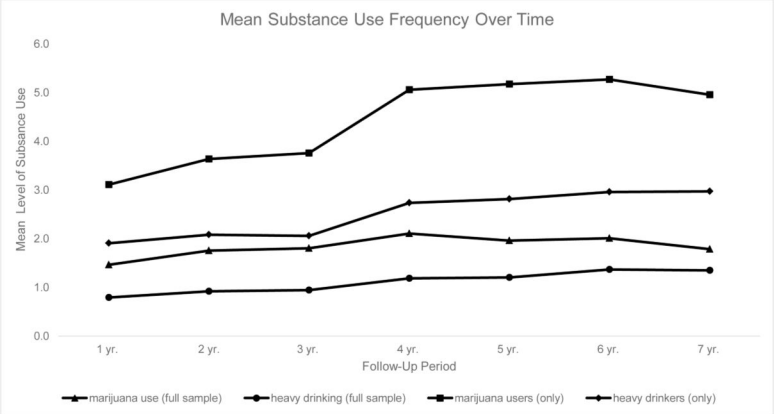

Figure 1. Average use for marijuana and heavy alcohol use (number of times drunk) over time

Values on the y axis represent adolescents' frequency over the past year from 0 (*Not at all*), 1 (*1–2 times*), 2 (*3–5 times*), 3 (*1 time per month*), 4 (*2–3 times per month*), 5 (*1 time per week*), 6 (*2–3 times per week*), 7 (*4–5 times per week*), to 8 (*everyday*).

Table 1

Descriptive Statistics (N=1,056)

Variable	Mean (SD) or Percentage	Range
African-American (% yes)	41.2%	
Hispanic (% yes)	34.5%	
Other race/ethnicity (% yes)	4.5%	
White (% yes)	19.6%	
Parental index of social position	51.6 (12.3)	11.0–77.0
Family arrest (% yes)	77.9%	
Diagnosed prefrontal disorders (% yes)	3.5%	
Full scale IQ	84.5 (12.9)	55.0–128.0
Cognitive set switching	2.2 (1.0)	1.0–4.0
Impulse control	2.9 (1.0)	1.0–5.0
Internal emotionality	2.7 (0.5)	1.1–4.7
Neighborhood problems	2.3 (0.7)	1.0–4.0
Peer delinquency	2.3 (0.9)	0.0–5.0
Unsupervised routine activities	3.8 (0.8)	1.0–5.0
Gang involvement (% yes)	17.2%	
Gun carrying (% yes)	50.8%	

Note. Greater detail for the calculation of all variables can be found within the Methods. Parental index of social position was calculated via formula, wherein lower scores are indicative of "higher" social position (e.g., score of 11–17 = *upper*; 18–31 = *upper-middle*; 32–47 = *middle*; 48–63 = *lower-middle*; 64–67 = *lower*); Family arrest dichotomously measured whether anyone in the youth's family had ever been arrested; Diagnosed Prefrontal Disorders was assessed with the Stroop task; Full scale IQ was measured with the Wechsler Abbreviated Scale of Intelligence, where higher scores indicate greater intellectual ability; Ability to shift cognitive set was measured with the Trail making test-Part B, which represents youths' ability to shift cognitive sets. Values are 1=*perfectly normal*, 2=*normal*, 3=*mildly/moderately impaired* and 4=*moderately/severely impaired*; internal emotionality was measured with the EASI, with higher scores representing greater emotionality; Neighborhood problems reflects physical and social disorder around the youth's home, with higher values indicating greater problems; Peer delinquency reflects the estimate of peer antisocial behaviors, with greater values indicating more delinquency; Unsupervised routine activities reflect activities done without adult supervision, with higher values reflecting less adult supervision; Gang involvement reflects whether youth have been in a gang; Gun carrying reflects whether they have carried a gun (lifetime).

Table 2

Random-Effects Regression Predicting 7-year Marijuana Use. (Coef. (SE))

Variable	Model 1 Demographics	Model 2 Neuropsychological	Model 3 Personality	Model 4 Situational	Model 5 Full Model
African-American	0.11 (0.16)				0.03 (0.18)
Hispanic	−0.35 (0.18)*				−0.59 (0.18)*
Other race/ethnicity	−0.31 (0.31)				−0.64 (0.31)*
Parental index of social position	−0.00 (0.01)				−0.00 (0.01)
Family arrest	0.54 (0.14)*				0.29 (0.15)*
Exposure time	−1.57 (0.08)*				−1.65 (0.09)*
Diagnosed prefrontal disorders		0.39 (0.32)			0.18 (0.32)
Full scale IQ		0.00 (0.01)			−0.00 (0.01)
Cognitive set switching		−0.09 (0.06)			−0.08 (0.06)
Impulse control			−0.32 (0.06)*		−0.19 (0.07)*
Internal emotionality			−0.13 (0.12)		−0.03 (0.12)
Neighborhood problems				0.15 (0.09)*	0.17 (0.09)*
Peer delinquency				0.26 (0.08)*	0.31 (0.08)*
Unsupervised routine activities				0.14 (0.08)*	0.11 (0.08)
Gang involvement				0.12 (0.17)	0.27 (0.17)
Gun carrying				0.12 (0.14)	0.27 (0.14)*
-rho	0.41	0.40	0.39	0.38	0.39

Note. Greater detail for the calculation of all variables can be found within the Methods. Parental index of social position was calculated via formula, wherein lower scores are indicative of "higher" social position (e.g., score of 11–17 = *upper*; 18–31 = *upper-middle*; 32–47 = *middle*; 48–63 = *lower-middle*; 64–67 = *lower*); Family arrest dichotomously measured whether anyone in the youth's family had ever been arrested; Diagnosed Prefrontal Disorders was assessed with the Stroop task; Full scale IQ was measured with the Wechsler Abbreviated Scale of Intelligence, where higher scores indicate greater intellectual ability; Ability to shift cognitive set was measured with the Trail making test-Part B, which represents youths' ability to shift cognitive sets. Values are 1=*perfectly normal*, 2=*normal*, 3=*mildly/moderately impaired* and 4=*moderately/severely impaired*; internal emotionality was measured with the EASI, with higher scores representing greater emotionality; Neighborhood problems reflects physical and social disorder around the youth's home, with higher values indicating greater problems; Peer delinquency reflects the estimate of peer antisocial behaviors, with greater values indicating more delinquency; Unsupervised routine activities reflect activities done without adult supervision, with higher values reflecting less adult supervision; Gang involvement reflects whether youth have been in a gang; Gun carrying reflects whether they have carried a gun (lifetime);

*p<.05; constant estimated but not shown.

Table 3

Random-Effects Regression Predicting 7-Year Heavy Alcohol Use. (Coef. (SE))

Variable	Model 1 Demographics	Model 2 Neuropsychological	Model 3 Personality	Model 4 Situational	Model 5 Full Model
African-American	−0.90 (0.09)*				−0.88 (0.10)*
Hispanic	−0.56 (0.10)*				−0.62 (0.10)*
Other race/ethnicity	−0.09 (0.17)				−0.18 (0.18)
Parental index of social position	−0.01 (0.00)*				−0.00 (0.00)
Family arrest	0.27 (0.08)*				0.19 (0.08)*
Exposure time	−1.10 (0.05)*				−1.17 (0.06)*
Diagnosed prefrontal disorders		0.09 (0.19)			0.24 (0.18)
Full scale IQ		0.01 (0.00)*			−0.00 (0.00)
Cognitive set switching		−0.13 (0.04)*			−0.08 (0.04)*
Impulse control			−0.25 (0.04)*		−0.12 (0.04)*
Internal emotionality			−0.21 (0.07)*		−0.15 (0.07)*
Neighborhood problems				−0.12 (0.05)*	0.06 (0.05)
Peer delinquency				0.16 (0.05)*	0.16 (0.05)*
Unsupervised routine activities				0.13 (0.05)*	0.09 (0.04)*
Gang involvement				0.00 (0.10)	−0.02 (0.1)
Gun carrying				−0.08 (0.08)	0.09 (0.08)
-rho	0.30	0.32	0.33	0.34	0.28

Note. Greater detail for the calculation of all variables can be found within the Methods. Parental index of social position was calculated via formula, wherein lower scores are indicative of "higher" social position (e.g., score of 11–17 = *upper*; 18–31 = *upper-middle*; 32–47 = *middle*; 48–63 = *lower-middle*; 64–67 = *lower*); Family arrest dichotomously measured whether anyone in the youth's family had ever been arrested; Diagnosed Prefrontal Disorders was assessed with the Stroop task; Full scale IQ was measured with the Wechsler Abbreviated Scale of Intelligence, where higher scores indicate greater intellectual ability; Ability to shift cognitive set was measured with the Trail making test-Part B, which represents youths' ability to shift cognitive sets. Values are 1=*perfectly normal*, 2=*normal*, 3=*mildly/moderately impaired* and 4=*moderately/severely impaired*; internal emotionality was measured with the EASI, with higher scores representing greater emotionality; Neighborhood problems reflects physical and social disorder around the youth's home, with higher values indicating greater problems; Peer delinquency reflects the estimate of peer antisocial behaviors, with greater values indicating more delinquency; Unsupervised routine activities reflect activities done without adult supervision, with higher values reflecting less adult supervision; Gang involvement reflects whether youth have been in a gang; Gun carrying reflects whether they have carried a gun (lifetime);

*p<.05; constant estimated but not shown.