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Cognitive and academic functioning of juvenile detainees: Implications for correctional populations and public health

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Abstract

Cognitive functioning affects health. This study assessed cognitive functioning among participants in the Northwestern Juvenile Project, a stratified random sample of 1,829 newly detained juveniles (10-18 years old) from Cook County, Illinois. We examined receptive vocabulary, oral reading, arithmetic computation skills, and general intellectual abilities. Our sample exhibited impaired overall intellectual functioning and deficits in all areas. Males performed more poorly than females overall. More than three-quarters of males showed below average overall intellectual functioning, and nine in ten males had below average receptive vocabulary skills. Hispanic and African American males performed more poorly than non-Hispanic white males; The multiple systems that serve delinquent youth—correctional, health, legal, and rehabilitative—must collaborate to tailor needed services to the cognitive level of youth in the juvenile justice system.

Keywords

Detained youth; juvenile detention; intellectual functioning; academic skills; verbal abilities; correctional health

An estimated 1.9 million arrests of juveniles were made in the United States in 2009 (Puzzanchera & Adams, 2011). Each high-risk youth deterred from a life of antisocial behavior saves an estimated \$2.6 to \$5.3 million in their lifetime (Cohen & Piquero, 2009). Deficits in cognitive functioning among delinquent youth contribute to these costs in many ways. Cognitive deficits reduce youths' ability to successfully negotiate traditional educational and occupational pathways (Greenwood, Model, Rydell, & Chiesa, 1996; Spreen, 1988; Welsh et al., 2008). Deficits are associated with health problems, such as heart disease, HIV/AIDS, substance abuse, psychiatric disorders, and suicide (Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, & Lonnqvist, 2008; Deary, Weiss, & Batty, 2011). They also impact health-related decision making, the capacity to benefit from treatment, adherence to medication regimens, and treatment compliance (Teichner, Horner, & Harvey, 2001).

Prior research suggests that delinquent youth have notable cognitive deficits (Lynam, Moffitt, & Stouthamer-Loeber, 1993). The most severe cognitive impairments are observed among youth whose delinquency begins in childhood and persists past adolescence (Moffitt & Caspi, 2001). Much of this difference appears attributable to poorer verbal abilities, relative to perceptual reasoning (Moffitt & Caspi, 2001; Walsh, Petee, & Beyer, 1987). Moreover, delinquency is associated with cognitive deficits regardless of sex, race/ethnicity, socioeconomic status, academic achievement, and arrest history (Lynam et al., 1993; Moffitt, Gabrielli, Mednick, & Schulsinger, 1981; Moffitt & Silva, 1988).

Despite important social and fiscal implications, there are no large-scale studies of cognitive functioning among delinquent youth in the United States (US). Prior studies of cognitive functioning among delinquent youth are limited by small sample sizes (Culbertson, Feral, & Gabby, 1989; Davis, Sanger, & Morris-Friehe, 1991; Lewis, Pincus, Lovely, Spitzer, & et al., 1987; Vermeiren, De, Schwab-Stone, Ruchkin, & Deboutte, 2002; Zinkus & Gottlieb, 1983), narrowly defined populations (e.g., psychopaths (Raine, O'Brien, Smiley, Scerbo, & et al., 1990), sex offenders (Kelly, Richardson, Hunter, & Knapp, 2002), violent incarcerated youth (Lewis et al., 1987; Lewis, Yeager, Blake, Bard, & Strenziok, 2004)), restricted age ranges (Beitchman, Wilson, Brownlie, & Walters, 1996; Lynam et al., 1993; Ratchford & Beaver, 2009), or inadequate representation of groups with potentially distinct cognitive profiles (females, Hispanics, young delinquents) (Davis et al., 1991; Farrington & Hawkins, 1991; Karniski, 1982; Krezmien, Mulcahy, & Leone, 2008; Lewis, Shanok, Balla, & Bard, 1980; Lynam et al., 1993; Moffitt et al., 1981; Vermeiren et al., 2002; Walsh et al., 1987; Zinkus & Gottlieb, 1983). Studies conducted in New Zealand or Canada used primarily non-Hispanic white samples (Brownlie et al., 2004; Moffitt & Caspi, 2001; Moffitt & Silva, 1988; White, Moffitt, & Silva, 1989). These findings are not generalizable to the US, where 65% of incarcerated youth are racial/ethnic minorities, primarily African Americans and Hispanics (Sickmund, Sladky, & Kang, 2008).

Data on the cognitive functioning of detained youth in the US are needed to address health disparities, guide public health policies, and direct future research efforts. Nearly all detained youth eventually return to their communities, where they become a burden to the community public health system.

Using data from the Northwestern Juvenile Project, the present study addresses the limitations of prior studies by (1) evaluating cognitive functioning in a large and diverse sample of detained juveniles, randomly sampled from an urban detention center in the US, and (2) examining gender, age, and racial/ethnic differences in cognitive functioning.

Methods

Participants and Sampling Procedures

Participants were randomly sampled during intake to the Cook County Juvenile Temporary Detention Center (CCJTDC) in Chicago. The sample of 1,829 youth was stratified by sex, race/ethnicity (African American, non-Hispanic white, Hispanic), age (10-13 years, 14-18 years), and legal status (processed in the juvenile or adult criminal court) to obtain adequate numbers of youth in key subgroups. The final sampling fractions ranged from .018 to .689.

The CCJTDC is used for pretrial detention and for offenders sentenced to fewer than 30 days. Like detention centers nationwide (Sickmund et al., 2008), most youth in CCJTDC are racial/ethnic minorities and have similar age and offense distributions.

Studying detained youth requires special procedures because they are minors and may not have a legal guardian who can provide consent. Participants signed an assent form (if they were <18 years) or consent form (if they were ≥ 18 years). Consistent with federal regulations, the Northwestern University Institutional Review Board, Centers for Disease Control and Prevention Institutional Review Board, and the US Office of Protection from Research Risks waived parental consent. We attempted to contact guardians. Despite repeated attempts, none were found for 44% of participants. In lieu of parental consent, youths' assent was overseen by a participant-advocate who represented the youths' interests. Study methods and consent forms were approved by the Northwestern University Institutional Review Board, Centers for Disease Control and Prevention Institutional Review Board, and the US Office of Protection from Research Risks.

Two of our three measures of cognitive functioning were assessed at baseline interviews, which were conducted between 1995 and 1998. One measure was assessed at a 4-year follow-up interview on a random subsample ($n = 997$) of the 1829 participants. Follow-up interviews were conducted with participants irrespective of where they were living (community, correctional facilities, or by phone if they lived more than 2 hours away). Procedures for obtaining assent and consent were similar to baseline. For baseline and follow-up interviews, female participants were interviewed by female interviewers. Most interviewers had graduate degrees in psychology or an associated field and had experience interviewing at-risk youth; one-third were fluent in Spanish. All interviewers were trained for at least 1 month. Additional information about our methods has been published

elsewhere (Abram et al., 2004; Abram, Teplin, McClelland, & Dulcan, 2003; Teplin, Abram, McClelland, Dulcan, & Mericle, 2002).

Measures

Cognitive measures have standard scores (mean = 100, standard deviation = 15) and were the most current standardized, norm-referenced measures available at the start of the project.

Peabody Picture Vocabulary Test–Revised (PPVT-R: Form L) (Dunn & Dunn, 1981)—The PPVT-R is a test of receptive vocabulary assessing single-word comprehension. The PPVT-R evaluates language comprehension independent of language production (expressive language) abilities. Words are read to the participant by the examiner and the participant chooses, by pointing, which of four pictures visually depicts the word.

Wide Range Achievement Test, 3rd edition (WRAT-3) (Wilkinson, 1993), Oral Reading and Arithmetic subtests—The WRAT-3 assesses basic skills learned during school. The reading subtest is entirely expressive and includes 42 word pronunciations (15 letters named if < 5 correct pronunciations). The arithmetic subtest includes 40 computation problems (each youth is asked to count, read number symbols, and solve word problems if < 5 correct computations).

Kaufman Brief Intelligence Test (KBIT) (Kaufman & Kaufman, 1990)—The KBIT is an abbreviated measure of intellectual ability with established reliability and validity for normal and special populations (e.g., learning disabled, juvenile offenders). The KBIT produces a composite full-scale intelligence quotient (IQ) score and scale scores for two subtests: (1) Vocabulary, measuring *expressive* word knowledge through definitions and confrontation naming (an indicator of “crystallized” verbal intelligence), and (2) Matrices, measuring visual-spatial problem solving and abstraction (an indicator of “fluid” nonverbal intelligence).

The PPVT and WRAT were assessed at baseline. The KBIT was administered at follow-up to obtain a more comprehensive measure of intelligence that includes both verbal and non-verbal components. These intelligence traits are fairly stable over time and therefore may be tested at different time points.

Sample

Table 1 presents the demographic characteristics of the baseline sample (N = 1829). The PPVT was administered to 1653 participants (90.4%). Some interviews ended prematurely because of the rigors of the detention center's schedule. An additional 48 cases had administration errors (missing ceiling or basal scores) and were treated as missing because they could not be scored; 3 participants received the Spanish version and were also treated as missing. The WRAT-3 was administered to 1653 participants; an additional 12 cases were missing the reading component, and 11 cases were missing the arithmetic component. There were significant gender (chi-squared test, 1 df, $p < .05$) and racial/ethnic (chi-squared test, 2 df, $p < .05$) differences in who was administered the PPVT and WRAT. We accounted

for potential bias from demographic differences in test administration by using sample weights augmented with non-response adjustments (see **Statistical Analysis** subsection).

KBIT data came from a 4-year follow-up interview scheduled for a random subsample of 997 participants (600 males, 397 females; 550 African Americans, 117 non-Hispanic whites, 165 Hispanics, and 4 other race/ethnicity). Among the 997 participants, 753 had valid KBIT scores. Participants were missing KBIT scores because they were interviewed over the phone (40; the KBIT cannot be administered via phone), had a shorter interview due to time constraints (67), could not be located for the interview (45), withdrew from the study (21), or died (15). An additional 56 participants were administered the KBIT but did not have valid scores due to administration errors. We found no racial/ethnic or gender differences between participants who were missing KBIT scores and those who were not. Additional details on our methods are available from the authors.

Statistical Analysis

All analyses were conducted using the survey routines in Stata, version 11 (StataCorp, College Station, TX). To generate descriptive statistics and model parameters that reflect CCJTDC's population, each participant was assigned a sampling weight augmented with a nonresponse adjustment to account for missing data. Taylor series linearization was used to estimate standard errors. We present weighted means and standard errors for all standard scores of each measure. Multiple linear regression was used to assess demographic differences in each measure. Models comparing scores by gender controlled for race/ethnicity and age. We compared scores by race/ethnicity separately among males and females because combining them could obfuscate important differences. These models also included a covariate to control for age at test administration. We tested for differences between specific groups (e.g., African American versus Hispanic) only when the overall effect (e.g., inclusion of race/ethnicity in the model) was significant ($p < .05$). Only statistically significant findings ($p < .05$) are noted in the text and tables.

Analyses used standard scores from each of the cognitive measures instead of percentiles, or age or grade equivalents, because they are the most robust scores for comparisons across groups. Because the WRAT-3 does not provide standard scores below 45, we assigned a standard score of 45 to participants who scored below 45 on the WRAT-3 subtests (oral reading scores, 16 participants; arithmetic scores, 4 participants; both scores, 1 participant). Results did not differ substantially when we counted these scores as missing rather than assigning scores of 45.

Results

Age at test administration was significantly associated with higher test scores for males on the WRAT-3 Reading (1.41 points [pts]/year, $SE = 0.58$, $p < .05$), KBIT Composite IQ (2.07 pts/year, $SE = 0.69$, $p < .05$), KBIT Vocabulary subtest (1.65 pts/year, $SE = 0.57$, $p < .05$), and KBIT Matrices subtest (2.12 pts/year, $SE = 0.86$, $p < .05$). Among females, age was significantly associated with lower scores on the WRAT-3 Arithmetic subtest (-1.07 pts/year, $SE = 0.41$, $p < .05$). Accordingly, we adjusted for age at administration in comparisons of scores by gender and race/ethnicity.

Table 2 shows mean standard scores for each of the cognitive measures for males and females, by race/ethnicity. Males performed more poorly on all specific indicators of language and academic achievement (i.e., PPVT-R, WRAT-3) than females. Among both males and females, African Americans had significantly lower scores than non-Hispanic whites on all measures. Hispanic males also had significantly lower scores than non-Hispanic white males on all measures; Hispanic females had significantly lower scores than non-Hispanic white females on all measures except the KBIT Matrices subtest. Among males, African Americans had significantly lower standard scores than Hispanics on the WRAT-3 Reading subtest. Among females, African Americans had significantly lower standard scores than Hispanics on all specific indicators of language, but not on the WRAT-3 Arithmetic or KBIT Matrices subtests. We found no significant interactions between gender and race/ethnicity.

We examined within-person differences in performance between the Vocabulary and Matrices subtests of the KBIT. Overall, the mean difference was 4.61 points (SE = 1.30). African Americans had the highest mean difference (males = 5.11 points [SE = 1.72], females = 4.81 points [SE = 1.07]), followed by Hispanics (males = 3.79 points [SE = 2.44], females = 3.07 points [SE = 1.26]), and non-Hispanic whites (males = 1.01 points [SE = 1.55], females = 0.29 points [SE = 1.67]). We found that 31.0% of males and 29.7% of females had statistically significant differences between their KBIT Vocabulary and Matrices subtests. Only 10.4% of males and 9.6% of females, however, demonstrated large enough differences between the subtests to qualify as a meaningful discrepancy. The proportion of delinquent youth with a large discrepancy on the KBIT is similar to that found among the “standardization sample” (a representative sample from the general population upon which the KBIT was standardized (Kaufman & Kaufman, 1990)).

Table 3 shows the distribution of test scores by descriptive categories. For both males and females, the vast majority of scores were below average, and very few scores were above average (< 3% for males; < 5% for females). For example, more than three-quarters of males scored “Below Average” or lower on the KBIT Composite IQ and KBIT Vocabulary subtest; one-fifth had scores in the “Lower Extreme” for the KBIT Composite IQ and KBIT Matrices subtest. Nearly one-third of males scored as “Deficient” on the WRAT-3 Reading test, and 85% scored below average (within or below “Low Average”) on the WRAT-3 Arithmetic test. Nearly all males scored below average (within or below “Moderately Low”) on the PPVT-R.

In terms of percentiles, more than half of males scored below the 10th percentile on the WRAT-3 Reading, the WRAT-3 Arithmetic, the KBIT IQ Composite, and the KBIT Vocabulary; 85% of males scored below the 10th percentile on the PPVT-R. More than 90% of males scored below the 25th percentile on the PPVT-R; more than 70% scored below the 25th percentile on the WRAT-3 Reading, WRAT-3 Arithmetic, KBIT Composite IQ, and KBIT Vocabulary subtest; and more than 60% scored below the 25th percentile on the KBIT Matrices subtest. Approximately 40% of females scored below the 10th percentile, regardless of the measure, except for the PPVT-R (72% of females below the 10th percentile).

Discussion

Delinquent youth have substantially poorer cognitive functioning compared with the general population. On nearly every measure of cognitive functioning—including overall intellectual ability, receptive verbal skills, and basic academic achievement—our participants scored below average. The degree of cognitive deficit in this sample is notable, compared with the general population and with prior studies of delinquent youth. The estimated full-scale IQ in our sample was approximately 20 points (1.3 SD) lower than the mean full-scale IQ for the general population. The mean full-scale IQ in this sample is more than 10 points lower than that found in a prior study of delinquent youth living in the community (Lynam et al., 1993), similar to the level of cognitive functioning found in youth with serious and persistent antisocial behavior (Moffitt & Caspi, 2001).

Consistent with prior research (Rosso, Falasco, & Koller, 1984), delinquent youth exhibit the greatest relative and absolute deficits in *receptive* verbal skills: the ability to demonstrate one's understanding of a word's meaning without having to describe it. On average, our findings show that our participant's abilities to recognize the meaning of words presented orally is 2 standard deviations below the general population and 10 points lower than their own scores on measures of *expressive* verbal skills. Nearly one-fourth of our sample had “major impairment” in their receptive verbal skills (PPVT-R score < 60). Although deficits in receptive verbal skills have been found in prior studies of delinquent youth (Rosso et al., 1984), the magnitude of the deficit in our sample is notable. Scores for receptive verbal skills in our sample are comparable to populations with developmental receptive language disorders and learning disabilities, as well as those with profound developmental global cognitive impairment (Lincoln, Dickstein, Courchesne, & Elmasian, 1992; Slate, Jones, Graham, & Bower, 1994).

Males had significantly worse receptive vocabulary, reading skills, and arithmetic skills than females. Consistent with trends in the general population, males have higher rates than females of most neurodevelopmental disorders, disruptive behavior disorders, and identified learning disabilities, including delays in verbal milestones and reading failure (Fombonne, 2003; Moffitt & Caspi, 2001; Rutter et al., 2004).

Prior studies demonstrate that delinquent youth have better perceptual reasoning abilities than they do verbal abilities, as evaluated by tests designed to tap “general intellectual ability” (Moffitt & Caspi, 2001; Walsh et al., 1987). Our study confirmed prior findings. However, the difference between these abilities is smaller than what has been found in these prior studies of delinquent youth (Moffitt & Caspi, 2001; Walsh et al., 1987). The difference also does not fully explain the lower full-scale IQ scores and is comparable to the difference in abilities found in the general population. In our sample, both perceptual reasoning and verbal abilities are impaired (Kaufman & Kaufman, 1990; Moffitt & Caspi, 2001; Walsh et al., 1987).

Performance on the cognitive tests differed by race/ethnicity, regardless of gender. Non-Hispanic whites scored significantly higher than Hispanics and African Americans on all indicators of intellectual functioning, receptive vocabulary, and oral reading and arithmetic

skills. Despite probable variability in bilingualism, Hispanic females performed significantly better than African American females on receptive (PPVT-R) and expressive (KBIT) verbal skills, as well as oral reading (WRAT-3) skills. Attempts to interpret racial/ethnic differences in cognitive functioning have been controversial and there are many confounding factors (e.g., differential opportunity, cumulative disadvantage, poor performing schools in neighborhoods with lower socioeconomic status (Nisbett et al., 2012)). Regardless, the disproportionate numbers of delinquent youth with academic deficits, especially for racial/ethnic minorities, constitute a public health crisis. Furthermore, the *overall* magnitude of cognitive impairment in this sample indicates continued risk for poor academic, health, and occupational outcomes, regardless of race/ethnicity.

Limitations

Our findings are drawn from one site and best represent youth in urban detention centers with similar demographic characteristics. The PPVT-R and WRAT-3 data were gathered during confinement and may not represent a youth's "optimal" performance. Although intelligence is considered to be a fairly stable trait, KBIT scores might have been different had we administered the testing at baseline. Moreover, our analyses of demographic differences are limited because it was not feasible to interview parents to collect data on socioeconomic status and indicators of language acquisition (e.g., bilingual home environment, developmental milestones).

Implications for Correctional Populations and Public Health

Our findings illustrate the substantial cognitive and academic deficits of delinquent youth, especially for racial/ethnic minorities and males. We recommended the following:

1. Modify health services to address the cognitive deficits of delinquent youth

—Our findings suggest that delinquent youth may not receive full advantage from verbally based health interventions, not only because of their general language difficulties (e.g., verbal IQ, oral reading), but also because of their receptive language difficulties (not understanding what is said to them). This is critical, as most public health interventions rely on verbal communication. For example, functional family therapy—one of the few interventions for delinquent youth rated as “exemplary” by the US Office of Juvenile Justice and Delinquency Prevention—provides behavioral skills training, problem solving, and conflict management primarily through verbal interaction with youth and their families. Similarly, most “best-evidence” interventions for the prevention of HIV/AIDS, as identified by the Centers for Disease Control and Prevention, incorporate verbally based education and behavioral skills training. Instead, interventions should incorporate in vivo skills training and direct behavioral modeling, approaches that have been used successfully in populations with similar cognitive and language limitations (e.g., psychiatric and developmentally disabled populations).

2. Provide legal services commensurate with academic skills—Juveniles with below average intelligence or poor academic skills may have some difficulty engaging in legal proceedings. Extrapolating from our data and national justice statistics (Sickmund, Sladky, & Kang, 2012), nearly 900,000 juvenile court cases involving males and more than

280,000 cases involving females may include a youth whose cognitive abilities may impair their ability to fully participate in their legal defense. The system must provide legal information (court proceedings, plea bargaining, parole hearings) that is understandable to these youth, most of whom have poor reading abilities.

3. Implement early interventions to improve health—Strengthening academic skills, particularly in the verbal realm, may improve health outcomes and also reduce delinquency and recidivism rates. To be successful, prevention and intervention efforts for verbal deficits must focus on basic oral reading skills as well as underlying auditory processing and receptive language deficits. Although the Individuals with Disabilities Education Act is designed to ensure that children with learning, language, and other targeted disabilities receive services, there is variability in implementation of the Act and a lack of clarity regarding eligibility (U.S. Department of Education, 2008). Delinquent youth—many of whom live in poor neighborhoods—may attend poorly performing schools and be at even greater risk for receiving substandard services. Despite ongoing concerns with the over-identification of disabilities among minority youth, our data suggest that language deficits should be identified and addressed through targeted educational instruction. Improving language skills will improve public health. (Jaeggi, Buschkuhl, Jonides, & Perrig, 2008)

Recommendations for Research in Corrections and in the Community

We recommend the following:

1. Investigate the associations among delinquency, cognitive deficits, and impairment in health and functioning—Longitudinal studies are needed to identify temporal associations. For example, do cognitive deficits and antisocial behavior result from similar or different neurodevelopmental underpinnings? How do cognitive deficits affect health literacy and health-related decision-making? How does incarceration affect the association between cognitive deficits and impairments in health and functioning?

2. Assess how cognitive functioning affects retention in treatment and outcomes of health interventions—We know little about how cognitive functioning affects delinquent youths' capacity to adhere to treatment regimens or to benefit from treatment. Such studies will help public health professionals design more effective interventions for high-risk populations. Future studies will indicate how to use time in corrections to improve health literacy and functioning.

3. Assess multiple domains of cognitive and academic functioning—Future studies of mental health needs should also assess multiple cognitive domains (e.g., memory, visual-spatial skills, executive functioning). Understanding the specific domains in which delinquent youth show the greatest deficits will inform the development of interventions in corrections and in the community.

Our findings on cognitive impairment add to a growing literature identifying the numerous challenges faced by delinquent youth: disproportionate rates of mental illness, HIV/AIDS risk, school failure, and early mortality. Males and racial/ethnic minorities—who comprise the majority of juvenile arrests—face the greatest challenges. Without intervention, many of

these youth will experience an accumulation of disadvantages as they age into adulthood. Early assessments and educational interventions are needed to foster the cognitive development of these high-risk youth. The multiple systems that serve delinquent youth—correctional, health, legal, and rehabilitative—must collaborate to tailor needed services to the cognitive level of youth in the juvenile justice system.

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Abbreviations Used

CCJTDC	Cook County Juvenile Temporary Detention Center
PPVT-R	Peabody Picture Vocabulary Test-Revised
WRAT-3	Wide Range Achievement Test, 3 rd edition
KBIT	Kaufman Brief Intelligence Test

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TABLE 1

Unweighted Sample Characteristics: Northwestern Juvenile Project (N = 1829)

Characteristic	n (%)
Race/Ethnicity	
African American	1005 (54.9)
non-Hispanic white	296 (16.2)
Hispanic	524 (28.6)
Other	4 (0.2)
Sex	
Female	657 (35.9)
Male	1172 (64.1)
Legal Status at Detention	
Processed in adult court	275 (15.0)
Processed in juvenile court	1554 (85.0)
Education	
<= 6th grade	89 (4.9)
7th grade	171 (9.3)
8th grade	306 (16.7)
9th grade	568 (31.1)
10th grade	455 (24.9)
11th grade	172 (9.4)
12th grade	27 (1.5)
Currently in general equivalency diploma classes	31 (1.7)
Alternative or home schooling	5 (0.3)
Unknown	5 (0.3)
Age, years	
Mean (SD)	14.9 (1.4)
Median	15
Range	10 -18

Note. Percentages may not sum to 100% because of rounding error.

TABLE 2

Gender and Racial/Ethnic Differences in Mean Standard Scores of Cognitive Tests^a: Northwestern Juvenile Project

Cognitive Test	Males				Racial/Ethnic Differences ^b	Gender Differences ^c
	All, Mean (SE)	African American, Mean (SE)	Non-Hispanic White, Mean (SE)	Hispanic, Mean (SE)		
PPVT-R	68.8 (0.7)	67.2 (0.9)	87.4 (1.2)	70.1 (1.2)	W > AA ; W > H	M < F
WRAT-3:R	79.0 (0.8)	77.3 (1.0)	92.1 (1.1)	83.7 (1.2)	W > AA ; W > H; H > AA	M < F
WRAT-3:A	78.3 (0.6)	77.8 (0.7)	85.4 (1.0)	78.8 (0.9)	W > AA ; W > H	M < F
KBIT:IQ	79.8 (1.3)	79.5 (1.6)	92.0 (1.7)	77.8 (2.1)	W > AA ; W > H	
KBIT:Voc	79.4 (1.1)	78.9 (1.4)	92.2 (1.4)	78.1 (1.4)	W > AA ; W > H	
KBIT:Mat	84.1 (1.6)	84.0 (1.9)	93.2 (1.9)	81.9 (2.8)	W > AA ; W > H	
Cognitive Test	Females				Racial/Ethnic Differences ^b	
	All, Mean (SE)	African American, Mean (SE)	Non-Hispanic White, Mean (SE)	Hispanic, Mean (SE)		
PPVT-R	72.9 (1.3)	69.0 (0.8)	86.4 (1.6)	74.2 (1.6)	W > AA ; W > H; H > AA	
WRAT-3:R	84.4 (0.6)	81.6 (0.7)	95.4 (1.3)	87.6 (1.4)	W > AA ; W > H; H > AA	
WRAT-3:A	83.8 (0.9)	82.2 (0.6)	89.3 (1.4)	82.9 (1.0)	W > AA ; W > H	
KBIT:IQ	81.3 (0.9)	79.0 (1.1)	90.1 (1.4)	83.5 (1.5)	W > AA ; W > H; H > AA	
KBIT:Voc	81.0 (0.8)	78.5 (1.0)	90.9 (1.2)	83.5 (1.4)	W > AA ; W > H; H > AA	
KBIT:Mat	85.1 (0.9)	83.3 (1.2)	91.2 (1.8)	86.5 (1.6)	W > AA	

Note. PPVT-R = Peabody Picture Vocabulary Test - Revised; WRAT-3:R = Wide Range Achievement Test, 3rd Edition, Oral Reading subtests; Test; WRAT-3:R = Wide Range Achievement Test, 3rd Edition, Arithmetic subtest; KBIT:IQ = Kaufman Brief Intelligence Test, Composite Intellectual Quotient; KBIT:Voc = Kaufman Brief Intelligence Test, Vocabulary subtest; KBIT:Mat = Kaufman Brief Intelligence Test, Matrices subtest; W = non-Hispanic white; AA = African American; H = Hispanic

^aDescriptive statistics are weighted to adjust for sampling design and reflect the demographic characteristics of the Cook County Juvenile Temporary Detention Center.

^bBased on weighted multiple linear regression. We report specific differences (e.g. W > AA) only when the overall test for race/ethnicity was statistically significant ($p < 0.05$). We excluded 4 participants (3 male, 1 female) who self-identified race/ethnicity as "other."

^cBased on weighted multiple linear regression.

TABLE 3

Distribution of Cognitive Test Scores by Descriptive Categories^a: Northwestern Juvenile Project

Category	KBIT Standard Scores ^b		WRAT-3 Standard Scores ^b			PPVT-R Standard Scores ^b		
	IQ Composite, %	Vocabulary, %	Matrices, %	Category	Reading, %	Arithmetic, %	Category	Total, %
Males								
Upper Extreme (< 130)	0.0	0.0	0.0	Very Superior (< 130)	0.0	0.0	Extremely High (< 130)	0.0
Well Above Average (120 - 129)	0.0	0.0	0.0	Superior (120 - 129)	0.1	0.0	Moderately High (115 - 129)	0.4
Above Average (110 - 119)	0.4	0.1	2.8	High Average (110 - 119)	1.2	0.3	Average (85 - 114)	9.6
Average (90 - 109)	21.7	16.3	34.1	Average (90 - 109)	27.7	14.9	Moderately Low (70 - 84)	43.8
Below Average (80 - 89)	28.5	33.1	28.0	Low Average (80 - 89)	23.9	34.0	Lower Extreme (< 70)	46.2
Well Below Average (70 - 79)	29.7	36.3	14.1	Borderline (70 - 79)	14.9	25.6		
Lower Extreme (< 70)	19.7	14.1	20.9	Deficient (< 70)	32.2	25.1		
Females								
Upper Extreme (< 130)	0.0	0.0	0.0	Very Superior (< 130)	0.0	0.1	Extremely High (< 130)	0.0
Well Above Average (120 - 129)	0.0	0.0	0.2	Superior (120 - 129)	0.6	0.0	Moderately High (115 - 129)	0.9
Above Average (110 - 119)	0.5	0.5	1.7	High Average (110 - 119)	3.7	1.4	Average (85 - 114)	20.7
Average (90 - 109)	31.9	24.4	39.0	Average (90 - 109)	33.6	29.0	Moderately Low (70 - 84)	36.9
Below Average (80 - 89)	24.8	35.1	24.7	Low Average (80 - 89)	25.0	34.7	Lower Extreme (< 70)	41.5
Well Below Average (70 - 79)	25.0	23.7	19.2	Borderline (70 - 79)	21.0	22.1		
Lower Extreme (< 70)	17.9	16.4	15.2	Deficient (< 70)	16.2	12.7		

^a Descriptive statistics are weighted to adjust for sampling design and reflect the demographic characteristics of the Cook County Juvenile Temporary Detention Center.^b Mean standard score = 100, standard deviation = 15.