RESILIENCE Questionnaire

Please circle the most accurate answer under each statement:

1. I believe that my mother loved me when I was little.

Definitely true Probably true Not sure Probably Not True Definitely Not True

2. I believe that my father loved me when I was little.

Definitely true Probably true Not sure Probably Not True Definitely Not True

3. When I was little, other people helped my mother and father take care of me and they seemed to love me.

Definitely true Probably true Not sure Probably Not True Definitely Not True

4. I've heard that when I was an infant someone in my family enjoyed playing with me, and I enjoyed it, too.

Definitely true Probably true Not sure Probably Not True Definitely Not True

5. When I was a child, there were relatives in my family who made me feel better if I was sad or worried.

Definitely true Probably true Not sure Probably Not True Definitely Not True

6. When I was a child, neighbors or my friends' parents seemed to like me.

Definitely true Probably true Not sure Probably Not True Definitely Not True

7. When I was a child, teachers, coaches, youth leaders or ministers were there to help me.

Definitely true Probably true Not sure Probably Not True Definitely Not True

8. Someone in my family cared about how I was doing in school.

Definitely true Probably true Not sure Probably Not True Definitely Not True

9. My family, neighbors and friends talked often about making our lives better.

Definitely true Probably true Not sure Probably Not True Definitely Not True

10. We had rules in our house and were expected to keep them.

Definitely true Probably true Not sure Probably Not True Definitely Not True

11. When I felt really bad, I could almost always find someone I trusted to talk to.

Definitely true Probably true Not sure Probably Not True Definitely Not True

12. As a youth, people noticed that I was capable and could get things done.

Definitely true Probably true Not sure Probably Not True Definitely Not True

13. I was independent and a go-getter.

Definitely true Probably true Not sure Probably Not True Definitely Not True

14. I believed that life is what you make it.

Definitely true Probably true Not sure Probably Not True Definitely Not True

How many of these 14 protective factors ***did I have as a child and youth?***

(How many of the 14 were circled "Definitely True" or "Probably True"?) _____

Of these circled, how many are *still true* for me? _____

This questionnaire was modeled after the ACE Study questions, based on research by Emmy Werner, among others, and developed by the early childhood service providers, pediatricians, psychologists (Mark Rains, Kate McClinn), and health advocates of Southern Kennebec Healthy Start, Augusta, Maine (2006, updated in February 2013).

Finding Your ACE Score

While you were growing up, during your first 18 years of life:

1. Did a parent or other adult in the household **often or very often**...
   Swear at you, insult you, put you down, or humiliate you?
   or
   Act in a way that made you afraid that you might be physically hurt?
   Yes No If yes enter 1 _____

2. Did a parent or other adult in the household **often or very often**...
   Push, grab, slap, or throw something at you?
   or
   Ever hit you so hard that you had marks or were injured?
   Yes No If yes enter 1 _____

3. Did an adult or person at least 5 years older than you **ever**...
   Touch or fondle you or have you touch their body in a sexual way?
   or
   Attempt or actually have oral, anal, or vaginal intercourse with you?
   Yes No If yes enter 1 _____

4. Did you **often or very often** feel that ...
   No one in your family loved you or thought you were important or special?
   or
   Your family didn't look out for each other, feel close to each other, or support each other?
   Yes No If yes enter 1 _____

5. Did you **often or very often** feel that ...
   You didn't have enough to eat, had to wear dirty clothes, and had no one to protect you?
   or
   Your parents were too drunk or high to take care of you or take you to the doctor if you needed it?
   Yes No If yes enter 1 _____

6. Were your parents **ever** separated or divorced?
   Yes No If yes enter 1 _____

7. Was your mother or stepmother:
   Often or very often pushed, grabbed, slapped, or had something thrown at her?
   or
   Sometimes, often, or very often kicked, bitten, hit with a fist, or hit with something hard?
   or
   Ever repeatedly hit at least a few minutes or threatened with a gun or knife?
   Yes No If yes enter 1 _____

8. Did you live with anyone who was a problem drinker or alcoholic or who used street drugs?
   Yes No If yes enter 1 _____

9. Was a household member depressed or mentally ill, or did a household member attempt suicide?
   Yes No If yes enter 1 _____

10. Did a household member go to prison?
    Yes No If yes enter 1 _____

Now add up your "Yes" answers: _____ This is your ACE Score.

092406RA4CR

Journal of Psychoeducational Assessment
Volume 25 Number 1
March 2007 29-40

10.1177/0734282906292403
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Creativity Lost

The Importance of Testing Higher-Level Executive Functions in School-Age Children and Adolescents

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In school settings, students are typically evaluated using group achievement tests, IQ scales, and college entrance exams that focus more on rote-verbal skills (e.g., vocabulary, mathematical facts) than on higher level executive functions (e.g., abstract thinking, problem solving). However, recent neuropsychological findings suggest that rote-knowledge skills and executive functions are divergent cognitive domains that can be dissociated in both adults with frontal lesions and children with neurodevelopmental disorders. New correlational findings obtained from 470 children and adolescents provide additional support for the divergent nature of these cognitive domains and the existence of subgroups of students who exhibit either strengths in abstract, creative thinking with relative weaknesses in rote-verbal skills or vice versa. The results suggest that current school assessment practices may result in academic roadblocks for those students who have strengths in abstract, creative thinking but whose relative weaknesses in rote-verbal skills may hinder their ability to take college entrance exams.

Keywords: *IQ; Delis-Kaplan Executive Function System; neuropscyhology; achievement tests*

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In recent decades, the field of neuropsychology has made great strides in charting the cognitive architecture of the brain. One of the most important discoveries centers on the role of the frontal lobes, which were among the last and most complex brain regions to evolve, in mediating cognitive functions. Research has shown that patients with focal damage in the frontal lobes often perform normally on IQ composite measures and other tests of basic achievement skills (e.g., reading and spelling; Damasio, 1995; Luria, 1973; Mesulam, 1986; Stuss et al., 1983; Teuber, 1964). Rather, these patients tend to exhibit deficits in higher-level cognitive skills, such as abstract thinking, problem solving, inhibition, concept formation, mental fluency, multitasking, and cognitive flexibility (Cato, Delis, Abildskov, & Bigler, 2004; Bechara, Damasio, Damasio, & Anderson, 1994; Delis, Kaplan, & Kramer, 2001; Luria, 1973; Stuss & Knight, 2002). These higher-level cognitive abilities are referred to collectively as "executive functions" because they often draw on more fundamental or primary cognitive skills, such as attention, language, and perception, to generate higher levels of creative and abstract thought. These important findings have compelled neuropsychologists to broaden the scope of the types of cognitive tests they administer to individuals with possible brain injury or disease to include measures of executive functions in addition to tests of intellectual abilities and other, more fundamental cognitive skills. These discoveries have also given neuropsychologists an appreciation of the limitations of traditional IQ and achievement tests for evaluating the full spectrum of human cognitive abilities.

In school settings, however, tests of basic achievement skills and intellectual functions tend to dominate the assessment landscape. School systems frequently track the academic progress of students by administering annual group achievement tests that assess more rote-verbal skills such as vocabulary, reading, spelling, and math. When a child is referred for an individual assessment to evaluate a potential learning disorder or other cognitive problems, the child is typically assessed with an intelligence scale and additional achievement tests. In high school, college-bound adolescents are typically required to take group entrance exams such as the Scholastic Aptitude Test (SAT), the results of which often play a critical role in the admissions criteria used by colleges and universities. All of these traditional school-based cognitive tests–group achievement tests, IQ measures, and college entrance exams–share two general features. First, these tests tend to focus more on the acquisition of rote knowledge and skills (e.g., vocabulary level; math facts and equations). And second, these tests often do not provide an adequate and comprehensive evaluation of higher-level executive functions such as abstract thinking, concept formation, and problem solving (see also Gardner, 1993; Sternberg, 1985; Sternberg, Lautrey, & Lubart, 2003).

Rote-knowledge skills such as vocabulary, reading, and basic mathematics are unquestionably vital cognitive abilities for success in all aspects of life, including academic and occupational attainment. It is essential that school-age children and adolescents continue to receive regular evaluations of these more fundamental cognitive abilities. However, the relative lack of formal cognitive evaluations of higher-level executive functions in school settings may represent a serious deficiency in our educational system.

One reason for the lack of formal assessments of executive functions in school settings may stem, in part, from long-standing beliefs about the utility of the IQ composite measure in providing an adequate global index of all cognitive skills. That is, since the early 1900s, a popular psychometric theory has been that all cognitive functions are significantly

intercorrelated and ultimately load on the G factor or IQ index (Jensen, 1998). According to this traditional psychometric view, there would be little to no need to assess executive functions independent of the cognitive functions tapped by IQ tests, because the variance in all cognitive functions is explained sufficiently by IQ indices. However, three lines of modern research run counter to this notion. First, as discussed above, patients with acquired focal frontal-lobe damage often exhibit intact intellectual abilities in the face of significant deficits in higher-level executive functions (e.g., Bechara et al., 1994; Cato et al., 2004; Luria, 1973). Such cognitive dissociations indicate that IQ tests are not sufficient for evaluating the full spectrum of executive functions. Second, pediatric case studies have documented the presence of developmental learning disabilities in which the children exhibit selective deficits on executive-function tests with normal scores on IQ and achievement tests (Bohm, Smedler, & Forssberg, 2004; Filley, Young, Reardon, & Wilkening, 1999; Geurts, Verte, Oosterlaan, Roeyers, & Sergeant, 2005). These cases suggest that, even in the absence of *acquired* brain damage, some children still show marked dissociations between more rote-knowledge skills as assessed by IQ and achievement tests on one hand and higher-level executive functions on the other. And third, preliminary studies on the correlations between IQ and executive-function measures in children have found that the correlation coefficients tend to be either nonsignificant or significant but relatively low, with the IQ scores accounting for only about 4% to 25% of the variance on executive-function measures (Ardila, Pineda, & Rosselli, 2000; Welsh, Pennington, & Grossier, 1991).

These initial findings, which suggest that IQ and executive-function measures may tap different components of cognition, have potentially important implications for school assessment practices. These results invite the hypothesis that there may be subgroups of normal-functioning children who show different profiles of strengths and weaknesses on IQ measures relative to executive-function measures. That is, there may be some children who have strong rote-knowledge skills but who have relative weaknesses in their capacity for abstract, creative thinking. In contrast, another subgroup of children may have strengths in higher-level executive functions such as abstract thinking and problem-solving skills in the face of relative weaknesses in more rote-knowledge skills as assessed by IQ and achievement measures. If such subgroups of children exist, then our current school assessment practices, which tend to emphasize IQ and achievement testing over the assessment of executive functions, may have at least two major shortcomings. First, these practices may fail to identify children with normal verbal skills but with developmental weaknesses or disorders in areas of higher-level executive functions. And second, the current assessment practices may create academic roadblocks for children who are very creative but who have relative weaknesses in more rote-verbal skills, because the scholastic entrance exams that are often used as a key criterion for college admission (e.g., SAT) tend to focus primarily on their areas of weaknesses and fail to also identify their areas of strength.

A problem in this area of research is that the few studies that have been conducted thus far to examine correlations between IQ and executive-function tests in children have often use relatively small sample sizes (e.g., $N = 50$) with restricted age ranges (e.g., 13-16 years old; see Ardila et al., 2000; Welsh et al., 1991). In addition, these studies have not investigated whether or not subgroups of normal-functioning children exist who show discrepancies between their

IQ and executive-function abilities. In the present study, we undertook a large-scale investigation of 470 normal-functioning children and adolescents, ages 8 to 19, who were administered both an IQ scale and a set of nationally normed executive-function tests. Using this large sample, we conducted (a) correlational analyses between the IQ and executive-functions measures, and (b) discrepancy analyses to determine if there are subgroups of children and adolescents with IQ/executive-function discrepancies. On the basis of past correlational studies, we hypothesized that (a) the correlations between the IQ indices and executive-function measures would tend to be relatively low, thereby supporting the divergent nature of these two domains of cognition, and (b) discrepancy analyses would reveal subgroups of children with better performances on executive-function measures relative to IQ tests or vice versa.

Method

Participants

Four hundred and seventy healthy youths, ages 8 to 19, participated in this study. The sample represents children involved in the national standardization study of the Wechsler Abbreviated Scale of Intelligence (WASI; Wechsler, 1999) and the Delis-Kaplan Executive Function System (D-KEFS; Delis et al., 2001). The WASI and D-KEFS were costandardized using a national sample of individuals matched to the demographic characteristics of the U.S. population based on the 2000 U.S. census report. The normative sample matched the U.S. population in terms of age, sex, race/ethnicity, years of parental education, and geographic region. Specific details about the national standardization study are described in the technical manuals of the WASI and D-KEFS (Delis et al., 2001; Wechsler, 1999). The WASI normative sample included 1,000 youths between the ages of 8 and 19, and the D-KEFS normative sample included 875 youths between the ages of 8 and 19. Of these individuals, 470 youths were administered both the WASI and the D-KEFS; these children and adolescents comprised the sample for the present study. Table 1 provides a demographic breakdown of this sample.

Exclusion criteria. Screening for exclusion criteria was based on parent questionnaires about developmental, educational, medical, and psychiatric histories of the children. Potential participants were excluded if one or more of the following criteria were endorsed: insufficient English-language proficiency; color blindness; uncorrected visual impairment; seeing a health professional for cognitive problems; upper extremity motor disability; history of head trauma (hospitalization greater than 24 hours), or other significant medical, psychiatric (e.g., schizophrenia), or neurological disorder (e.g., epilepsy, meningitis) that could affect cognitive performance.

Materials and Procedures

The cognitive measures included in this study were administered to participants as part of a national standardization study. Examiners were selected on the basis of experience with psychometric testing, certification, and licensing.

Table 1
Demographic Characteristics and Mean IQ Scores of the Normal Child Sample (N = 470)

Variable	N	% Sample
Demographics		
Race/ethnicity		
Caucasian	384	81.7
African American	40	8.5
Latino	33	7.0
Other	13	2.8
Gender		
Female	260	55.3
Male	210	44.7
Geographic region		
Northcentral	136	28.9
Northeast	104	22.1
South	155	33.0
West	75	16.0
	M (*SD*)	Range (minimum-maximum)
Age at assessment	12.69 (3.02)	8–19 years old
Grade level at assessment	6.83 (3.14)	1st grade to post–high school
WASI Full Scale IQ (4 subtest)	102.48 (12.94)	(66-139)
WASI Verbal IQ	102.52 (13.83)	(63-142)
WASI Performance IQ	101.89 (12.79)	(64-135)

Note: WASI = Wechsler Abbreviated Scale of Intelligence.

WASI. The WASI (Wechsler, 1999) was developed to provide an abbreviated test of intellectual functioning. The scale, which consists of four subtests (Vocabulary, Similarities, Block Design, and Matrix Reasoning), yields measures of Verbal IQ (VIQ), Performance IQ (PIQ), and Full Scale IQ.

D-KEFS. The D-KEFS consists of executive-function tests that assess a broad range of higher-level cognitive skills. The present study focused on five executive-function measures that, in recent studies, have been found to be particularly sensitive to frontal-lobe damage (e.g., Baldo, Shimamura, Delis, Kramer, & Kaplan, 2001; Cato et al., 2004; Delis, Squire, Bihrle, & Massman, 1992; McDonald, Delis, Norman, Tecoma, & Iragui, 2005; McDonald, Delis, Norman, Tecoma, & Iragui-Madozi, 2005; McDonald, Delis, Norman, Wetter, et al., 2005). These measures include the Switching Condition of the D-KEFS Trail Making Test, the Category Switching Condition of the D-KEFS Verbal Fluency Test, the Switching Condition of the D-KEFS Design Fluency Test, the Inhibition/Switching Condition of the D-KEFS Color-Word Interference Test, and the Sort Recognition Description measure of the D-KEFS Sorting Test. Table 2 provides a brief description of these tasks. Details about these measures are provided in the D-KEFS manual (Delis et al., 2001).

Table 2
Description of Selected Executive-Function Measures From the Delis-Kaplan Executive Function System (D-KEFS)

Executive-Function Measure	Description
Category Switching Condition, D-KEFS Verbal Fluency Test	Say as many "fruits" and "pieces of furniture" in 60 seconds while alternating between the two categories.
Switching Condition, D-KEFS Design Fluency Test	Draw as many designs in 60 seconds while switching between connecting filled and empty dots.
Number-Letter Switching Condition, D-KEFS Trail Making Test	Draw a line connecting numbers and letters in order while switching between the two sequences.
Inhibition/Switching Condition, D-KEFS Color-Word Interference Test	Switch between saying the ink color or read the word on a Stroop task that uses color words printed in a dissonant colored ink.
Sort Recognition Description, D-KEFS Sorting Test	Describe each of eight sorting rules of six cards that can be sorted into two groups, with three cards in each group.

Statistical Analysis

We conducted Pearson correlations between the selected D-KEFS scaled scores and the WASI VIQ and PIQ indices. In addition, we computed standardized discrepancy scores between the D-KEFS and WASI measures. To conduct discrepancy analyses directly between the WASI IQ indices and the D-KEFS scores, each D-KEFS scaled score was first converted to an IQ-like standardized score. This transformation was accomplished by first converting participants' scaled scores for each D-KEFS measure into z scores ([scaled score − 10] / 3] = z score), then transforming the participants' z scores into an IQ-like metric ([15 × z score] + 100). Finally, these IQ-like D-KEFS standardized scores were subtracted from each participant's WASI VIQ and PIQ indices, yielding standardized discrepancy scores between the D-KEFS and WASI measures. After computing these difference scores, we examined the percentages of participants who had (a) a standardized score on a D-KEFS measure that was at least 1.0 standard deviation higher compared to his or her WASI VIQ or PIQ and (b) a standardized score on a D-KEFS measure that was at least 1.0 standard deviation lower compared to his or her WASI VIQ or PIQ. We also conducted a subgroup analysis to examine the frequency with which the children and adolescents fell into one of the following two general categories: (a) above-average mean executive-function (EF) score with average or lower VIQ level (the high-EF group) or (b) below-average mean EF score with average or higher VIQ level (the low-EF group). We chose to analyze VIQ for this global subgroup analysis because most school group achievement tests and college entrance exams are verbal in nature. Consistent with standard IQ classification ranges, an above-average mean EF score or VIQ index was defined as 110 or higher, and a below-average mean EF score or VIQ index was defined as 89 or lower.

Results

Table 3 shows the results of the Pearson correlations between the five D-KEFS measures and the two IQ indices for the entire sample of children and adults. The most important

Table 3
Intercorrelations Between D-KEFS Measures and WASI Verbal and Performance IQ Indices for the Entire Sample of Children and Adolescents (N = 470)

Variable	VIQ	PIQ
Category Switching Accuracy	.263**	.154**
Design Fluency Switching	.186**	.336**
Trail Making Test: Switching	.248**	.341**
Color-Word Interference Test: Inhibition/Switching	.156**	.210**
Sort Recognition Description	.402**	.427**

Note: D-KEFS = Delis-Kaplan Executive Function System; WASI = Wechsler Abbreviated Scale of Intelligence; VIQ = Verbal IQ; PIQ = Performance IQ.
**$p < .01$.

Table 4
Intercorrelations Between D-KEFS Measures and WASI Verbal and Performance IQ Indices for Different Age-Groups

	8-10 Years		11-13 Years		14-16 Years		17-19 Years	
Variable	VIQ N = 133	PIQ N = 133	VIQ N = 143	PIQ N = 143	VIQ N = 137	PIQ N = 137	VIQ N = 57	PIQ N = 57
Category Switching Accuracy	.165	.032	.296**	.216**	.453**	.294**	.321*	.292*
Design Fluency Switching	.064	.271**	.283**	.428**	.176*	.262**	.220	.441*
Trail Making Test: Switching	.143	.321**	.256**	.416**	.399**	.296**	.193	.319*
Color-Word Interference Test: Inhibition/Switching	.029	.135	.099	.212*	.316**	.274**	.240	.237
Sort Recognition Description	.393**	.460**	.374**	.416**	.463**	.452**	.348**	.335*

Note: D-KEFS = Delis-Kaplan Executive Function System; WASI = Wechsler Abbreviated Scale of Intelligence; VIQ = Verbal IQ; PIQ = Performance IQ.
*$p < .05$. **$p < .01$.

finding was that the majority of the correlations were relatively low, accounting for 0% to 18% of the total variance. As can be seen, all but one of these relatively low correlations reached statistical significance, which was likely due to the large sample size used in the present study (470 participants).

We also conducted Pearson correlations between the five D-KEFS measures and the two IQ indices for different age-groups (see Table 4) and for male and female participants (Table 5). As can be seen, relatively low correlations were also found for these subgroups, with the IQ measures accounting for 0% to 22% of the variance of the EF measures.

Table 5
Intercorrelations Between D-KEFS Measures and WASI Verbal and Performance IQ Indices for Males and Females

	Males		Females	
Variable	VIQ $N = 210$	PIQ $N = 210$	VIQ $N = 260$	PIQ $N = 260$
Category Switching Accuracy	.240**	.143*	.302**	.186**
Design Fluency Switching	.174*	.408**	.217**	.306**
Trail Making Test: Switching	.252**	.413**	.260**	.303**
Color-Word Interference Test: Inhibition/Switching	.232**	.252**	.089	.191**
Sort Recognition Description	.472**	.413**	.364**	.459**

Note: D-KEFS = Delis-Kaplan Executive Function System; WASI = Wechsler Abbreviated Scale of Intelligence; VIQ = Verbal IQ; PIQ = Performance IQ.
*$p < .05$. **$p < .01$.

Table 6
Percentage of Children and Adolescents Whose Verbal or Performance IQ Indices Were Significantly Discrepant From Their Scores on Executive-Function Measures

D-KEFS Variables	Verbal IQ vs. Executive-Function Measure	Performance IQ vs. Executive-Function Measure
Design Fluency Switching		
IQ < Design Fluency Switching	20.2	14.5
IQ > Design Fluency Switching	22.6	21.3
Category Fluency Switching		
IQ < Category Fluency Switching	17.9	19.1
IQ > Category Fluency Switching	19.6	20.6
Color-Word Interference Test		
IQ < Inhibition/Switching	17.1	17.5
IQ > Inhibition/Switching	22.8	19.2
Trails Switching		
IQ < Trails Switching	16.7	13.0
IQ > Trails Switching	22.0	16.7
Sort Recognition Description		
IQ < Sort Recognition	16.5	15.0
IQ > Sort Recognition	20.3	15.0

Note: D-KEFS = Delis-Kaplan Executive Function System.

The percentages of participants who exhibited significant discrepancies between the IQ indices and each of the D-KEFS EF measures are shown in Table 6. These analyses revealed that the percentages of participants with such discrepancies ranged from 13% to 23% across the different measures. For the subgroup analysis, 12.9% of the youths fell into the high-EF subgroup (above-average mean EF score with average or lower VIQ), and 7.2% of the youths fell into the low-EF subgroup (below-average mean EF score with average or higher VIQ).

Thus, a substantial percentage of children and adolescents exhibited different profiles of strengths and weaknesses on the IQ and EF measures.

Discussion

Neuropsychological research has increasingly discovered that IQ and achievement tests, although critical for evaluating more rote knowledge or fundamental skills such as language, reading, spelling, math, and perception, generally do not provide an adequate assessment of higher-level executive functions that are thought to be mediated largely by the frontal lobes. These findings have created the need for neuropsychologists to include measures of executive functions in addition to tests of more rote-knowledge skills in the assessment of individuals with possible cognitive deficits from brain injury or disease. These discoveries have also raised concerns about long-standing assessment practices in school settings in which the emphasis has been placed largely on the evaluation of more rote-knowledge skills using IQ and achievement measures, with less attention given to the assessment of higher-level cognitive abilities (Gardner, 1993; Sternberg, 1985; Sternberg et al., 2003).

The present study examined this potential shortcoming further by (a) conducting a large-scale correlational study between IQ and EF measures using 470 normal-functioning children and adolescents, (b) exploring the frequency with which school-age youths exhibit significant discrepancies between their intellectual and EF skills, and (c) examining whether subgroups of children exist who have above-average EF skills with average or lower VIQ scores (the high-EF group) or who have below-average EF skills with average or higher VIQ scores (the low-EF group). Consistent with previous preliminary studies, we found that the correlations between IQ and EF measures for the entire sample of children and adolescents were generally low, with the IQ measures accounting for only 0% to 18% of the variance of the EF tests. These relatively low correlations were also found across the different age-groups and for male and female participants. These results suggest that, as reported in numerous neuropsychological studies, IQ and EF skills are relatively divergent cognitive domains and that IQ tests do not provide a sufficient or comprehensive assessment of higher-level executive functions.

The most important finding in the present study was the frequency with which children and adolescents exhibit significant discrepancies on IQ tests relative to EF measures. We found that 13% to 23% of children and adolescents display significant discrepancies on IQ tests relative to EF measures. In addition, in our sample of 470 youths, 12.9% fell into the high-EF subgroup (i.e., above-average EF skills with average or lower VIQ scores), whereas 7.2% fell into the low-EF subgroup (below-average EF skills with average or higher VIQ scores).

The present findings have potentially important implications for school assessment practices. The results suggest that a significant subgroup of school-age children exists who have relative strengths in more rote-verbal skills but who have relative weaknesses in their capacity for abstract, higher-level thinking. For these children, the current emphasis on IQ and achievement testing in our school systems likely results in academic promotions and honors for them without identifying and helping them in their areas of weaknesses. The current findings also suggest that there is another subgroup of children who could represent perhaps the most alarming fallout of our current school assessment practices. Specifically, a substantial

number of youths likely have relative weaknesses in more rote-verbal skills but have strengths in higher-level executive functions such as abstract thinking, cognitive flexibility, and problem-solving skills. These children and adolescents are at risk for being hindered or precluded in their pursuit of higher levels of educational attainment in large part by the relatively low scores they obtain on IQ scales, group achievement tests, and college entrance exams. That is, these tests may represent roadblocks to areas of study that could benefit from the creativity that these students offer. It is not uncommon for these students to develop lower self-esteem based on the scores they receive on these tests.

Although the current findings provide empirical support for the limitations of our long-standing school assessment practices, more poignant illustrations of these shortcomings can often be seen in the accounts of creative individuals who, at some point along their educational paths, had struggled with the hardships created by tests that focus primarily on more rote-verbal skills. For example, one scientist found that the most significant "blow" that he had experienced as an aspiring scholar occurred when he was trying to advance his academic career:

> At that time, the most famous technical school in central Europe outside of Germany was the Swiss Federal Polytechnic School in Zurich. Einstein went there and took the entrance examination. He showed that his knowledge of mathematics was far ahead of that of most of the other candidates, but his knowledge of modern languages and the descriptive natural sciences (zoology and botany) was inadequate, and he was not admitted. (Frank, Kusaka, & Rosen, 1947/2002, p. 18)

A recent account of how the emphasis on more rote-verbal testing in school settings may hinder a student's desire to pursue more creative fields of study was written by the renowned behavioral neurologist Dr. Kenneth Heilman. In a recent book called *Pathways to Prominence in Neuropsychology* (Stringer, Cooley, & Christensen, 2002), which is composed of autobiographical chapters written by famous neuropsychologists and neurologists on how they became researchers in this field, Dr. Heilman discussed his early struggles in school:

> When my friends were taking placement tests for college preparatory high schools in New York, I was not allowed to even attempt the tests. I had scored too low on standardized tests back in the third grade, and I was steered toward trade school. I knew, however, that if I went to trade school I could not be a scientist.
>
> I did not do well in my academic courses. For example, my Spanish teacher, Mrs. X, failed to understand why I could not spell in Spanish, since Spanish has complete sound-letter correspondence. Mrs. X told me that I was not "college material" and repeatedly failed me, I suspect, to prevent me from getting my college preparatory degree.
>
> I think that my third-grade teacher, my junior high advisors, and Mrs. X would be surprised that I graduated from high school, got into college, attended medical school, and contributed to the growth of scientific knowledge. When they predicted failure for me, they could not have known that I would be fortunate to have wonderful mentors, friends, and colleagues. It is the support, guidance, and knowledge of these people that allowed me to make contributions to our understanding of the brain. (Heilman, 2002, p. 139)

As discussed above, more rote-verbal skills like vocabulary, reading, and math are vital cognitive abilities for success in all aspects of life, including academic advancement and career success. It is essential that school-age children and adolescents continue to receive

regular evaluations of these more fundamental cognitive abilities. However, the relative lack of formal evaluations of higher-level executive functions in school-age children and adolescents may represent a serious deficiency in our educational system. In our modern society, a growing number of professions are in need of individuals who have particular strengths in abstract, problem-thinking skills. The relative lack of assessment tools used in school settings to assess these higher-level cognitive skills may hinder our ability to steer the best students into these types of careers (see also Sternberg et al., 2003).

In summary, the present results suggest that school and university systems should strive to broaden the scope of their cognitive evaluations to include tests of both rote knowledge and higher-level executive functions. In this way, children with either selective deficits or strengths in executive functions can be more accurately identified and guided into the educational programs and career paths that best fit their needs and abilities.

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J Correct Health Care 2014 20: 18

DOI: 10.1177/1078345813505450

Article

Journal of Correctional Health Care
2014, Vol 20(1) 18–30

DOI: 10.1177/1078345813505450
jcx.sagepub.com
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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 to 18 years old) from Cook County, Illinois. The study examined receptive vocabulary, oral reading, arithmetic computation skills, and general intellectual abilities. The sample exhibited impaired overall intellectual functioning and deficits in all areas. Males performed more poorly than females. More than three quarters of males showed below average overall intellectual functioning, and 9 in 10 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 US$2.6 million to US$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

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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. Prior studies of cognitive functioning among delinquent youth are limited by small sample sizes (Culberton, Feral, & Gabby, 1989; Davis, Sanger, & Morris-Friehe, 1991; Lewis, Pincus, Lovely, Spitzer, & Moy, 1987; Vermeiren, De, Schwab-Stone, Ruchkin, & Deboutte, 2002; Zinkus & Gottlieb, 1983), narrowly defined populations (e.g., psychopaths) (Raine, O'Brien, Smiley, Scerbo, & Chan, 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 and 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 United States, 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 United States 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 United States, and (2) examining gender, age, and racial/ethnic differences in cognitive functioning.

Method

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 to 13 years and 14 to 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 (CDC) Institutional Review Board, and the U.S. 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, CDC Institutional Review Board, and the U.S. 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 1,829 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 [*SD*] = 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). The PPVT-R (Dunn & Dunn, 1981) 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, Third Edition (WRAT-3), Oral Reading and Arithmetic subtests. The WRAT-3 (Wilkinson, 1993) 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). The KBIT (Kaufman & Kaufman, 1990) is an abbreviated measure of intellectual ability with established reliability and validity for normal and special populations (e.g., learning disabled and 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).

Table 1. Unweighted Sample Characteristics: Northwestern Juvenile Project ($N = 1,829$).

Characteristic		*n*	(%)
Race/ethnicity			
African American		1,005	(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			
$\leq$ 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.

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 nonverbal 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 ($N = 1,829$). The PPVT was administered to 1,653 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; three participants received the Spanish version and were also treated as missing. The WRAT-3 was administered to 1,653 participants; 12 cases were missing the reading component, and 11 cases were missing the arithmetic component. There were significant gender (χ^2 test, 1 *df*, $p < .05$) and racial/ethnic (χ^2 test, 2 *df*, $p < .05$) differences in whom the PPVT and WRAT was administered to. We accounted for potential bias from demographic differences in test administration by using sample weights augmented with nonresponse 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 and 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, Texas). 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 vs. 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 indictors of language, but not on the WRAT-3 Arithmetic or KBIT Matrices subtests. We found no significant interactions between gender and race/ethnicity.

Table 2. Gender and Racial/Ethnic Differences in Mean Standard Scores of Cognitive Tests[a]: Northwestern Juvenile Project.

	Males											
Cognitive Test	All, Mean (*SE*)		African American, Mean (*SE*)		Non-Hispanic White, Mean (*SE*)		Hispanic, Mean (*SE*)		Racial/Ethnic Differences[b]	Gender Differences[c]
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	
	Females									
Cognitive Test	All, Mean (*SE*)		African American, Mean (*SE*)		Non-Hispanic White, Mean (*SE*)		Hispanic, Mean (*SE*)		Racial/Ethnic Differences[b]	
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, Third Edition, Oral Reading subtest; Test; WRAT-3: A = Wide Range Achievement Test, Third 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.

[a]Descriptive statistics are weighted to adjust for sampling design and reflect the demographic characteristics of the Cook County Juvenile Temporary Detention Center. [b]Based on weighted multiple linear regression. We report specific differences (e.g., W > AA) only when the overall test for race/ethnicity was statistically significant ($p < .05$). We excluded four participants (three male and one female) who self-identified race/ethnicity as "other." [c]Based on weighted multiple linear regression.

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

Table 3. Distribution of Cognitive Test Scores by Descriptive Categories[a]: Northwestern Juvenile Project.

KBIT Standard Scores[b]				WRAT-3 Standard Scores[b]			PPVT-R Standard Scores[b]	
Category	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.

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 when 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 participants' abilities to recognize the meaning of words presented orally is 2 *SD*s 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 $\leq$ 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 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) than females.

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 and 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 and 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 U.S. 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 CDC, 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, and 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 overidentification 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, Buschkuehl, 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, and 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.

Acknowledgment

We thank our participants for their time and willingness to participate, our talented project staff, and the Cook County and State of Illinois systems for their cooperation.

Declaration of Conflicting Interests

The authors disclosed no conflicts of interest with respect to the authorship and/or publication of this article. For information about *JCHC*'s disclosure policy, please see the Self-Study Exam.

Funding

The authors disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This work was supported by National Institute on Drug Abuse grants R01DA019380, R01DA022953, and R01DA028763; National Institute of Mental Health grants R01MH54197 and R01MH59463 (Division of Services and Intervention Research and Center for Mental Health Research on AIDS); and grants 1999-JE-FX-1001, 2005-JL-FX-0288, and 2008-JF-FX-0068 from the Office of Juvenile Justice and Delinquency Prevention. Major funding was also provided by the National Institute on Alcohol Abuse and Alcoholism, the Office of Behavioral and Social Sciences Research, the Substance Abuse and Mental Health Services Administration (Center for Mental Health Services, Center for Substance Abuse Prevention, Center for Substance Abuse Treatment), the NIH Center on Minority Health and Health Disparities, the CDC (National Center for Injury Prevention and Control and National Center for HIV/AIDS, Viral Hepatitis, STD and TB Prevention), the NIH Office of Research on Women's Health, the NIH Office of Rare Diseases, Department of Labor, Department of Housing and Urban Development, The William T. Grant Foundation, and The Robert Wood Johnson Foundation. Additional funds were provided by The John D. and Catherine T. MacArthur Foundation, The Open Society Institute, and The Chicago Community Trust.

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