4-22-2013

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Gabrielle Alvarez
Pacific University
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Abstract
Although neuropsychological evaluations are used as part of the basis for legal and rehabilitation decisions regarding juvenile delinquents, the effects of psychiatric disorders on their neuropsychological functioning are not sufficiently addressed in the literature. The present study examined the influence of emotional disturbance on neuropsychological test performance in a juvenile delinquent population. Regression analyses were conducted to determine the extent to which scores on the Youth Self-Report (YSR) Anxious/Depressed, Withdrawn/Depressed, and Somatic Complaints scales and the Drug Use Screening Inventory (DUSI) Substance Use scale predicted performance on measures of language, executive functions, visual-spatial ability, memory, and attention. Results indicated that the Anxious/Depressed scale was a significant predictor of visual-graphic memory ($b = .40, t = 2.72, p < .01$), the Somatic Complaints scale was a significant predictor of executive functions ($b = -.42, t = -3.11, p < .01$), and the Substance Use scale was a significant predictor of visual-spatial construction ($b = -.25, t = -2.12, p < .05$). However, YSR and DUSI subscale scores accounted for only 5-10% of the variance in these measures. Notably, social-emotional functioning was not associated with neuropsychological test performance on eight measures. These findings indicate emotional disturbance is generally not a significant influence on the neuropsychological functioning of juvenile delinquents.
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THE EFFECT OF SOCIAL-EMOTIONAL FACTORS ON NEUROPSYCHOLOGICAL FUNCTIONING IN JUVENILE DELINQUENTS

A THESIS

SUBMITTED TO THE FACULTY

OF

SCHOOL OF PROFESSIONAL PSYCHOLOGY

PACIFIC UNIVERSITY

HILLSBORO, OREGON

BY

GABRIELLE ALVAREZ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN CLINICAL PSYCHOLOGY

4/22/2013

APPROVED:

Michael Daniel, Ph.D.
Abstract

Although neuropsychological evaluations are used as part of the basis for legal and rehabilitation decisions regarding juvenile delinquents, the effects of psychiatric disorders on their neuropsychological functioning are not sufficiently addressed in the literature. The present study examined the influence of emotional disturbance on neuropsychological test performance in a juvenile delinquent population. Regression analyses were conducted to determine the extent to which scores on the Youth Self-Report (YSR) Anxious/Depressed, Withdrawn/Depressed, and Somatic Complaints scales and the Drug Use Screening Inventory (DUSI) Substance Use scale predicted performance on measures of language, executive functions, visual-spatial ability, memory, and attention. Results indicated that the Anxious/Depressed scale was a significant predictor of visual-graphic memory ($\beta = .40, t = 2.72, p < .01$), the Somatic Complaints scale was a significant predictor of executive functions ($\beta = -.42, t = -3.11, p < .01$), and the Substance Use scale was a significant predictor of visual-spatial construction ($\beta = -.25, t = -2.12, p < .05$). However, YSR and DUSI subscale scores accounted for only 5-10% of the variance in these measures. Notably, social-emotional functioning was not associated with neuropsychological test performance on eight measures. These findings indicate emotional disturbance is generally not a significant influence on the neuropsychological functioning of juvenile delinquents.

Keywords: delinquency, neuropsychological test performance, emotional disturbance
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Introduction

Juvenile delinquency is a growing nationwide crisis (Siegel & Welsh, 2011). Understanding delinquent behavior is important not only for the prevention of criminal acts, but also for interventions targeted at the societal problems delinquents face prior to and after committing antisocial acts. Delinquent behavior is seen in an expanding number of children, increasingly younger children, and more commonly as the result of substandard living conditions (Siegel & Welsh, 2011). However, not all children and adolescents raised in unhealthy environments develop antisocial tendencies; therefore, the study of risk factors and influences preceding and/or concurrently developing with juvenile delinquent behavior is critical to prevention, identification, treatment, and rehabilitation programs.

Of particular importance are psychological and neurobehavioral markers associated with juvenile delinquency. Current literature suggests emotional issues play a significant role in the development and maintenance of antisocial behavior, including factors such as depression, anxiety, bipolarity, and attention-deficit (Ryan & Redding, 2004; Ulzen & Hamilton, 1998). A separate body of research demonstrates that neuropsychological functioning is often impaired in juvenile delinquents (Gorenstein, 1990; Moffitt, 1993; Morgan & Lilienfeld, 2000; Teichner et al., 2000). Deficits in neuropsychological functioning, executive functions and language in particular, are thought to predate delinquent behavior and theories suggest delinquent adolescents develop maladaptive behavioral patterns because they initially navigate life with inefficient cognitive skills. Neuropsychological and psychological influences interact
with countless other social and environmental factors associated with the development of delinquent behavior. In this context, the confluence of social-emotional and neuropsychological contributing factors is poorly understood.

It appears the best understanding of juvenile delinquency can be achieved by considering the relationship of these variables together rather than researching single variables in isolation. However, although it has been demonstrated in both child and adult literature that psychological problems can impact neurocognitive functions and vice versa, these phenomena are rarely examined together within the context of delinquency. Developing an integrated understanding of neuropsychological and psychological factors in juvenile delinquency is important because of their potential influence on the success of corrections and rehabilitation.

Review of the Literature

The following literature review is organized into four sections aimed at describing various dimensions of juvenile delinquency. First, mental health problems in juvenile detention center populations are examined. Next, the review focuses on the ways in which emotional factors may impact neuropsychological evaluations. The third portion of the review describes current knowledge on the neuropsychological correlates of juvenile delinquency. Finally, problems in the current literature as well as the importance of synthesizing these research domains are addressed.

Mental Health and Juvenile Delinquency
Although a growing body of evidence indicates otherwise (Desai et al., 2006), some people believe psychiatric patients are in need of mental health therapy while juvenile delinquents are in need of punishment and tougher reform (Mears, 2001; Teplin et al., 2002). Despite decades of research on emotional disturbance and psychiatric problems in juvenile delinquent populations, overall findings indicate psychological problems in these children and adolescents continue to be under-diagnosed and under-treated. Prevalence rates of emotional disturbance in detention centers and juvenile court systems are significantly higher than those of community populations. Studies have estimated conservative rates of 17% to as high as 78% of delinquent individuals meet criteria for some type of psychiatric disorder, with differences in rates most often resulting from different modes of assessment (Ryan & Redding, 2004; Teplin, Abram, McClelland, Dulcan, & Mericle, 2002; Ulzen & Hamilton, 1998). However, overcrowded detention centers in conjunction with large numbers of emotionally disturbed juvenile detainees means the availability of mental health care is not commensurate with this high need for treatment. This results in increasing pressure on the juvenile justice system and staff, including problems of self-injury and suicidality, inappropriate detention placement, and recidivism (Desai et al., 2006). Cohen et al. (1990) found few significant behavioral, emotional, and demographic differences between children in a psychiatric hospital and children in a corrections facility, further emphasizing the need to treat emotionally disturbed delinquents.

Particularly alarming is the high rate of mood/affective and anxiety disorders in juvenile detention centers, as these conditions are well researched and very treatable. One
study of incarcerated adolescents found that a standardized clinical interview revealed 71% of the sample met criteria for depressive and anxiety disorders, otherwise understood as internalizing conditions (Ulzen & Hamilton, 1998). Other researchers have found similarly high rates of depressive and anxiety disorders in delinquent youth populations (Atkins et al., 1999; Pliszka, Sherman, Barrow, & Irick, 2000; Ryan & Redding, 2004). Further, Mallet, Stoddard, and Seck (2009) found that for youth offenders under juvenile probation, mood disorders were predictive of further delinquent behavior later in life. This was untrue for individuals diagnosed with attention-deficit/hyperactivity disorder (ADHD) in the same sample.

There is limited understanding about causal, correlational, or linear relationships between internalized emotional disturbance and the development of delinquent behavior. It is conceivable that in some cases mood and anxiety symptoms are situational reactions to confinement and detention, and some researchers have indicated that conduct problems predated mood or anxiety disorders in their samples (Pliszka et al., 2000). However, internalizing symptoms often predate, and are exacerbated by, delinquent behavior. Teplin et al. (2002) examined children and adolescents in detention centers and discovered approximately 60-66% of detainees met criteria for psychiatric disorders entirely independent of conduct or defiance problems, and that these disorders emerged prior to antisocial behavior. Social factors frequently contributing to both psychiatric problems and delinquency included experiencing trauma, parental divorce or substance problems, and general maltreatment during childhood and/or adolescence (Abram et al., 2004; Mallet et al., 2009; Ulzen & Hamilton, 1998). Researchers for the U.S. Department of Justice (1999) indicated that mood or anxiety disturbances resulting from societal
problems, such as indifference, withdrawal, and rejection, could further complicate and exacerbate antisocial behavioral acts leading to delinquency and detention.

Other psychiatric problems are widely observed in juvenile delinquent populations as well, highlighting the heterogeneity of emotional-behavioral maladjustment in these youth. It has been estimated that more than half of incarcerated adolescents experience externalizing disorders, including but not limited to Attention Deficit Hyperactivity Disorder (ADHD), mania, substance abuse, and conduct/oppositional disorders (Ulzen & Hamilton, 1998); however, it has been repeatedly noted that some or all of these conditions may share underlying construct overlap (Biederman, Faraone, Chu, & Wozniak, 1999; Faraone, Biederman, Mennin, Wozniak, & Spencer, 1997). One study found conduct disorder and oppositional defiant disorder to be the most prevalent psychiatric diagnoses in a detention center (Pliszka et al., 2000); as such, incarcerated adolescents may share more externalizing personality traits than their non-offending counterparts. Other research indicates high comorbidity between conduct disorder and anxiety or depression in incarcerated youth (Abram, Teplin, McClelland, & Dulcan, 2003; Atkins et al., 1999). Externalized emotional disturbances in juvenile offenders may elicit more immediate concern than internalizing behaviors because while internalized problems take the form of indifference, hopelessness, and fear, externalizing problems manifest in outward aggression, hostility, and self-harm. As the literature consistently demonstrates, diverse mental health disturbances are prevalent in the juvenile justice system, and are critically in need of targeted attention and resources.
Mental Health Factors and Cognitive Functioning

There is growing evidence that supports the idea that neuropsychological deficits are associated with pediatric depressive disorders. Though the neuropsychological correlates of depression are poorly understood, most researchers agree that cognitive problems do exist in this group (Cataldo, Nobile, Lorusso, Battaglia, & Molteni, 2005; Shenal, Harrison, & Demaree, 2003). Several studies demonstrate that pediatric depression is related to problems with attention and working memory, particularly when subjects are required to sustain attention for prolonged periods of time (Cataldo et al., 2005; Han et al., 2012; Kovacs, 1996; Matthews, Coghill, & Rhodes, 2008). Participants in these studies made several more errors of commission and omission on neuropsychological tasks than did control subjects, and errors increased with sustained attention requirements. It is not clear if working memory deficits predate depression or if depression contributes to the development of working memory weaknesses. Han et al. (2012) found that although depressed patients exhibited problems with attention, their performance on attention tasks improved when working with stimuli that had emotional or meaningful appeal. Further, other researchers noted no problems with attention and working memory in depressed children and adolescents (Maalouf et al., 2011). One study that did observe auditory-verbal working memory deficits found that problems with attention and working memory could be a subset of larger overall deficits in language ability (Klimkeit, Tonge, Bradshaw, Melvin, & Gould, 2011).

A number of other neurocognitive deficits have been observed in depressed children and adolescents. An area of debate is the extent to which executive functioning
is affected in depressed youth; several studies have found impaired executive functioning amongst young depressed patients (Cataldo et al., 2005; Kovacs, 1996; Maalouf et al., 2011). Baune, Czira, Smith, Mitchell, and Sinnamon’s (2012) found depressed 13-25 year olds made errors on sorting and organization tasks, although planning and task monitoring performances were generally intact. A number of studies also indicated more impulsivity and disinhibition in depressed children and adolescents (Cataldo et al., 2005; Maalouf et al., 2011). Chantiluke et al. (2012) used fMRI to measure prefrontal activation of depressed patients during executive functioning tasks. Activation was limited, and the researchers theorized that pediatric depression might compromise the healthy development of top-down prefrontal executive control.

Other researchers agree that cognitive differences exist in depressed patients, but not in the domain of executive functioning (Kovacs, 1996; Matthews et al., 2008). Klimkeit et al. (2011) found intact executive functioning in depressed adolescents that had impaired overall verbal abilities. Several researchers hypothesize that depressed patients have slowed psychomotor response speed because they often experience slowed movements and sluggishness. Some research findings support this hypothesis (Baune et al., 2012; Semrud-Clikeman & Teeter Ellison, 2009), while others do not (Chantiluke et al., 2012). Global processing speed was generally slower in depressed youth than in non-depressed youth, and patients typically displayed slow and conservative, yet accurate, response styles (Cataldo et al., 2005; Klimkeit et al., 2011; Semrud-Clikeman & Teeter Ellison, 2009). Lastly, Baune et al. (2012) found no visuospatial deficits, and most studies made no mention of this neuropsychological domain.
Much less research has been done on the neuropsychological performance of youth with emotional disorders other than depression. Pediatric anxiety disorders, for example, are common, and frequently comorbid with mood disorders (Brady & Kendall, 1992). The term “anxiety” is an umbrella term that includes several variations of nervousness, worry, tension, and avoidance symptoms. In the context of neuropsychological testing, anxiety disorders may interfere with cognitive ability and test performance, making interpretation and validity of test results uncertain. Specifically, it is often difficult to assess anxious children and adolescents because they frequently experience anxiety related to being evaluated, and can be emotionally reactive to failure or item difficulty (Semrud-Clikeman & Teeter Ellison, 2009; Tramontana, Hooper, Watts-English, Ellison, & Bethea, 2009). This may result in false positive diagnoses or invalid inferences regarding test performance, all of which qualifies research findings about neuropsychological functioning in youth with anxiety disorders. Despite these limitations, some data exists on the neurocognitive functioning of anxious children and adolescents. Bodas & Ollendick (2005) found that anxious youth experience more off-task thoughts than controls, resulting in lower cognitive performance overall. Similar problems related to attention and executive functioning tasks have been noted in anxious youth (Beers & De Bellis, 2002; Dalgleish et al., 2003; Shin et al., 2008). In addition, several studies found deficits in overall learning and memory for adolescents with anxiety (Beers & De Bellis, 2002; Roth, Milovan, Baribeau, & O’Connor, 2005; Yasik, Saigh, Oberfield, & Halamandaris, 2007). However, it is conceivable that anxious adolescents have problems with attention, task monitoring, and categorization skills that inhibit successful acquisition and consolidation of presented information. As such, demonstrated
memory problems may be secondary to executive function difficulties. These cognitive weaknesses can be further exacerbated by comorbidity with mood disorders. Emerson, Mollet, & Harrison (2005) found that anxious-depressed children and adolescents showed deficits in sequencing, task switching, and novel problem-solving. A growing body of literature indicates that although causal relationships regarding neurocognitive deficits and anxiety symptoms have not been established, when these emotional symptoms are present, their effect should be carefully considered in the context of neuropsychological evaluation.

A growing body of research indicates cognitive deficits are associated with early-onset bipolar disorder. Several researchers have found executive function deficits in pediatric bipolar patients, including but not limited to areas of attention, reasoning, planning, inhibition, and set-shifting (Biederman et al., 2011; Doyle et al., 2005; Semrud-Clikeman & Teeter Ellison, 2009). Bipolar patients also had significant academic deficits, requiring extensive tutoring and special education. McClellan, Prezbindowski, Breiger, and McCurry (2004) discovered verbal learning and memory deficits in pediatric bipolar patients, but concluded that these problems were more related to symptoms of psychosis as they found no significant neuropsychological differences between bipolar and schizophrenia patients. Several studies highlighted the difficulty of discriminating the effects of bipolar disorders and ADHD on neuropsychological test results because of their high comorbidity (Doyle et al., 2005; Gellar et al., 2000). However, as noted previously, it may be that these two psychiatric conditions potentially share common underlying constructs.
Researchers have not yet determined the causal or interactive relationships between emotional factors and neuropsychological deficits. Data derived from pediatric patients is generally mixed. However, overall, it is agreed that emotional symptoms are generally associated with impairment in neurocognitive functioning (Beers & De Bellis, 2002; Biederman et al., 2011; Cataldo et al., 2005; Han et al., 2012; Maalouf et al., 2011; Semrud-Clikeman & Teeter Ellison, 2009). Distinguishing the effects of psychopathology from other factors related to poor neuropsychological performance may be important for accurate diagnosis, treatment planning, and rehabilitation of emotionally disturbed youth, and more research is needed to further disentangle these critical issues.

**Juvenile Delinquency and Cognitive Functioning**

Current literature suggests specific neurocognitive deficits may be associated with juvenile delinquent behavior. Delinquent youth may experience neurocognitive problems prior to, or in addition to, impairments associated with emotional disturbance, further complicating the diagnostic and rehabilitation planning processes. Similar to neurocognitive-emotional relationships, research findings related to cognitive correlates of juvenile delinquency are inconsistent and poorly understood. Information about the neuropsychological profiles of juvenile delinquents may be valuable for identification of risk factors of delinquency. Understanding the cognitive challenges juvenile delinquents face is also critical in forming accurate conceptualizations to properly diagnose and rehabilitate these youth.
Researchers have often examined the executive functions of juvenile delinquents in order to determine their capacity to regulate behavior. One of the first theories of executive control and delinquent behavior arose from Luria’s (1973) model, which explained that internal mediation of behavior is fragile, and is particularly vulnerable to disruption with damage to or improper development of the frontal lobes. Others have elaborated on this model to create theories conceptualizing maladaptive social functioning, asserting that frontal lobe damage could result in behaviors such as risk taking, stimulation seeking, over-response to reward, avoidance or ignorance of punishment, and reduced fear of adverse events (Gorenstein, 1990).

Building on these models of behavior, several researchers have identified executive functioning deficits in juvenile delinquents or other youth committing antisocial behaviors (Moffitt, 1993; Seguin, Pihl, Harden, Tremblay, & Boulerice, 1995; Teichner et al., 2000). Common areas of demonstrated weakness include impulsivity and dysinhibition, as well as poor emotional control and reactivity, all thought to be regulated by frontal-subcortical neurocognitive pathways. A meta-analytic review of executive functions in children and adolescents committing antisocial behaviors revealed significant cognitive deficits in this area (Morgan & Lilienfeld, 2000); however, it was nonetheless noted that factors such as motivation, impulsivity, and self-regulation could be more related to developmental personality traits than to neurocognitive dysfunction. White et al. (1994) measured impulsivity in children and adolescents with behavioral measures such as inhibition games, rewards and punishment, cognitive measures of executive functioning, and personality measures including self and parent ratings of behavior. The authors found that performance on cognitive measures was strongly
associated with overall intellectual ability and school performance, while other
behavioral measures (i.e., inhibition games) were more predictive of delinquent behavior.
It may be that there are multiple factors that influence overall juvenile delinquent
behavior, including personality trait, neurocognitive, and behavioral factors.

Another topic of debate in the literature is the verbal ability of juvenile
delinquents. Studies have demonstrated generalized verbal deficits in children and
adolescents with a history of delinquency or antisocial/psychopathic traits (Leech, Day,
Richardson, & Goldschmidt, 2003; Moffitt, 1993; Nigg, Quamma, Greenberg, & Kusche,
1999; Seguin et al., 1995; Teichner et al., 2000), as well as some weaknesses in memory
for verbal information (Moffitt & Silva, 1987). Various theories exist on the relationship
between verbal deficits and antisocial behavior, though a causal relationship has not been
established. Moffitt, Lynam, & Silva (1994) have hypothesized that lower achievement in
school could contribute to lower verbal ability, both of which can contribute to delinquent
behavior. Another possibility they described is one in which verbal deficits predate
educational problems, leading to both reduced academic achievement and antisocial
behavior. Despite unknown causal relationships, the authors argued that verbal problems
contribute to poor expression of self, memory for verbal information, communication
skills, and school performance, all of which are associated with antisocial behavior. In
contrast, other authors found that intact verbal skills may be used inappropriately by
juvenile delinquents to facilitate manipulation, deception, and callous-unemotionality
(Munoz, Frick, Kimonis, & Aucoin, 2008; Salekin, Neumann, Leistico, & Zalot, 2004).
These authors concluded that strong verbal skills are necessary to successfully plan and
carry out antisocial thoughts and behaviors.
Other intellectual and cognitive domains are insufficiently addressed in the literature, although some mixed findings exist. Several authors implicate low overall IQ as a limiting factor in the development of healthy and adaptive behavior (Moffitt, 1993; Teichner et al., 2000), though it is important to note the heavy influence of verbal ability, as well as the heterogeneity of skills, on globally measured intellectual functioning. Some authors have found deficits in visual-spatial abilities related to antisocial behavior (Cauffman, Steinberg, & Piquero, 2005; Teichner et al., 2000), as well as in motor control (Morgan & Lilienfeld, 2000). In contrast, other findings indicate IQ and visual-spatial ability do not differ between antisocial youth and controls (Nigg et al., 1999).

Similar to neuropsychological research with emotionally disturbed populations, causal relationships have not been established and the neurocognitive correlates of antisocial behavior and juvenile delinquency are not yet completely understood. Nonetheless, much research exists supporting claims that cognitive deficits are pronounced in delinquent youth (Morgan & Lilienfeld, 2000). Learning about cognitive limitations in these populations is important for identifying risks factors, understanding delinquent behavior, and properly diagnosing and treating delinquent youth.

**Conclusions**

Improved understanding of juvenile delinquency is increasingly critical; delinquent behavior has risen steadily over the years, detention centers are overcrowded, behavioral problems are seen in younger children, and delinquent youth are meted out stringent punishments (Siegel & Welsh, 2011). Comprehensive psychological and
neuropsychological evaluations are important for many of these individuals in order to inform proper diagnoses, treatment plans, medication management, and rehabilitation recommendations for corrections, school, work, and home environments. Further, understanding the complicated relationships between social-emotional factors and neurocognitive functions is essential for accurate implementation of rehabilitation.

There are several methodological factors that could explain inconsistent research findings across studies. For example, the studies reviewed generally utilized small and highly selected samples. Overall methods of assessment were highly variable; studies differentially used self-report measures, standardized assessments, researcher-developed assessments, un-standardized or other qualitative clinical measures, behavioral observations, collateral ratings, and archive reviews. Another major methodological difference across studies was age of youth who were participants. The trajectories of neuropsychological functioning and emotional disturbance in children are highly dependent on age and development, and differences in participant ages could result in variable neurocognitive or emotional presentations. All of these factors could have contributed to the mixed and inconsistent state of findings in the current literature.

Of major concern is the absence of research that conjointly examines neurocognitive functions and emotional disturbance with respect to juvenile delinquent populations. The above review reflects the separation between two extensive bodies of research, one analyzing emotional disturbance in antisocial youth and the other describing cognitive dysfunction of antisocial youth. One study examined neurocognitive functions in addition to emotional factors in antisocial youth, yet the study focused on children at risk for delinquency rather than those having already committed acts of
delinquent behavior (Pine, Wasserman, & Workman, 1999). The authors found that the younger brothers of convicted delinquents exhibited elevated rates of anxiety as well as impaired memory functions and lower overall IQ, suggesting a familial risk factor for future psychological and cognitive problems in children. While the information gathered from this study is useful, the fact that there is only a single study in this area highlights the lack of knowledge about conjoint neuropsychological and emotional relationships within the context of juvenile delinquency. Emotional measures have been frequently used in conjunction with neurocognitive measures to study other child populations (i.e., pediatric health conditions; Barkley, Smith, Fischer, & Navia, 2006; Swillen et al., 1999), and it is important to expand this line of research to include antisocial and delinquent child populations as well.

Purpose of the Study

The purpose of this study is two-fold. First, determine if scores on certain subscales of the Youth Self-Report (YSR; Achenbach, T. M., 1991) are associated with neuropsychological test performance in a juvenile delinquent population. The YSR is a self-completed psychological measure for children and adolescents assessing the following areas: internalizing vs. externalizing behaviors, DSM-oriented scales reflecting certain psychiatric disorders, anxiety, depression, social problems, thought problems, somatic problems, social competence, attention, antisocial behavior, and aggression. Second, determine if scores on a subscale of the Drug Use Screening Inventory (DUSI; Tarter, R. & Hegedus, A., 1991) are associated with neuropsychological test performance
in the same population. The DUSI is a brief self-report measure for children and adolescents intended to screen for drug and alcohol abuse and related behaviors, and will be utilized in the present study to capture potential substance use not addressed in the YSR. In accordance with the literature, it is expected that those with higher elevations on these psychological measures will demonstrate more impaired neuropsychological test scores. The results of this study will contribute to knowledge about the emotional-behavioral functioning of juvenile delinquent populations as well as how their neuropsychological test profiles are affected by various areas of emotional disturbance.

Methodology

Participants

The experimental sample was selected from data originally collected as part of a larger study through Pacific University’s School of Professional Psychology that included neuropsychological and psychological test scores as well as personal demographics (e.g., age, gender) for 100 male and female juvenile delinquents aged 12-17. The sample consisted of primarily Caucasian youth (approximately 75%). Participants resided at either Hillcrest Youth Correctional Facility (HYCF), the Oregon state adolescent correctional institution administered by the Oregon Youth Authority (OYA), or St. Mary’s Home for Boys (SMHB), a private residential treatment facility where participants were court mandated for treatment. All participants carried a diagnosis of conduct disorder assessed by a licensed psychologist, master’s level therapist, or
psychiatrist, and had documented legal charges including but not limited to arson, burglary, criminal mischief, assault, harassment, criminally negligent homicide, unlawful use of a motor vehicle, possession of a controlled substance, fraud, theft, assault on a public safety officer, resisting arrest, unlawful use of a weapon, murder, and attempted murder. Exclusionary criteria for inclusion in the original database included head trauma with loss of consciousness, FSIQ less than 80, and/or history of neurological problems. All participants were native English speakers, and written informed consent was obtained from all participants and their legal guardians.

Procedure

Pacific University Institutional Review Board (IRB) approval was obtained for the present study prior to accessing or analyzing data (File Number 189-13). Original data collection approval was granted by the executive directors of the Oregon Youth Authority (OYA), HYCF, Oregon Services to Children and Families (OSCF), and SMHB and approved by Pacific University IRB.

Participants completed the Youth Self-Report and Drug Use Screening Inventory. Participants also were administered a battery of neuropsychological tests assessing the cognitive domains of overall intelligence, language, visual-spatial processing, verbal memory, visual-graphic memory, academic achievement, attention, and executive functioning. The neuropsychological tests in the original database were all standardized measures normed on child and adolescent populations. Based on previously theorized neuropsychological deficits in social-emotionally disturbed youth, the cognitive domains
of executive functioning, language, visual-spatial and construction skills, overall processing speed, auditory-verbal and visual-graphic memory, and verbal learning were selected for regression analysis in the current study. Specific tests used in this study are summarized in Table 1 below.

Table 1
Neuropsychological measures included in regression analyses.

<table>
<thead>
<tr>
<th>Cognitive Domain</th>
<th>Neuropsychological Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Language</td>
<td>WASI – Vocabulary</td>
</tr>
<tr>
<td>Visual-Spatial/Construction</td>
<td>WASI – Block Design</td>
</tr>
<tr>
<td>Processing Speed</td>
<td>D-KEFS Trails Number</td>
</tr>
<tr>
<td></td>
<td>D-KEFS Trails Letter</td>
</tr>
<tr>
<td>Memory</td>
<td>Rey-O Delayed Recall</td>
</tr>
<tr>
<td></td>
<td>RAVLT Delayed Recall</td>
</tr>
<tr>
<td>Learning</td>
<td>RAVLT Trials 1-5 Total</td>
</tr>
<tr>
<td>Executive Functions</td>
<td>D-KEFS Verbal Fluency Switching</td>
</tr>
<tr>
<td></td>
<td>D-KEFS Color-Word Interference: Inhibition</td>
</tr>
<tr>
<td></td>
<td>D-KEFS Card Sorting: Total Correct Sorts</td>
</tr>
<tr>
<td></td>
<td>D-KEFS Tower: Total Achievement</td>
</tr>
</tbody>
</table>

Note. WASI = Wechsler Abbreviated Scale of Intelligence. Rey-O = Rey-Osterrieth Complex Figure. RAVLT = Rey Auditory Verbal Learning Test. D-KEFS = Delis-Kaplan Executive Function System.

Results

Eleven standard multiple regression analyses were conducted to examine the relationship between neuropsychological test scores (eleven dependent variables listed in Table 1) and scores on the Youth Self-Report and Drug Use Screening Inventory (four independent or predictor variables). Group means and standard deviations for neuropsychological tests, YSR, and DUSI scales are presented in Table 2 below.
Table 2
Means and standard deviations for tests used in regression analyses.

<table>
<thead>
<tr>
<th>DV</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>WASI Vocabulary</td>
<td>94</td>
<td>48.35</td>
<td>9.62</td>
</tr>
<tr>
<td>WASI Block Design</td>
<td>91</td>
<td>48.75</td>
<td>9.81</td>
</tr>
<tr>
<td>D-KEFS Verbal Fluency</td>
<td>94</td>
<td>10.35</td>
<td>2.77</td>
</tr>
<tr>
<td>D-KEFS Color-Word</td>
<td>94</td>
<td>7.81</td>
<td>3.65</td>
</tr>
<tr>
<td>D-KEFS Cart Sort</td>
<td>94</td>
<td>8.49</td>
<td>2.51</td>
</tr>
<tr>
<td>D-KEFS Towers</td>
<td>94</td>
<td>10.17</td>
<td>2.23</td>
</tr>
<tr>
<td>D-KEFS Trails Number</td>
<td>94</td>
<td>9.89</td>
<td>2.55</td>
</tr>
<tr>
<td>D-KEFS Trails Letter</td>
<td>94</td>
<td>9.64</td>
<td>2.71</td>
</tr>
<tr>
<td>RAVLT Total Learning</td>
<td>94</td>
<td>51.86</td>
<td>29.76</td>
</tr>
<tr>
<td>RAVLT Delayed Recall</td>
<td>93</td>
<td>42.65</td>
<td>34.47</td>
</tr>
<tr>
<td>RCFT Delayed Recall</td>
<td>94</td>
<td>40.98</td>
<td>13.63</td>
</tr>
<tr>
<td>YSR Anxious/Depressed</td>
<td>94</td>
<td>57.45</td>
<td>8.23</td>
</tr>
<tr>
<td>YSR Withdrawn/Depressed</td>
<td>94</td>
<td>57.86</td>
<td>7.54</td>
</tr>
<tr>
<td>YSR Somatic Complaints</td>
<td>94</td>
<td>56.31</td>
<td>7.99</td>
</tr>
<tr>
<td>DUSI Substance Use</td>
<td>94</td>
<td>23.76</td>
<td>30.93</td>
</tr>
</tbody>
</table>

Note. $t = t$-score; $ss =$ Scaled Score; $\% =$ Percentile.

Pre-screening data analyses were done to assess for outliers based on z-scores for all the criterion and predictor variables. Specifically, subjects with z-scores greater than +/- 3.29 were identified as potential outliers. Across the key variables there were five subjects meeting this criterion. In all cases outlier data was not due to any known errors, and the participant(s) represented the population sample characteristics. Further, the potential undue influence of these cases on each regression model was examined (i.e., Cook’s Distance; $D > 1$) and results suggested no points of concern. Therefore, all outlier data were included in the analysis. The data were tested to ensure that pertinent parametric assumptions were met prior to interpretation of the tests of hypotheses, and these results will be included below for each regression model.

Examination of the histogram of standardized residuals suggested reasonable normality. Assumptions of linearity and homoscedasticity were met upon examination of
residual plots with standardized predicted values and residuals. Examination of Durbin-Watson, Tolerance, and VIF statistics indicated independence and multicollinearity assumptions were met.

**WASI Vocabulary**

In the first regression analysis, the dependent variable was the $t$-score for the WASI Vocabulary test (language). Results indicated YSR and DUSI combined predictor scales did not account for a significant amount of variance in the dependent variable; $R = .23$, $R^2 = .051$, $\Delta R^2 = .051$, $F(4,89) = 1.19$, $p = .32$. Coefficient statistics are presented in Table 3 below.

<table>
<thead>
<tr>
<th>IV</th>
<th>B</th>
<th>$\beta$</th>
<th>$t$</th>
<th>95% CI</th>
<th>Correlations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance Use</td>
<td>-.01</td>
<td>-.02</td>
<td>-.19</td>
<td>-.08-.06</td>
<td>Zero-order</td>
</tr>
<tr>
<td>Anxious/Depressed</td>
<td>.08</td>
<td>.06</td>
<td>.41</td>
<td>-.28-.43</td>
<td>Partial</td>
</tr>
<tr>
<td>Withdrawn/Depressed</td>
<td>.23</td>
<td>.18</td>
<td>1.24</td>
<td>-.14-.59</td>
<td>Part</td>
</tr>
<tr>
<td>Somatic Complaints</td>
<td>-.31</td>
<td>-.26</td>
<td>-1.85</td>
<td>-.65-.02</td>
<td></td>
</tr>
</tbody>
</table>

Note. * denotes significance ($p < .05$).

**WASI Block Design**

The second dependent variable was the $t$-score for the WASI Block Design test (visual-spatial). Results indicated YSR and DUSI combined predictor scales did not account for a significant amount of variance in the dependent variable; $R = .302$, $R^2 = .091$, $\Delta R^2 = .091$, $F(4,86) = 2.156$, $p = .081$. However, it was found that scores on the DUSI: Substance Use scale significantly predicted the WASI Block Design score, $\beta = -.25$, $t = -2.12$, $p < .05$, with higher scores on the DUSI scale predicting lower WASI
Block Design performance scores. This predictor accounted uniquely for 4.8% of the Block Design score variance, and 4.8% of the Block Design score variance not accounted for by the other three predictors, $sr^2 = .048, pr^2 = .048$. The 95% confidence interval for $\beta$ ranged from -.15 to -.01. The presence of a single significant predictor, in the absence of a significant overall regression model, indicated other predictors within the model were strongly unrelated to the outcome variable. Coefficient statistics are presented in Table 9 below.

**Table 9**
*Regression analysis coefficient statistics for WASI Block Design.*

<table>
<thead>
<tr>
<th>IV</th>
<th>$B$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>95% CI</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance Use</td>
<td>-.08</td>
<td>-.25</td>
<td>-2.12*</td>
<td>-.15-.01</td>
<td>-.23</td>
<td>-.22</td>
<td>-.22</td>
</tr>
<tr>
<td>Anxious/Depressed</td>
<td>.31</td>
<td>.26</td>
<td>1.67</td>
<td>-.06-.68</td>
<td>.13</td>
<td>.18</td>
<td>.17</td>
</tr>
<tr>
<td>Withdrawn/Depressed</td>
<td>-.03</td>
<td>-.02</td>
<td>-.16</td>
<td>-.40-.34</td>
<td>.02</td>
<td>-.02</td>
<td>-.02</td>
</tr>
<tr>
<td>Somatic Complaints</td>
<td>-.11</td>
<td>-.09</td>
<td>-.63</td>
<td>-.45-.23</td>
<td>-.04</td>
<td>-.07</td>
<td>-.07</td>
</tr>
</tbody>
</table>

Note. * denotes significance ($p < .05$).

**D-KEFS Verbal Fluency: Category Switching**

In the third regression analysis, the dependent variable was the Total Category Switching score for the D-KEFS Verbal Fluency test (executive functioning). Results indicated YSR and DUSI combined predictor scales did not account for a significant amount of variance in the dependent variable; $R = .15, R^2 = .021, \Delta R^2 = .021, F(4,89) = .487, p = .746$. Coefficient statistics are presented in Table 4 below.

**Table 4**
*Regression analysis coefficient statistics for DKEFS Verbal Fluency.*

<table>
<thead>
<tr>
<th>IV</th>
<th>$B$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>95% CI</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance Use</td>
<td>-.01</td>
<td>-.01</td>
<td>-.66</td>
<td>-.03-.01</td>
<td>-.02</td>
<td>-.07</td>
<td>-.07</td>
</tr>
</tbody>
</table>
D-KEFS Color-Word Interference: Inhibition

In the fourth regression analysis, the dependent variable was the Inhibition Total Score for the D-KEFS Color-Word Interference test (executive functioning). Results indicated YSR and DUSI combined predictor scales did not account for a significant amount of variance in the dependent variable; $R = .18$, $R^2 = .032$, $\Delta R^2 = .032$, $F(4,89) = .743$, $p = .566$. Coefficient statistics are presented in Table 5 below.

Table 5
Regression analysis coefficient statistics for DKEFS Color-Word Interference.

<table>
<thead>
<tr>
<th>IV</th>
<th>$B$</th>
<th>$\beta$</th>
<th>$t$</th>
<th>95% CI</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance Use</td>
<td>-.003</td>
<td>-.03</td>
<td>-.24</td>
<td>-.03-.02</td>
<td>.04</td>
<td>-.03</td>
<td>-.03</td>
</tr>
<tr>
<td>Anxious/Depressed</td>
<td>-.06</td>
<td>-.14</td>
<td>-.87</td>
<td>-.20-.08</td>
<td>.03</td>
<td>-.09</td>
<td>-.09</td>
</tr>
<tr>
<td>Withdrawn/Depressed</td>
<td>.11</td>
<td>.24</td>
<td>1.63</td>
<td>-.03-.25</td>
<td>.15</td>
<td>.17</td>
<td>.17</td>
</tr>
<tr>
<td>Somatic Complaints</td>
<td>.01</td>
<td>.03</td>
<td>.22</td>
<td>-.11-.14</td>
<td>.06</td>
<td>.02</td>
<td>.02</td>
</tr>
</tbody>
</table>

Note. * denotes significance ($p < .05$).

D-KEFS Card Sorting: Total Correct Sorts

The fifth dependent variable was the Confirmed Correct Sorts score for the D-KEFS Card Sorting test (executive functioning). Results indicated YSR and DUSI combined predictor scales did not account for a significant amount of variance in the dependent variable; $R = .24$, $R^2 = .059$, $\Delta R^2 = .059$, $F(4,89) = 1.394$, $p = .243$. Coefficient statistics are presented in Table 6 below.
Table 6
Regression analysis coefficient statistics for DKEFS Card Sorting.

<table>
<thead>
<tr>
<th>IV</th>
<th>B</th>
<th>β</th>
<th>t</th>
<th>95% CI</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance Use</td>
<td>-.02</td>
<td>-.22</td>
<td>-1.92</td>
<td>-.04-.001</td>
<td>-.21</td>
<td>-.20</td>
<td>-.20</td>
</tr>
<tr>
<td>Anxious/Depressed</td>
<td>.01</td>
<td>.04</td>
<td>.29</td>
<td>-.08-.11</td>
<td>.002</td>
<td>.03</td>
<td>.03</td>
</tr>
<tr>
<td>Withdrawn/Depressed</td>
<td>.04</td>
<td>.12</td>
<td>.86</td>
<td>-.05-.14</td>
<td>.01</td>
<td>.09</td>
<td>.09</td>
</tr>
<tr>
<td>Somatic Complaints</td>
<td>-.03</td>
<td>-.11</td>
<td>-.78</td>
<td>-.12-.05</td>
<td>-.11</td>
<td>-.08</td>
<td>-.08</td>
</tr>
</tbody>
</table>

Note. * denotes significance (p < .05).

D-KEFS Towers: Total Achievement

The sixth dependent variable was the Total Achievement score for the D-KEFS Towers test (executive functioning). Results indicated YSR and DUSI scales combined accounted for 10.6% of the variance in the D-KEFS Tower score; $R = .325$, $R^2 = .106$, $\Delta R^2 = .106$, $F(4,89) = 2.636$, $p = .039$.

Scores on the YSR: Somatic Complaints scale significantly predicted the D-KEFS Towers Total Achievement score, $\beta = -.42$, $t = -3.11$, $p < .01$, with higher scores on the YSR scale predicting lower D-KEFS Towers performance scores. This predictor accounted uniquely for 9.7% of the D-KEFS score variance, and 9.8% of the D-KEFS score variance not accounted for by the other three predictors, $sr^2 = .097$, $pr^2 = .098$. The 95% confidence interval for $\beta$ ranged from -.193 to -.043. No significant predictors were found for scores on the YSR: Anxious/Depressed scale ($B = .04$, $\beta = .15$, $t = .98$, $p = .33$, $CI = -.041$ to .12), YSR: Withdrawn/Depressed scale ($B = .05$, $\beta = .16$, $t = 1.16$, $p = .25$, $CI = -.03$ to .13), or DUSI: Substance Use scale ($B = .01$, $\beta = .10$, $t = .91$, $p = .36$, $CI = -.01$ to .02).

D-KEFS Trails: Number Sequencing
In the seventh regression analysis, the dependent variable was the Number Sequencing score for the D-KEFS Trail Making test (processing speed). Results indicated YSR and DUSI combined predictor scales did not account for significant variance in the dependent variable; \( R = .31, R^2 = .097, \Delta R^2 = .097, F(4,89) = 2.401, p = .056. \) Coefficient statistics are presented in Table 7 below.

Table 7
Regression analysis coefficient statistics for DKEFS Trails Number Sequencing.

<table>
<thead>
<tr>
<th>IV</th>
<th>B</th>
<th>( \beta )</th>
<th>t</th>
<th>95% CI</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance Use</td>
<td>-.02</td>
<td>-.03</td>
<td>-23</td>
<td>-.02 -.02</td>
<td>-.16</td>
<td>-.02</td>
<td>-.02</td>
</tr>
<tr>
<td>Anxious/Depressed</td>
<td>.06</td>
<td>.18</td>
<td>1.23</td>
<td>-.04 -.15</td>
<td>-.12</td>
<td>.13</td>
<td>.12</td>
</tr>
<tr>
<td>Withdrawn/Depressed</td>
<td>-.07</td>
<td>-.20</td>
<td>-1.45</td>
<td>-.16 -.03</td>
<td>-.23</td>
<td>-.15</td>
<td>-.15</td>
</tr>
<tr>
<td>Somatic Complaints</td>
<td>-.08</td>
<td>-.26</td>
<td>-1.93</td>
<td>-.17 -.002</td>
<td>-.26</td>
<td>-.20</td>
<td>-.20</td>
</tr>
</tbody>
</table>

Note. * denotes significance \((p < .05)\).

D-KEFS Trails: Letter Sequencing

In the eighth regression analysis, the dependent variable was the Letter Sequencing score for the D-KEFS Trail Making test (processing speed). Results indicated YSR and DUSI combined predictor scales did not account for a significant amount of variance in the dependent variable; \( R = .18, R^2 = .031, \Delta R^2 = .031, F(4,89) = 0.712, p = .586. \) Coefficient statistics are presented in Table 8 below.

Table 8
Regression analysis coefficient statistics for DKEFS Trails Letter Sequencing.

<table>
<thead>
<tr>
<th>IV</th>
<th>B</th>
<th>( \beta )</th>
<th>t</th>
<th>95% CI</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance Use</td>
<td>.001</td>
<td>.02</td>
<td>.13</td>
<td>-.02 -.02</td>
<td>-.04</td>
<td>.01</td>
<td>.01</td>
</tr>
<tr>
<td>Anxious/Depressed</td>
<td>.06</td>
<td>.18</td>
<td>1.16</td>
<td>-.04 -.16</td>
<td>.02</td>
<td>.12</td>
<td>.12</td>
</tr>
<tr>
<td>Withdrawn/Depressed</td>
<td>-.02</td>
<td>-.04</td>
<td>-.28</td>
<td>-.12 -.09</td>
<td>-.03</td>
<td>-.03</td>
<td>-.03</td>
</tr>
<tr>
<td>Somatic Complaints</td>
<td>-.08</td>
<td>-.22</td>
<td>-1.55</td>
<td>-.17 -.02</td>
<td>-.12</td>
<td>-.16</td>
<td>-.16</td>
</tr>
</tbody>
</table>

Note. * denotes significance \((p < .05)\).
Rey Auditory Verbal Learning Test: Total Learning

The ninth dependent variable was the Total Learning score for the Rey Auditory Verbal Learning test (learning). Results indicated YSR and DUSI combined predictor scales did not account for a significant amount of variance in the dependent variable; \( R = .165, R^2 = .027, \Delta R^2 = .027, F(4,89) = 0.624, p = .646 \). Coefficient statistics are presented in Table 11 below.

Table 11
Regression analysis coefficient statistics for RAVLT Total Learning.

<table>
<thead>
<tr>
<th>IV</th>
<th>B</th>
<th>β</th>
<th>t</th>
<th>95% CI</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
<tbody>
<tr>
<td>Substance Use</td>
<td>-.08</td>
<td>-.02</td>
<td>-.17</td>
<td>-.95-.795</td>
<td>-.04</td>
<td>-.02</td>
<td>-.02</td>
</tr>
<tr>
<td>Anxious/Depressed</td>
<td>3.26</td>
<td>.23</td>
<td>1.45</td>
<td>-1.22-7.74</td>
<td>.096</td>
<td>.15</td>
<td>.15</td>
</tr>
<tr>
<td>Withdrawn/Depressed</td>
<td>-.79</td>
<td>-.05</td>
<td>-.34</td>
<td>-5.35-3.77</td>
<td>.02</td>
<td>-.04</td>
<td>-.04</td>
</tr>
<tr>
<td>Somatic Complaints</td>
<td>-2.2</td>
<td>-.15</td>
<td>-1.03</td>
<td>-6.36-2.03</td>
<td>-.04</td>
<td>-.11</td>
<td>-.11</td>
</tr>
</tbody>
</table>

Note. * denotes significance (\( p < .05 \)).

Rey Auditory Verbal Learning Test: Delayed Recall

The tenth dependent variable was the Delayed Recall score for the Rey Auditory Verbal Learning test (verbal memory). Results indicated YSR and DUSI combined predictor scales did not account for a significant amount of variance in the dependent variable; \( R = .22, R^2 = .048, \Delta R^2 = .048, F(4,88) = 1.113, p = .356 \). Coefficient statistics are presented in Table 10 below.

Table 10
Regression analysis coefficient statistics for RAVLT Delayed Recall.

<table>
<thead>
<tr>
<th>IV</th>
<th>B</th>
<th>β</th>
<th>t</th>
<th>95% CI</th>
<th>Zero-order</th>
<th>Partial</th>
<th>Part</th>
</tr>
</thead>
</table>

<p>| Substance Use       | -.08 | -.02 | -.17 | -.95-.795  | -.04       | -.02    | -.02 |
| Anxious/Depressed   | 3.26 | .23  | 1.45 | -1.22-7.74 | .096       | .15     | .15  |
| Withdrawn/Depressed | -.79 | -.05 | -.34 | -5.35-3.77 | .02        | -.04    | -.04 |
| Somatic Complaints  | -2.2 | -.15 | -1.03| -6.36-2.03 | -.04       | -.11    | -.11 |</p>
<table>
<thead>
<tr>
<th>Substance Use</th>
<th>-.06</th>
<th>-.05</th>
<th>-.45</th>
<th>-.31-.19</th>
<th>-.08</th>
<th>-.05</th>
<th>-.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxious/Depressed</td>
<td>.98</td>
<td>.23</td>
<td>1.51</td>
<td>-.31-2.3</td>
<td>.09</td>
<td>.16</td>
<td>.16</td>
</tr>
<tr>
<td>Withdrawn/Depressed</td>
<td>.10</td>
<td>.02</td>
<td>.16</td>
<td>-1.2-1.4</td>
<td>.03</td>
<td>.02</td>
<td>.02</td>
</tr>
<tr>
<td>Somatic Complaints</td>
<td>-1.01</td>
<td>-.24</td>
<td>-1.65</td>
<td>-2.2-.21</td>
<td>-.096</td>
<td>-.17</td>
<td>-.17</td>
</tr>
</tbody>
</table>

Note. * denotes significance (p < .05).

**Rey-Osterrieth Complex Figure Test: Delayed Recall**

In the eleventh regression analysis, the dependent variable was the Delayed Recall score for the Rey-O Complex Figure test (visual memory). Results indicated YSR and DUSI combined predictor scales accounted for 12.2% of the variance in the dependent variable, \( R = .35, R^2 = .122, \Delta R^2 = .122, F(4, 89) = 3.102, p = .019 \).

It was found that scores on the YSR: Anxious/Depressed scale significantly predicted the RCFT Delayed Recall score, \( \beta = .40, t = 2.72, p < .01 \), with higher scores on the YSR scale predicting higher RCFT performance. This predictor accounted uniquely for 7.3% of the RCFT score variance, and 7.7% of the RCFT score variance not accounted for by the other three predictors, \( sr^2 = .073, pr^2 = .077 \). The 95% confidence interval for \( \beta \) ranged from .18 to 1.16. No significant predictors were found for scores on the YSR: Somatic Complaints scale (\( B = -.29, \beta = -.17, t = -1.27, p = .21, CI = -.75 \) to .17), YSR: Withdrawn/Depressed scale (\( B = -.10, \beta = -.06, t = -.41, p = .68, CI = -.60 \) to .39), or DUSI: Substance Use scale (\( B = -.08, \beta = -.20, t = -1.75, p = .08, CI = -.18 \) to .01).

**Discussion**
The purpose of the present study was to determine if there is a significant relationship between emotional/psychological functioning and neuropsychological performance for juvenile delinquents, an area of research so far insufficiently addressed in the literature. For the majority of neuropsychological tests (8 of 11), scores on the YSR and DUSI subscales were not significant predictors. Regression analyses for 3 neuropsychological tests were significant.

The most striking result of the current study is that the vast majority of neuropsychological test scores were not associated with YSR and DUSI subscale scores. This finding suggests that emotional disturbance and self-reported substance use were not predictive of neuropsychological test performance in this group of juvenile delinquents. Clinically, these findings suggest that impaired neuropsychological test performance for juvenile delinquents is reflective of true neurocognitive dysfunction and is not secondary to emotional problems.

Results of the current study are discrepant from previous research findings describing negative neuropsychological outcomes associated with psychiatric symptoms in non-delinquent populations (Baune et al., 2012; Biederman et al., 2011; Cataldo et al., 2005; Matthews et al., 2008). However, the difference in findings likely is due to method of subject selection. Studies in the literature that examined neuropsychological functioning of adolescents with psychiatric disorders employed a wide range of subject selection criteria including unstructured clinical interviews, the Structured Clinical Interview for DSM-IV (SCID), and referrals from psychiatric inpatient units, etc. (Ryan & Redding, 2004; Teplin et al., 2002; Ulzen & Hamilton, 1998). This likely resulted in subject samples with more severe levels of emotional disturbance. In contrast, the present
study selected subjects based on their delinquent behavior, not based on the presence of psychiatric disorders and it appears they had less significant, or at least a different type of, emotional disturbance than subjects in studies reviewed above. Furthermore, it is noted that social-emotional measures used in the present study yielded generally average scores across subscales (average $t$-score ranging from 56 to 57), evidencing little presence of emotional disturbance in this particular juvenile delinquent population as measured by these assessment tools. It is likely the low level of emotional problems in the present subject sample may be why there were not significant associations between neuropsychological test performance and psychological test scores in contrast to findings in the literature.

In light of extensive research outlining the widespread presence of emotional disturbance in juvenile delinquent and antisocial populations (Ryan & Redding, 2004; Teplin et al., 2002), it may be that self-report measures like the YSR and DUSI subscales are broad, generalized, and/or not sufficiently sensitive to capture specific psychiatric problems experienced by delinquent youth. Emotional problems specific to this population may best be captured by more conventional psychiatric assessment procedures including structured interview and review of records. Alternatively, as previously noted, it may be that the YSR and DUSI are adequate measures and that the present sample simply had a low level of emotional disturbance.

Despite these considerations, in the current study there was sufficient range in both neuropsychological test scores and YSR/DUSI scores to allow detection of a significant association between emotional disturbance (as measured by the YSR) and neuropsychological test performance had one existed in this sample of juvenile
delinquents. These results therefore indicate there is not a strong association between emotional disturbance and neuropsychological test performance in an unselected sample of juvenile delinquents.

Turning to statistically significant findings, the Somatic Complaints scale of the YSR was a significant predictor of D-KEFS: Towers Achievement performance, which is hypothesized to measure executive functions including planning ability, error monitoring, and maintenance of rule-sets (Homack, Lee, & Riccio, 2004). Higher scores on the YSR, potentially reflecting more symptoms related to social-emotional problems, were predictive of lower D-KEFS Tower Test performance. Elevations of the Somatic Complaints scale, which includes various symptoms such as headache, stomachache, and dizziness, suggests a higher likelihood that children and adolescents may express emotional and psychological concerns as physical sensations (Egger, Costello, Erkanli, & Angold, 1999). The tendency to express psychological stress as physical symptoms may be due to age-appropriate developmental language skills (e.g., children may not have the ability to verbally communicate depressive thoughts), incomplete emotional development, the lack of understanding about different emotions, or cultural factors, among other reasons. Although physical sensations are often embedded into formal criteria for diagnosis of child psychiatric disorders (e.g., tension and/or sweating as symptoms of an anxiety disorder), relationships between sensation-specific somatic complaints and particular psychiatric disorders are not clearly identified. Specifically, caution should taken in interpreting child somatic complaints because there is substantial overlap between various somatic concerns and related emotional problems, and underlying associations between physical symptoms and psychiatric disorders may be
different for boys and girls (Egger et al., 1999). Another important consideration is that physical symptoms may actually be indicative of medical illness rather than emotional disturbance (Perrin, Stein, & Drotar, 1991). It may be that elevations on somatic-oriented scales are reflective of patients with genuine medical problems resulting in aches and pains, without the presence of comorbid emotional disturbance.

Whether expression of psychological stress through physical symptoms or just physical symptoms, the present findings indicate that whatever is measured by the Somatic Complaints scale has an influence on the efficient completion of a task requiring higher-order executive functions. If the Somatic Complaints scale represents physical symptom expression of psychological stress, it may be this psychological stress interfered with the planning ability required in the Towers test. However, it is unclear why the physical expression of psychological stress would affect only this particular executive function test and not other neuropsychological tests. Another possibility is that the Somatic Complaint scale is reflective of true physical symptoms (i.e., medical concerns) rather than a psychological process; however, similar uncertainty exists as to why physical complaints would influence this particular test of executive functioning and not others.

Since there is no rationale that predicts elevations on Somatic Complaints would be selectively associated with Tower performance, it is possible that this result is a chance statistical finding, and as such, is not valid. Even if it is a valid finding, it is important to note that only 10% of the variance in Tower Achievement performance was accounted for by the Somatic Complaint scale. Further, the mean and standard deviation for Tower Achievement scores where average, indicating that the performance of
delinquents in the present study was age-typical with normal variability. As such, juvenile delinquents in the present study did not have impairment on this particular executive functioning test, raising additional questions about the significance of this finding.

The Substance Use scale on the DUSI was significantly associated with WASI Block Design performance (visual-spatial construction skills), with higher scores on the DUSI (i.e., more substance use) being predictive of lower Block Design scores. The Substance Use scale was used in the present study because the frequent comorbidity of substance abuse and adolescent delinquence raises questions about the association between substance abuse and neuropsychological test performance in this group (Brook, Cohen, & Brook, 1998). Adolescents that abuse substances are a heterogeneous group with respect to types of substances used, substance use trajectories (i.e., duration of use, age of onset), substance abuse patterns (i.e., amount used per episode, number of episodes per week), and other associated behaviors (i.e., truancy or other school issues, social isolation, delinquent behavior). Given the heterogeneity of substance abuse factors, as well as the understanding that not every juvenile delinquent will engage in problematic substance use behavior, the examination of specific dimensions of substance abuse and associated neuropsychological sequelae were beyond the scope of the current study and literature review. Rather, the DUSI Substance Use scale was used in present analyses as a general screen for substance abuse concerns. In light of present findings, it is conceivable that substance abuse behaviors may negatively influence visual-spatial/construction performance; however, it is noted that the mean and standard deviation of scores on Block Design are generally average, and the DUSI scale accounted for only 5% of the
variance in neuropsychological test scores. While this is a statistically significant finding, the result is not indicative of a strong effect.

Finally, the significant association between RCFT Delayed Recall score (visual-graphic memory) and YSR scores was unexpected and of questionable validity. Specifically, scores on the Anxious/Depressed subscale of the YSR were associated with RCFT performance for the participants in this study. The Anxious/Depressed scale assesses symptoms of child anxiety and depressive disorders. The scale combines anxiety and depression because they often co-occur in children and adolescents, presumably due to common developmental characteristics related to a range of negative emotions (Watson, 2005). However, there is no reason to think that increasing levels of anxiety and depression are associated with better visual-graphic memory and this finding unlikely is valid.

The current study has some limitations. Primarily, several multiple regression analyses were conducted in efforts to comprehensively address numerous neuropsychological and social-emotional domains. Conducting multiple analyses increases the likelihood of alpha type I error and chance findings of significant results. It is quite possible that all significant results in the present study are chance findings as the result of multiple comparisons. Also of noteworthy concern is that the present study does not account for cultural and ethnic diversity of the individuals comprising the study sample. Furthermore, the sample includes male and female delinquents, and research suggests that youth may differentially experience and endorse emotional symptoms across genders and sexes (Egger et al., 1999).
Future research could examine the heterogeneity of juvenile delinquent populations. Topics of investigation may include associations between neuropsychological performance and different criminal acts (i.e., variability in severity levels of delinquent behavior), as well as environmental factors preceding delinquent behavior. Additionally, specific and operationally defined social-emotional symptoms and psychiatric disorders, including less-studied presentations (i.e., psychosis, somatization), could be examined in the context of neuropsychological test performance and delinquent behavior. Finally, cultural differences within juvenile delinquent populations can further be taken into consideration. Future research may investigate aspects of culture such as language, acculturation, socio-economic status, ethnic origin, etc.

Neuropsychological test results and social-emotional evaluations are useful to the degree that they reflect true individual functioning and inform decisions about real people; as such, it is critically important to consider multiple factors influencing emotional presentations and neurocognitive test performance throughout assessment procedures. Future research with respect to these factors will be beneficial for delinquent youth because these evaluations and subsequent recommendations will affect legal procedures, rehabilitation and treatment options, and their own opportunity for success.
References


