PEER RELATIONSHIPS IN AFRICAN AMERICAN ADOLESCENTS: THE ROLE OF COGNITIVE FUNCTIONING

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Developmental research on social functioning has consistently demonstrated an association between peer reports of a child's social functioning and adjustment in multiple domains. Because peer reports of social functioning have demonstrated stability and predictive power for subsequent behavioral and emotional functioning, there is a strong interest in gaining a better understanding of factors that contribute to variation in peer reports of a child's social behavior and acceptance. The current study examined the relationship between an individual child's cognitive functioning and peer reports of the same child's social functioning for an inner city urban sample of 116 African American adolescents, ages 14 to 17. Cognitive data were obtained utilizing an extensive neuropsychological battery and one-to-one testing. Social functioning data were obtained in classrooms from peers and teachers.

A significant association was demonstrated between IQ-Achievement (IQA) and reciprocated friendships, with higher IQA scores associated with a greater number of reciprocated friendships. When specific aspects of cognitive functioning (attention, visual-spatial skills, motor skills, memory, executive functioning) were considered in combination with IQA, only attention was linked to social outcomes; poorer attentional abilities were associated with fewer peer reported popular-leadership behaviors. Two significant IQA interactions also emerged: an interaction between IQA and memory skills for teacher-reported aggressive disruptive behavior, and an interaction between IQA and motor skills for reciprocated friendships. All significant findings were of small to medium effect. The absence of significant findings and modest size of the few significant results that were obtained suggests that, in the current sample of African American inner city youth, our measures of neurocognitive functioning were marginally related to peer perceptions of the adolescent's social functioning. While replication is needed, results are discussed considering the role of contextual factors (e.g., age, race, SES), issues related to measurement of cognitive ability, and implications for existing models of social and cognitive development.

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1.0 INTRODUCTION

Social functioning, particularly an individual's ability to interact positively with peers, is a critical dimension of human behavior that has been shown to be related to current and later functioning in multiple areas (e.g., mental and physical health; academic and occupational performance) (Ewart & Jorgensen, 2004; Hay, Payne, & Chadwick, 2004). Much of the developmental research on social functioning has focused on the unique importance of children's peer relationships as specific index of social functioning, relating individual differences in peer relations to current and subsequent adjustment outcomes. Because peer relationships are thought to be complex, multidimensional phenomena they are often characterized in multiple ways and involve multiple measurement strategies. Among the aspects of peer relations most frequently described in the literature are social behavior and peer acceptance. Assessments of social behavior ask the question "What is a child like?", and focus on qualitative and quantitative differences in social behaviors such as aggression and/or leadership, whereas assessments of peer acceptance are concerned with the question "Is the child liked?", and focus on whether a child is seen by his or her peers as someone that is well-liked, and the number of friendships a child has. Notably, when utilizing peer-report strategies for describing such differences in social behavior and peer acceptance, considerable stability has been demonstrated in these particular aspects of peer relations (Asher, Singleton, & Tinsley, 1979; Masten, Morison, & Pellegrini, 1985; Ollendick, Greene, Weist, & Oswald, 1990; Olson & Lifgren, 1988).

When considering literature exploring the correlates of these individual differences in peer relations, problematic peer relations (e.g., those typically characterized by behavioral isolation or aggression, and/or a lack of acceptance and few friendships) have been associated with current problems in behavioral, academic, and emotional domains (Masten et al., 1985; Olson & Lifgren, 1988) and have been identified as a predictor of future emotional, scholastic, occupational, and behavioral problems (Morison & Masten, 1991; Ollendick et al., 1990; Olson & Lifgren, 1988; Parker & Asher, 1987). Conversely, adaptive peer relations (e.g., those typically characterized by leadership and prosocial behaviors, and/or peer acceptance, and a greater number of friendships) have been associated with better current adjustment in social, emotional, and behavioral domains (Bellanti & Bierman, 2000; Gest, Graham-Bermann, & Hartup, 2001; Masten et al., 1985; Newcomb, Bukowski, & Pattee, 1993; Wentzel & Caldwell, 1997) and they also have been identified as predictors of more adaptive functioning in social, emotional, educational, and occupational domains over time (Bellanti & Bierman, 2000; Gest et al., 2001; Morison & Masten, 1991; Olson & Lifgren, 1988; Wentzel & Caldwell, 1997).

Peer relations appear to have particular salience during adolescence (La Greca & Prinstein, 1999). Adolescents spend less time at home and more autonomous time with peers than school-aged children (Csikszentmihalyi & Larson, 1984). As parent-centered relationships decrease in centrality and as autonomy increases, peers become a more important source of advice and support increasing the potential for these peer relationships to affect adolescent adjustment (Buhrmester, 1996; Furman & Buhrmester, 1985; Furman & Buhrmester, 1992). Moreover, during adolescence the crowd a teen associates with becomes increasingly important and defined in the adolescent social hierarchy, further increasing active social comparison and intensifying the focus on peer-centered relationships (O'Brien & Bierman, 1988). This can further amplify the power of the peer group to affect adolescent’s social and emotional well-being.

A large literature suggests that peer victimization and/or rejection during adolescence is associated with a myriad of both current and future adjustment difficulties, particularly externalizing problems including aggression, violent and/or delinquent behaviors, substance use, and adult criminality (Dishion & Owen, 2002; Lacourse, Nagin, Tremblay, Vitaro, & Claes, 2003; Rabiner, Coie, Miller-Johnson, Boykin, & Lochman, 2005; Sullivan, Farrell, & Kliewer, 2006). Conversely, positive peer relationships during childhood and early adolescence have been shown to buffer the impact of adverse environmental influences both within and outside the peer group including peer victimization, ecological disadvantage, marital conflict, and harsh discipline (Hodges, Boivin, Vitaro, & Bukowski, 1999; Lansford, Criss, Pettit, Dodge, & Bates, 2003).

Given the developmental significance of peer relationships, their stability (when utilizing peer-report assessments), and their predictive validity, there is a critical need to further our understanding of factors that contribute to individual differences in peer relationships, particularly in groups of adolescents who are at-risk for adjustment difficulties. Articulating the factors that contribute to children's and adolescent's peer acceptance and social behavior, and exploring ways in which these factors exert their influence will enable a greater appreciation of possible mechanisms by which both adaptive and maladaptive peer relationships arise. Such research has the potential to lead to more effective ways to identify and intervene with children and adolescents at risk for problematic peer relations and associated negative outcomes.

1.1 GENERAL COGNITIVE ABILITY AND PEER RELATIONSHIPS

One domain of functioning that has received attention for its association with children's peer relationships is cognitive ability (Greenham, 1999). It seems logical to assume that how a child processes, stores, integrates, and utilizes information could affect his or her social behavior and interpretation of social interactions. While some research has explored associations between social cognitions and peer relationships (Crick & Dodge, 1996; Dodge et al., 2003; Dodge, Pettit, McClaskey, & Brown, 1986; Dodge & Price, 1994) limited attention has been devoted to understanding whether more general, less proximal neurocognitive abilities (e.g., attention, memory, visual-spatial skills, motor skills) contribute to variation in social behavior and social acceptance. In addition to the fact that these abilities are relatively stable throughout life, these more general neurocognitive abilities are thought to emerge earlier in life and may have greater potential to influence a child's social behavior and peer acceptance over time (Whishaw & Kolb, 2003).

A growing body of research suggests that from an early age children who perform better on tests of general cognitive abilities (e.g., IQ tests) are more socially competent and have more positive peer relationships (Hymel, 1983; Olson & Lifgren, 1988). Similarly, considerable work suggests that school-aged children who demonstrate better general cognitive ability are more likely to be accepted by peers (e.g., rated as "well-liked," have more reciprocated friendships), and are described as being leaders and demonstrating more prosocial behaviors, while they are less likely to be described as demonstrating aggressive or isolating behaviors (Bellanti & Bierman, 2000; Ladd, Birch, & Buhs, 1999; Masten et al., 1985; Morison & Masten, 1991; Mostow, Izard, Fine, & Trentacosta, 2002; Woodward & Fergusson, 2000). These relationships have been documented from the perspective of children's parents, teachers (Bellanti & Bierman, 2000; Woodward & Fergusson, 2000), and children's peers (Bellanti & Bierman, 2000; Masten et al., 1985; Mostow et al., 2002).

Similar findings have been reported related to children's academic achievement. Children with higher achievement scores are more often nominated as demonstrating prosocial and/or leadership behaviors, and have greater peer acceptance characterized by higher like-ratings, and increased numbers of both friendships and reciprocated friendships (Ladd et al., 1999; Morison & Masten, 1991). This finding is fortified by evidence suggesting that, in general, children with learning disabilities (LD) have more problematic relationships with peers (i.e., fewer best friends; not well liked; more sensitive isolated behaviors, fewer leadership behaviors) relative to comparison children with average, or above-average achievement (Conderman, 1995; Kavale & Forness, 1996; Nabuzoka & Smith, 1993; Ochoa, 1995; Ochoa & Palmer, 1991; Wiener & Harris, 1993; Wiener, Harris, & Shirer, 1990). While the evidence for associations between general cognitive functioning (IQ), academic achievement, and peer relationships have been consistently reported from multiple investigators, important questions related to context and specificity arise that limit our ability to understand this relationship.

To date, research examining associations between general cognitive functioning and peer relationships has utilized samples of predominantly white, middle-class, children in early and middle childhood (Hymel, Rubin, Rowden, & al., 1990; Woodward & Fergusson, 2000). While such work has enabled a general understanding of this association in this demographic, it is important to consider whether this association extends to samples with different socioeconomic, racial, and developmental contexts, particularly when some social and developmental theory and research suggest that this association between cognitive functioning and social functioning might be sensitive to context.

In disadvantaged environments where resources and opportunities are more limited and/or different, and where environmental instability and violence is higher, academic achievement may have less social capital, and may not be as important to an adolescent's peers (Orr, 2003). A such, it is feasible that the social context of disadvantaged neighborhoods may favor aggressive, risk-taking behaviors over behaviors that promote academic achievement (Miller-Johnson et al., 2003), whereby a lack of interest in academics could even be a pathway to success. Some developmental research on the nature of peer relationships in lower-SES, African American adolescents suggests that some individuals described as popular leaders demonstrate prosocial behaviors, while other popular leaders display aggressive behaviors (Farmer, Estell, Bishop, O'Neal, & Cairns, 2003; Miller-Johnson et al., 2003; Rodkin, Farmer, Pearl, & Van Acker, 2000). Furthermore, the subgroup of popular-aggressive children has been described as having a high level of school social network centrality (Xie, Farmer, & Cairns, 2003). Thus, it seems possible that in certain environmental contexts the social capital afforded by aggressive behavior may be as strong as, or potentially stronger than that of academic achievement. To the extent that academic success may be differently valued in this socio-economic context, it is possible that academic achievement will not contribute, or will negatively contribute to an adolescent's peer relationships.

Additionally, the cultural context may also influence associations between achievement and peer relationships. The notion of "acting white" has received increasing attention in both popular culture and research arenas (Fordham & Ogbu, 1986). This notion refers to the assertion that a significant number of African American youths disengage from their academic environment because of pervasive beliefs within their peer culture that academic achievement reflects "white" values (Peterson-Lewis & Bratton, 2004). Consequently, for an African

American, pursuing these “white,” academic achievement goals is seen as de-identifying from one’s own group, and as a result may be viewed negatively by the peer group.

While the above literature focuses on academic achievement, it is also important to explore whether associations between more general cognitive abilities and peer relationships would be sensitive to contextual factors, particularly given that better general cognitive abilities (e.g., IQ) tend to be associated with a wide array of adaptive outcomes in different contexts. It seems possible that differences in the association between general cognitive abilities and peer relationships for African American versus white adolescents might be seen as a result of the difficulties that arise when using traditional intelligence measures in minority populations. Even the most widely used measures of children’s general cognitive abilities that have utilized diverse normative samples have been criticized for having inherent cultural biases in test context, administration, and standardization procedures that favor European American values and experiences (Kwate, 2001). To the extent that these intelligence tests tap into abilities, experiences, and a motivational framework that may more highly valued by European Americans it may be that children from minority populations demonstrate poorer performance on these measures that reflects differences in cultural values and experiences, not necessarily poorer cognitive functioning. These issues are compounded when considering research that has demonstrated that SES is strongly linked to educational resources and opportunities, school quality (Orr, 2003), and aspects of the home environment (e.g., stimulating play materials) that have been shown to predict a significant proportion of the variance in children’s cognitive functioning scores (Bradley et al., 1989; Brooks-Gunn, Klebanov, & Duncan, 1996). Such research raises the possibility that scores on the vocabulary subtest of the WISC, for example, measure far more than just expressive language. Moreover, because these measures can tap into a broad range of abilities and experiences that can be influenced by cultural values, it is difficult to know whether tasks are measuring the same things in African-American, low-SES inner city 15-year olds as they are in white, middle-class suburban 15-year olds.

When considering the current literature looking specifically at peer relationships and cognitive functioning, many of the reviewed studies did not have samples with significant socioeconomic or racial diversity. Of the studies that appeared to have samples that demonstrated diversity along these dimensions, few reported whether the linkages between cognitive functioning and peer relationships varied dependent upon the child's SES, or race (Masten et al., 1985; Mostow et al., 2002). Importantly, one study that did explore the linkages between cognitive functioning and peer relationships suggested that this relationship may be sensitive to racial and socioeconomic factors. Specifically, Risi, Gerhardstein, and Kistner (2003) demonstrated that peer-rated social preference scores collected in grades 3, 4, or 5 predicted educational outcomes 10 years later, but only for Caucasian and middle SES students. Specifically, for Caucasian, middle SES students, higher social preference scores were associated with improved educational outcome (i.e., improved likelihood of having graduating high school). Further analyses indicated that SES was driving this association, such that when both race and SES were utilized as predictors of educational outcome, only SES remained a statistically significant predictor of graduating high school. This finding suggests that associations between peer relationships and academic achievement may be particularly sensitive to socio-economic factors.

Additional analyses in the same study (Risi, Gerhardstein, & Kistner, 2003) focusing on peer-reports of social behaviors (including aggressiveness and withdrawal) revealed that an association between peer-reported withdrawal and subsequent negative educational outcomes was moderated by race, with social withdrawal predicting more negative educational outcomes only for African American students. African Americans who failed to graduate on time, or who were enrolled in adult education classes were perceived by their elementary school classmates as more withdrawn than African Americans who graduated high school on time. However, for Caucasian students social withdrawal was unrelated to any educational outcomes. These types of findings would suggest that race could also affect associations between cognitive functioning and peer relationships.

It is also important to consider how the developmental context of peer relationships could affect associations between cognitive functioning and social functioning. During adolescence when one's peers and the values of one's peer group take on primary importance, it may be that academic achievement is less salient than other factors that are particularly important to adolescent culture (e.g., athletic ability, physical appearance), especially in the inner-city. The present review located no studies that examined the relationship between general cognitive functioning and social functioning in adolescents, with the oldest children represented in the reviewed studies being of approximately age 12. As such, it is unclear whether associations between cognitive functioning and peer relationships are similar for adolescents, much less adolescents who are minority youth, or from more disadvantaged socioeconomic groups.

There is some research to suggest that associations between cognitive functioning and peer relationships may be sensitive to developmental context. For example, findings from one longitudinal study of urban African American children by Coie et al. (Coie, Lochman, Terry, & Hyman, 1992) suggested that determinants of adaptive peer functioning can change over time. Specifically, the authors reported that aggressive behavior was negatively associated with social preference in grade three; demonstrated no association with social preference at grade 6; and was positively associated with social preference at grade 8. While no conclusions can be drawn about whether the developmental shifts demonstrated in this study are unique to African Americans samples, or are generalizable to individuals in suburban or rural areas, such research highlights the importance of considering the developmental stage of the participants, particularly when considering African Americans youths from urban environments.

A final limitation of studies examining relationships between general cognitive functioning and peer relationships is that most existing studies rely on one measure of “general” cognitive ability, or more commonly only one subtest from one particular measure of cognitive ability (e.g., using a vocabulary score from a measure of child IQ as a proxy for general cognitive functioning). While the fact remains that some measures, and particular subtests from these measures, may be highly correlated with overall IQ and achievement (Sattler, 2001), it is important to consider whether one or two subtests from a single measure of cognitive ability provides a valid estimate of general cognitive functioning, given the specificity any given task and the potential cultural biases in traditional cognitive testing. When assessing the role of cognitive ability in children’s peer relationships within a different environmental context it may be quite useful to explore whether making an assumption of unitary cognitive abilities by relying on assessments of general cognitive functioning masks patterns of strength or weakness in specific cognitive abilities that could hold additional explanatory power.

In summary, it seems that while a relationship has been established between general cognitive functioning and social functioning in children, some of the primary limitations of this literature are narrow contextual parameters, and reliance on assumptions of unitary cognitive ability. Specifically, there are very few studies that address the relationship between cognitive functioning and social functioning outside samples of white, middle-SES children, even in light of some theory that suggests that this association may be sensitive to context. As such, the first aim of the current study was to extend this research to a sample of inner-city, low SES, African American adolescents from a medium-size Midwestern city while utilizing a comprehensive assessment of neurocognitive ability. Examination of this association in such a sample would shed light on the generalizability of existing literature.

1.2 DOMAINS OF COGNITIVE ABILITY AND PEER RELATIONSHIPS

The aforementioned question related to specificity of cognitive abilities evokes recurring themes that have repeatedly surfaced in the dialogues of intelligence theorists related to the nature of intelligence. Theorists have repeatedly suggested that intelligence is not a single attribute; rather, it is a collection of intellectual abilities (Gardner, 1983; Hatch & Gardner, 1993). Likewise, in tandem with our advancing understanding of the structure and function of the human brain, decades of neuropsychological research have been devoted to identifying and describing different, distinct domains of cognitive functioning thought to be linked to specific areas of the brain. Such neuropsychological research asserts that a number of specific domains of cognitive ability exist; moreover, individuals differ in their profiles of cognitive abilities, and in areas of specific cognitive strength and weakness (Whishaw & Kolb, 2003). Among some of the most widely studied domains of cognitive ability are attention, memory, visual-spatial skills, verbal skills, motor skills, and executive functioning abilities. While some research has explored relationships between specific neurocognitive abilities and behavioral outcomes relative to psychopathology (Elevag & Goldberg, 2000; Nuechterlein et al., 2004; Quraishi & Frangou, 2002; Shenal, Harrison, & Demaree, 2003), limited research has focused on the relationships between specific cognitive abilities, and social functioning of children and adolescents. Inasmuch as intelligence theorists disagree about which domains of cognitive functioning are most representative of cognitive ability and most associated with adaptive functioning, this issue is compounded when considering ways in which these diverse domains of cognitive abilities could be differently valued under certain socioeconomic or racial contexts. As such, it is possible that our understanding of the relationship between a child's cognitive and social abilities may be further advanced and/or articulated by considering the relative impact of more specific domains of cognitive functioning in combination with more general cognitive abilities.

1.2.1 Attention

Deficits in attention involving distractibility and difficulty sustaining attentional focus could interfere with a child's peer relationships by affecting a child's ability to quickly and accurately process information during social interaction, potentially impacting the ability to initiate and maintain appropriate social interactions. Over time and across situations, such deficits could result in less successful social outcomes and poorer relationships with peers. Some literature has described such social information processing difficulties in populations of children with attention deficit hyperactivity disorder (ADHD; Kalff et al., 2005; Matthys, Cuperus, & Van Engeland, 1999), a disorder characterized by parent- and teacher-reported inattention among other behavioral traits. Other research has described difficulties in maintaining conversation during social interactions for children with ADHD (Humphries, Koltun, Malone, & Roberts, 1994). When exploring the peer relationships of children with ADHD, a sizable literature suggests that children diagnosed with ADHD have more problematic peer relationships and weaker social skills than children without ADHD (for a review see Nixon, 2001). Specifically, several studies have demonstrated that children with ADHD are seen by both their parents and teachers as being lonelier, having fewer close friendships, experiencing greater peer rejection, and as possessing weaker social skills than children without ADHD (Bagwell, Molina, Pelham, & Hoza, 2001; Heiman, 2005; Van der Oord et al., 2005), and there is additional evidence from several large-scale studies documenting similar problems from the perspective of children's peers (Blachman & Hinshaw, 2002; Carlson, Lahey, Frame, Walker, & Hynd, 1987; Diamantopoulou, Henricsson, & Rydell, 2005; Hoza et al., 2005; Hoza et al., 2005).

While the literature presents a compelling consensus of social problems for children with attention problems, it is important to note that the attentional deficits presented by children with ADHD do not occur in isolation, rather these deficits in attention are often accompanied by significant impairments in other behavioral domains including hyperactive and/or impulsive behavior. Such behaviors could also uniquely contribute to a child's social functioning, making it difficult to fully understand the specific impact of attentional difficulties to the peer relationships of a child with ADHD. Because these studies have utilized a population that manifests clinically significant attentional problems, it is difficult to assess the contribution of normal variation in this domain of functioning in which a broader range of abilities is seen. In light of these confounds there is a need to explore how normal variation in these cognitive abilities may impact social functioning. Additionally, none of these studies systematically explored the role of race or poverty, and all utilized samples of children below age 12 who were clinic-referred or who carried diagnoses of ADHD, significantly limiting our ability to understand whether peer difficulties for children with ADHD generalize to diverse populations.

Outside the ADHD literature only one study could be found that explored the contribution of attentional abilities to peer relationships. Specifically, Bellanti and Bierman (2000) explored the effect of teacher- and parent-reported inattention (partialling out the effects of IQ) on peer- and teacher-reported social outcomes in kindergarteners. Authors reported that children with high levels of inattention demonstrated increased aggressive behaviors, lower levels of prosocial behavior, and were rated as less well-liked from the perspective of both teachers and peers in comparison to both “normal” controls, and a low-cognitive functioning group (Bellanti & Bierman, 2000). Moreover, when considering the role of race, several significant interactions were found between race and inattention, such that correlations between inattention and social outcomes (including teacher-rated aggressive behavior, and peer friendship nominations) were stronger for African American children than for white children. Additionally, cognitive ability was a stronger predictor of peer-reported prosocial behavior for African American children than for white children. Thus, this study highlights the importance of carefully considering the role of context, specifically racial context, when exploring this association, though it can only speak only to the impact of inattention on social outcomes in young children. Furthermore, while the utilization of a teacher-reported measure of inattention represents a first step towards understanding how attentional abilities in the classroom relate to a child’s peer relationships, it is unclear the extent to which teacher-reported inattention corresponds with broader attentional abilities demonstrated outside the classroom, or with specific neuropsychological assessments of attention (e.g., continuous performance tests).

1.2.2 Visual-Spatial Skills.

The theory and research of Rourke (1985), has focused on understanding the behavioral profiles of individuals with specific patterns of LD. This work highlights the role that specific non-verbal processing deficits can play in the social relationships of individuals with LD. In particular, for individuals with nonverbal learning disability (NLD; Myklebust, 1975), a specific subtype of LD involving relative strengths in verbal skills and weaknesses in visual-spatial skills, social skill deficits and peer interaction difficulties have been described (Casey, Rourke, & Picard, 1991; Loveland, Fletcher, & Bailey, 1990; Ozols & Rourke, 1985; Rourke & Fuerst, 1991; Strang & Rourke, 1983).

These social problems are thought to be a result of deficits in the ability of children with NLD to interpret the subtle non-verbal cues inherent in social interactions such as facial expressions, gestures, and verbal prosody. Several studies have documented specific nonverbal social-perceptual skill deficits in children with NLD (Loveland et al., 1990; Petti, Voelker, Shore, & Hayman-Abello, 2003; Rourke, 1985). Such deficits may place children with NLD at risk for interpersonal problems such as social isolation, low social acceptance, and lack of friendships. Some work by Rourke and his colleagues has demonstrated that both primary caregivers and teachers reported that children with NLD had inappropriate affect and were socially isolated (Rourke, 1985). Of note to the current research, some work describes developmental changes in psychosocial functioning of children with NLD, suggesting that adolescents demonstrate relatively greater psychosocial disturbance than younger children with NLD (Rourke, Young, & Leenaars, 1989). Unfortunately, findings from subsequent work have failed to support links between NLD and peer-rejection (Hatzichristou & Hopf, 1993; White, Moffitt, & Silva, 1992), and there is a paucity of research examining Rourke's theory from the perspective of children's peers. Furthermore, no studies exploring the social impact of NLD have considered the impact of race or socioeconomic status, making it difficult to speculate about the social impact of NLD for inner city African American children. As with the literature on attentional abilities and peer relationships that has been grounded in ADHD samples, NLD also represents a disordered population that poses similar methodological problem (e.g., confounding deficits in other domains of functioning, manifestation of a clinically significant deficits that goes beyond normal variation in visual-spatial abilities, and clinically derived diagnoses of visual-spatial deficits that do not necessarily include specific neuropsychological testing or assessment). Beyond the limitations of research on children and adolescents with NLD, no work was found that explored the relationship between specific visual-spatial skill deficits and peer relationships in non-LD populations.

1.2.3 Motor Skills

In recent years there has been increasing recognition that a child's motor skills and coordination abilities can make an important contribution to his or her social and emotional well-being, as the ability to perform well in physical activities, particularly in sports and games, is highly regarded by children (Wall, Reid, & Paton, 1990), whereas children with poor motor skills may be avoided or ostracized as a result of their motor or coordination difficulties (Skinner & Piek, 2001). This notion has been somewhat supported by research exploring the social relationships of individuals with Developmental Coordination Disorder (DCD; APA, 2000), a disorder characterized by marked impairment in motor coordination that is in excess of what would be predicted based on chronological age and level of intellectual functioning. Specifically, children and adolescents with DCD are repeatedly described by parents, teachers, trained observers, and peers as having deficits in social functioning and poorer peer relationships relative to children with average motor functioning (Cummins, Piek, & Dyck, 2005; Dewey, Kaplan, Crawford, & Wilson, 2002; Kanioglou, Tsorbatzoudis, & Barkoukis, 2005; Skinner & Piek, 2001; Smyth & Anderson, 2000), and notably some research suggests that the social and emotional impact of DCD on adjustment outcomes may be greater for adolescents than for children (Skinner & Piek, 2001).

However, it is again difficult to draw conclusions about contribution of specific motor abilities outside the domain of DCD, as only one study (Rydell, 1993) has examined this association in a non-DCD population. While the existing study by Rydell (1993) demonstrated that 1st grade Scandiavin students rated by their teachers as having poorer fine and gross motor skills were over-represented in a low social acceptance group based on peer friendship nominations, it did not utilize performance on a specific test of motor skills as a basis for describing motor difficulties. Moreover, little descriptive information about the sample was provided, and the authors did not report whether they explored the impact of contextual factors such as SES. Likewise, DCD literature has not explored the role of SES, or race and it remains unclear the extent to which this context could impact an association between motor abilities and social functioning. An additional limitation of using DCD literature to inform our understanding of the contribution of motor skills to peer relationships is that a diagnosis of DCD can involve a number of different kinds of deficits that vary between individuals. For example, a diagnosis of DCD may include primarily gross motor deficits, or both gross and fine motor deficits. Thus it is unclear whether the poorer peer relationships for children with DCD are associated with gross motor deficits, fine motor deficits, or both deficits in combination. Moreover, individuals with cognitive delays consistent with mental retardation are not precluded from this diagnostic group, further restricting the conclusions that can be drawn from this literature.

1.2.4 Executive Functioning

Executive functioning (EF) is a multidimensional construct that has been described as including a number of cognitive operations such as working memory, inhibitory control, problem-solving, and attentional control (Spreen & Strauss, 1998). It seems feasible that such skills could be related to a child's ability to function with peers. Moreover, EF abilities may be particularly important during adolescence as teenagers start to engage in more independent problem-solving, and increasing levels of unsupervised social interaction with peers including situations that involve navigating decisions about risky behaviors such as substance use and sexual activity (Blakemore & Choudhury, 2006). Unfortunately, no research has explored a relationship between EF and peer relationships in older children and adolescents, and only two studies appear to have explored this question in younger samples. Bonino and Cattelino (1999) examined potential links between 7-year old children's EF abilities (as measured by a modified version of the Wisconsin Card Sorting Task that had been adapted for use with children) and cooperative behavior with peers in an Italian sample. They found that children with better EF task performance demonstrated significantly more cooperative interactions and productive behaviors with peers in comparison to children with poorer EF performance. Such increased cooperation and productive behavior could have the potential to foster greater success in peer interactions, and better peer acceptance.

A second study by Monks, Smith, and Swettenham (2003) explored the association between EF and social behavior in a British preschool sample (ages 4-6) by examining peer nominations for roles of aggressor, victim, and defender, and EF task performance on two EF measures including an inhibitory control task (the Day-Night Test), and a planning task (the Tower of London). Results suggested that children who were nominated for the defender role performed somewhat above average on the inhibitory control task and were also noted to perform significantly better than children classified as aggressors (who scored somewhat below average), while the victims did not significantly differ from either defenders or aggressors on either the inhibitory control or planning task. While these findings might suggest a developmental pathway relating stronger EF skills (particularly impulse control and goal-directed behavior) to the emergence of leadership and/or prosocial behavioral styles, and deficits in EF ability (e.g., weaker impulse control and poor planning) to the development of aggressive behavior, again these studies are not able to speak to the impact of EF abilities in older children and adolescents, and do not address the impact of contextual factors such as SES or race.

When looking across literatures, it seems that despite theoretical arguments that can be made for considering the contribution of specific domains of cognitive functioning to adolescents' peer relationships, the scope of the existing data is quite limited, making it difficult to understand the true nature of reported associations and to make predictions for these associations under different contexts. Additionally, limited attention has been paid to the mechanisms linking neurocognitive abilities to children's social acceptance, further limiting our ability to understand the ways in which particular neurocognitive deficits or strengths might actually affect peer functioning. Because neurocognitive abilities are distal to social behavior, and particularly distal to measures of peer acceptance, it is important to articulate the pathways from neurocognitive measures to these measures of social acceptance and friendship. One study by Bellanti and Bierman (2000) that utilized a large sample of both African American and white kindergarteners from disadvantaged areas demonstrated that social behavior partially mediated the relationship between cognitive abilities and social acceptance. Specifically, for children with low IQ, the relationship between low IQ and peer acceptance was explained fully by the impact of low-IQ on the child's social behavior, specifically prosocial behavior. Additionally, aggressive and prosocial behaviors partially mediated the relationship between inattention and social acceptance. Similar mediated relationships have been documented with respect to child temperament and peer acceptance where prosocial, and sensitive isolated behaviors, mediated the relationship between difficult temperament and peer acceptance (Sterry, 2004). This question relating to potential mechanisms linking cognitive functioning to social acceptance has received limited empirical attention and clearly needs additional focus, particularly in light of some findings that associations between cognitive ability and social behavior can be moderated contextual factors such as race (Bellanti & Bierman, 2000; Risi, Gerhardstein & Kistner, 2003).

1.2.5 Limitations of Research on Domains of Cognitive Ability and Peer Relationships

In summary, when considering the contribution of specific domains of cognitive functioning to peer relationships there appear to be a number of limitations that cut across these literatures including: non-specific measurement of cognitive abilities (e.g., use of disordered populations, reliance on parent- and teacher- report measures of ability in lieu of specific neuropsychological tests); sub-optimal measurement of peer relationships (e.g., parent- and teacher- reports of social functioning as opposed to obtaining information from children's peers); limited attention to contextual factors; and finally, poor understanding of mechanisms. First, because very few studies utilized one-to-one neuropsychological testing as means of describing specific neurocognitive abilities, with many instead relying on disordered populations or parent- or teacher-report measures, it is difficult to know the extent to which current studies are actually capturing the specific cognitive domains of interest. Disordered populations may present a number of behavioral problems other than the cognitive deficit of interest that could also be impacting peer relationships. Because deficits are manifested a more extreme level in disordered populations, more research is needed to explore how normal variation in these specific domains of cognitive functioning might contribute to social functioning. Additionally, because clinical diagnoses and parent- and teacher-reports of cognitive abilities are subject to bias based on informant, use of specific, clinically-validated neuropsychological tests may increase our understanding of these associations. It is possible that parent- or teacher- reports of attentional problems, for example, may have little to do with how well a child does on an individually administered test of attention.

Second, with few exceptions, most studies fail to utilize peer as a source of information about a child's social functioning despite considerable evidence suggesting that peers are a preferred source for this information (e.g., Zeller, Vannatta, Schafer, & Noll, 2003). As noted previously, when data are obtained from peers it is very reliable and has predictive validity as well as concurrent and contextual validity. Thus, additional research relating cognitive functioning to social functioning utilizing these strategies is needed. Third, because so few studies have carefully attended to the contextual factors of socioeconomic status, and developmental stage when considering potential linkages between cognitive abilities and peer relationships these issues must be considered in future work, particularly given some data suggesting that linkages between cognitive functioning and social functioning are, indeed, sensitive to such contextual influences (Bellanti & Bierman, 2001; Rourke, 1989). Finally, more careful consideration of the pathways between neurocognitive abilities and social acceptance is warranted to further our understanding of the ways in which such cognitive abilities could influence social behavior and/or peer acceptance in this population. Thus, the second aim of the current study was to use data from a number of clinically-validated neuropsychological tests, and peer- reports of adolescents' social behavior and acceptance to explore the contribution of specific domains of cognitive functioning to social acceptance in adolescence, in addition to considering the potential mechanisms driving these associations.

1.3 CURRENT STUDY

The current study was a secondary analysis of data collected by the Cincinnati Lead Study (CLS), a project originally established to assess the effects of childhood lead exposure on neurocognitive and behavioral development. Of primary interest for the current study were data describing the cognitive functioning of this cohort during adolescence derived from an extensive, individually-administered neuropsychological battery, and data on adolescents' social functioning that was independently collected in adolescents' classrooms that included peer- and teacher- reports of adolescents' social behavior and peer acceptance.

Previous work with the neurocognitive data set reported results of a factor analysis (FA) that yielded five distinct cognitive domains including general cognitive functioning, and four factors representing more specific domains of cognitive ability (attention, visual-spatial abilities, motor skills, and memory) (Ris, Dietrich, Succop, Berger, & Bornschein, 2004). These identified cognitive domains were considered in this work. Despite a number of previously reported associations between better general cognitive abilities and more adaptive peer relations, all analyses conducted were exploratory in nature given the methodological limitations of existing work (related to sample composition and measurement of cognitive abilities), and some theoretical arguments that would caution against making inferences across samples and measures. Consistent with the first aim of the study, the association between general cognitive ability (as indexed by higher scores on the general cognitive functioning factor) and peer relationships was explored.

Next, analyses were conducted to explore the contribution of the four cognitive domains identified in the FA (attention, visual-spatial abilities, motor skills, and memory), to variance in both social behavior and peer acceptance. Additional analyses were conducted to explore the association between performance on a particular measure of executive functioning and peer relationships. Finally, consistent with the mediational framework presented above, exploratory analyses were conducted to assess whether social behavior (what is a child like?) mediated any significant relationships between neurocognitive abilities and peer acceptance (is the child liked?).

2.0 METHOD

2.1 PARTICIPANTS

Participants were recruited as part of the Cincinnati Lead Study (CLS). The CLS is a birth cohort of approximately 300 participants who have been followed longitudinally since prenatal recruitment began in 1979 (for a full description of this cohort see Dietrich et al., 1987). Briefly, participants were seen for blood lead determinations, medical examinations, and developmental follow-up on a quarterly basis until 5 years of age and then again at 5.5, 6, 6.5, 10 and 15 years of age at which times comprehensive neurocognitive and behavioral assessments were administered (Dietrich, Berger, & Succop, 1993; Dietrich, Berger, Succop, Hammond, & Bornschein, 1993; Dietrich et al., 1987; Dietrich, Ris, Succop, Berger, & Bornschein, 2001; Dietrich, Succop, Berger, Hammond, & Bornschein, 1991; Ris et al., 2004).

From the initial CLS cohort, 195 (65 %) adolescents completed a 15 year follow-up assessment of neurocognitive functioning between 1997 and 1999. Reasons for attrition since the last published follow-up assessment at 6.5 years (n = 253) included refusals (n = 4), chronically missed appointments (n = 6), inability to locate (n = 38), long-term incarceration (n = 4), homicide (n = 2), severe developmental disability (n = 2), and scheduling error by research personnel (n = 2).

During the 15-year re-contact participants were simultaneously recruited for participation in classroom data collection on information about adolescents' friendships. Of the 195 CLS participants with complete neurocognitive data, 70 (36 %) did not complete the classroom data collection due to absence (N = 38) or failure to return a signed consent form (N = 32), leaving a sample of 125 individuals with both peer and neurocognitive data. Of these 125, the 9 white youths were excluded from current analyses, leaving a final sample of 116 adolescents ranging in age from 14-17 (*M* = 15.00, *SD* = .813), and 46 % male (Table 1). Participants ranged in grade level from grade 6 to grade 12 (*M* = 8.70, *SD* = 1.31), with a mean class size of 21.97 (*SD* = 4.88), and mean classroom participation rate of 67 % (*SD* = 15.72).

Table 1. Family Demographic Information (N = 113 - 116)

Single Parent Status	N = 91, 79.3 %
Education Primary Caregiver	M = 11.55 (SD = 1.28)
Education Other Caregiver	M = 11.44 (SD = 1.15)
Total Income	M = 25,130 (SD = 8,780)
Hollingshead SES Rank	
Lowest (1)	N = 36 (31.30 %)
Low (2)	N = 44 (38.30 %)
Medium (3)	N = 27 (31.30%)
High (4)	N = 8 (7.00 %)
Highest (5)	N = 0 (0 %)
Receiving Public Assistance	N = 42 (36.5 %)
Caregiver Unemployed	N = 30 (31.3 %)
Number of Children in Home	M = 2.82 (SD = 1.45)

Attrition analyses indicated that individuals with both neurocognitive and classroom data did not differ from those with only neurocognitive data on demographic variables including race, sex, SES, maternal marital status, maternal education, maternal employment, receiving public assistance, or any of the neurocognitive domain scores. Differences were found with respect to age (Mann-Whitney U = 3327.5, p >.05), childhood lead exposure (Mann-Whitney U = 2859, $p < .001$), and achievement scores in reading (Mann-Whitney U = 3084, $p > .05$), spelling (Mann-Whitney U = 2756.5, $p >.001$), and mathematics (Mann-Whitney U = 2650, $p < .001$). Specifically, individuals who participated in both neurocognitive and classroom data collection were slightly younger, had somewhat lower cumulative childhood lead exposure, and had better achievement scores.

2.2 MEASURES

2.2.1 Background

2.2.1.1 Blood Lead Levels

Blood samples for analysis of blood-lead levels were obtained by venipuncture or, if necessary, finger-stick. Samples were analyzed for lead by anodic stripping voltametry. For the purposes of this study childhood lead exposure was estimated by taking a mean of childhood blood lead concentration levels (in micrograms per deciliter) across all lead data collection time points for each child including quarterly blood lead determinations between 3 months and 60 months, and assessments at 66 and 72 months. Henceforth the mean childhood lead exposure variable will be referred to as “MPBLIFE.”

2.2.1.2 Hollingshead Rank SES

The Hollingshead scale (Hollingshead, 1985) uses marital status and gender, as well as education and occupation in assigning individuals or families to one of five socio-economic ranks, with (1) being the most disadvantaged rank, and (5) being the most advantaged.

2.2.2 Neurocognitive Measures

Neuropsychological measures used in this study were initially selected based upon the extensive literature on the neurodevelopmental effects of lead, focusing on EF, attention, memory, academic achievement, verbal skills, visual-spatial skills, and fine-motor coordination.

2.2.2.1 Block Design and Vocabulary subtests of the Wechsler Intelligence Scale for Children, Third Edition

Each youth was given these two subtests from the Wechsler Intelligence Scale for Children, third edition (WISC-III), the most widely used and well-normed child intelligence scale (Wechsler, 1991). This abbreviated version of the WISC-III includes subtests that load on both Verbal IQ (Vocabulary) and Performance IQ (Block Design), and has been shown to correlate highly (r = .87) with the full scale IQ score (Sattler, 2001). Vocabulary assesses a child's word knowledge by having the child provide a definition for orally-presented words. The Block Design subtest requires an individual to manipulate colored blocks to resemble a picture. Scaled scores are standardized to have a mean of 10 and a standard deviation of 3, with higher scores representing better performance. The WISC-III is one of the most widely used, and well-normed assessments of children's cognitive functioning, and demonstrates excellent psychometric properties (Sattler, 2001)

African American children represented 11% of the normative sample, which was further stratified by parent educational level and geographic region, consistent with 1988 U.S. Census data. However, it should be noted that there is ongoing debate about whether current norms are appropriate for minority populations (e.g., African Americans), whose average group scores are typically significantly lower than average scores for European American children, or whether existing norms and scoring systems are Eurocentrically biased (for a review see Kwate, 2001). While generally lower mean scores do not necessarily challenge the validity of this measure in African Americans, some research has shown that when WISC-III scores are used as the basis for diagnoses of mental retardation, or in determining qualification for special education services, disproportionately more African American children receive these diagnosis than European American children (Naglieri & Rojahn, 2001). It is important to note that these discrepancies are not always found when different measures of cognitive ability (e.g., Cognitive Assessment System) are employed (Naglieri & Das, 1997).

2.2.2.2 Wide Range Achievement Test- 3rd Edition

The Wide Range Achievement Test- third edition (WRAT-3) is a widely used, standardized test of academic achievement that yields scores in three domains: spelling, reading, and arithmetic (Wilkinson, 1993). The spelling subtest requires the individual to write one's name, 13 individual letters, and up to 40 individual words of increasing difficulty. The reading subtest includes 15 letters and 42 individual words. Finally, the arithmetic subtest is comprised of two parts: (1) counting, reading number symbols, and solving simple arithmetic problems presented orally, and (2) solving up to 40 arithmetic problems presented in a booklet. Scores are standardized to have a mean of 100, and a standard deviation of 15, with higher scores reflecting better performance. Good reliability has been demonstrated, with alternative form correlations ranging from .82 to .99, internal consistency reliabilities ranging from .69 to .95, and test-retest reliabilities ranging from .91 to .98 (Sattler, 2001; Wilkinson, 1993).

U.S. Census data from 1990 were used as a guideline for generating the normative sample, resulting in a sample that was 13.6% African American. It is important to note that literature has demonstrated that African American children and adolescents typically score lower than white children and adolescents on such measures of achievement, though often these differences can be attributed to differences in family background characteristics, such as SES, education, or family size and composition (Orr, 2003).

2.2.2.3 Rey Osterrieth Complex Figure

The Rey Osterrieth Complex Figure (ROCF) is a complex, two-dimensional line drawing containing 18 details including crosses, squares, triangles, and a circle, arranged around a central rectangle (Rey & Osterrieth, 1944; Waber & Holmes, 1986). Each component is easy to duplicate on its own, with the difficulty of the task coming from the arrangement of the elements. The child is first asked to copy the figure onto a paper. The drawing is scored for global and incidental accuracy of the structural elements. Organizational strategy is assessed by having the child use different colored pencils to complete the drawing, having the child switch to a different color after specific time periods. Following a 20 minute delay the child asked to reproduce the design from memory, without prior warning. It is scored using the same criteria employed for the copy condition. As such scores for the ROCF test are thought to reflect perceptual organization skill, spatial ability (especially visual-spatial and visual-motor integration abilities), and visual memory. With the exception of “number of errors,” higher index scores reflect better performance. Inter-scorer reliability coefficients range from .80 to .95 (Bennett-Levy, 1984; Carr

& Lincoln, 1988; Frazier, Adams, Strauss, & Redline, 2001; Rapport, Charter, Dutra, Farchione, & et al., 1997).

No studies have examined the psychometric properties of the ROCF in exclusively African American samples of children. Unfortunately, the racial composition of the normative sample has not been previously described in any of the available scoring system manuals. While a meta-analysis (Mitrushina, Boone, Razani, & D'Elia, 2005) failed to reveal any association between education and ROCF scores across studies employing both child and adult samples, race and other demographic factors (e.g., SES) have been under-explored suggesting that interpretations of ROCF scores in this sample should be made with caution.

2.2.2.4 Grooved Peg Board Test

The Grooved Peg Board Test (GPT) is a task that assesses manual dexterity and visual-motor coordination (Klove, 1963). The GPT has demonstrated reasonable test-retest reliability ($r \geq .82$) (Dikmen, Heaton, Grant, & Temkin, 1999). For the GPT, an individual is asked to place ridged pegs in a board that has a matrix of 25 holes with randomly angled slots. The individual is timed to see how long it takes to insert pegs in all holes using first the dominant hand, then the non-dominant hand. Faster completion times reflect better performance, though for the purposes of the FA, reverse scoring was used to be consistent with other assessments of motor functioning administered, so higher scores reflected better performance.

Existing research on psychometric properties of the GPT in children and adolescents is limited, and the handful of studies with developmental samples either fail to employ diverse populations, or fail to report racial composition or SES for the sample, making interpretation of the current sample's scores on this measure challenging (Mitrushina et al., 2005). However, a recent meta-analysis (Mitrushina et al., 2005) exploring the impact of level of education on GPT performance found mixed results, suggesting this measure may be less influenced by demographic factors, thereby potentially increasing the validity of this measure in the current sample.

2.2.2.5 Finger Tapping Test

The Finger Tapping Test (FTT) is one of the most widely-used tests of manual dexterity and simple motor speed (Reitan & Wolfson, 1992; Spreen & Strauss, 1998). The subject is asked to press a tapping lever with his or her index finger as quickly as possible for 10 seconds. This lever is mounted with a key-driven counter that records the number of presses per 10 second interval. Trials with the dominant and non-dominant hand are alternated. The subject's score reflects the average number of taps per trial, across 5 trials. A greater number of lever presses across trials reflects better performance. The FTT has high test-retest reliability (Gill, Reddon, Stefanyk, & Hans, 1986). Additionally, age-specific norm for test performance are available (Spreen & Strauss, 1998).

While a handful of small studies provide norms for children and adolescents on the FTT, no research examines psychometric properties of the FTT in African American children. Moreover, few studies included in a recent meta-analysis on FTT performance in children and adults (Mitrushina et al., 2005) included information about racial composition of the sample, making it difficult to determine whether the performance of African American individuals was represented in any of the existing normative data. The meta-analysis did suggest an effect of educational level on FTT performance, with lower educational attainment associated with a slower rate of tapping. This could raise questions about the validity of current norms for the present sample given that caregiver educational attainment is a component of SES as measured in this study, and that SES for the present sample has previously been described as low (Dietrich et al, 1993).

2.2.2.6 California Verbal Learning Test – child edition

The California Verbal Learning Test – child edition (CVLT-C) is a widely used test of verbal learning and memory in which immediate recall, recognition, learning, and time-delayed recall for a 15-item word list are assessed. Index scores are generated to describe the number of words recalled, and the number and types of recall errors made (Delis, Freeland, Kramer, & Kaplan, 1988; Delis, Kramer, & Kaplan, 1994). Split-half reliability correlation coefficients of .77 to .86, and test-retest reliability of .82 for the Total Trials score have been reported (Delis et al., 1994). A large general verbal learning factor has been consistently demonstrated in factor analyses (Delis et al., 1988; Millis, 1995; Schear & Craft, 1989).

While the CVLT-C standardization sample included a proportion of African Americans that was based on 1988 U.S. Census data regarding the racial distribution of US children aged 5-16, few studies have explored the psychometric properties of the CVLT-C specifically in African American populations. Though, one study by this group demonstrated that performance on the CVLT-C was not significantly associated with general cognitive functioning, representing a departure from existing studies that demonstrate a general effect of IQ (Beebe, Ris, Brown, & Dietrich, 2004). Some literature has linked parental education levels to children's CVLT-C scores. Specifically, more than 30% of children in the normative sample with below-average performance were from families with less than 12 years of parental education, whereas 22% of the highest-performing children came from families with a college education (Donders, 1999). Moreover, the effect of education (controlling for age) was well-documented in a meta-analysis of studies employing the adult CVLT (Mitrushina et al., 2005). These findings might qualify our interpretation of CVLT-C scores in this population as they suggest that for low-SES African American adolescents scores may tap into somewhat different abilities.

2.2.2.7 Wisconsin Card Sorting Test

The Wisconsin Card Sorting Test (WCST) is a measure of mental flexibility and abstract concept formation that has been shown to have excellent reliability and validity (Heaton, 1981; Lezak, Howieson, Loring, Hannay, & Fischer, 2004). It is considered to be a good measure of EF as it measures planning and organization, response to feedback, ability to shift behavioral strategies, goal-directed behavior, and impulsivity/inhibition (Mitrushina et al., 2005). The test requires participants to sort a deck of response cards depicting colored geometric shapes into piles that correspond with four unique key reference cards that are presented in a predetermined order. Sorting principles include color, form, and number, and are ranked as such. Beyond the instruction to place one response card under each key reference card, participants are given little instruction when completing the task, and they are not informed what sorting principle to use, rather they are merely provided with the feedback "right" or wrong". It is possible for a response card to match a key reference card on more than one principle. In this case it is up to the individual to decide what sorting principle he or she should follow, and the task becomes to determine what principle he or she is to use for sorting. When 10 correct, consecutive sorts are made to a category the examiner changes the sorting principle without altering the participant.

The WCST yields subscales measuring correct responses, and percent conceptual-level responses (for which higher scores indicate better performance), and additional subscales measuring perseverative responses, total errors, perseverative errors, nonperseverative errors, and failure to maintain set (inappropriate shifting of strategy), for which higher scores reflect weaker performance. While developmental norms are available (Heaton, Chelune, Talley, Kay,

& Curtiss, 1993) and African American individuals represented 11% of the normative sample, no studies have explored WCST performance solely in young African American populations. A review of both child and adult WCST studies (Mitrushina et al., 2005) suggests a moderate effect of education and level of intelligence, though the specific impact of SES has not been explored.

2.2.2.8 Conner's Continuous Performance Test

The Conner's Continuous Performance Test (CPT) is a widely used computer-based assessment of attention and vigilance (Conners, 1995). The task consists of 360 letters (approximately 1 inch in size) that appear one at a time on the computer screen for a duration of approximately 250 ms. The 360 trials are presented in 18 consecutive blocks of 20 trials. For each block of trials the inter-stimulus interval (ISI) varies, with either 1, 2, or 4 seconds between letter presentations. These ISI conditions are randomized so that each ISI condition occurs every three blocks, while also allowing the ISI presentations to vary within blocks. Participants are asked to press the space bar on the keyboard when any letter *except* the letter "X" appears on the screen. Prior to beginning the test, each participant completes a brief training period until it is clear to the examiner that the task and directions are understood. The event rate (the percentage of trials when letters other than "X" appeared on the screen), is 90 %, which is consistent across ISI and time blocks. The total task takes approximately 15 minutes to complete.

While many scores are derived from the computer-administered test, of principle interest are omission errors thought to reflect inattentiveness (occurring when the subject fails to press the space bar following presentation of letters other than "X") and commission errors thought to reflect impulsivity (occurring when the subject incorrectly presses the space bar following presentation of the letter "X"). Additionally, hit reaction time (Hit RT) and response consistency (Hit RT SE, the standard error of Hit RT) are measured, with Hit RT SE being measured both within and between blocks (PCVARSE, and Hit RT ISI Change, respectively). Most raw scores are transformed into T scores, with a mean of 50 and standard deviation of 10.

Split half reliability for the CPT performance measures range between .73 and .95 (Conners, 1995). In addition, test-retest reliabilities for a 3-month interval range between .55 and .84 (Conners, 1995). Both indices suggest adequate reliability for a neuropsychological test. The validity for the CPT has primarily been determined from documented performance differences between patients with ADHD and control subjects without ADHD (Hervey et al., 2006; Seidel & Joschko, 1990). Importantly, these documented performance differences between children with ADHD and children without ADHD hold true for both White and African American children. A recent epidemiological study using the CPT demonstrated no meaningful patterns of difference between ethnic groups (Conners, Epstein, Angold, & Klaric, 2003).

2.2.3 Peer Functioning

2.2.3.1 Revised Class Play

The Revised Class Play (RCP) assesses social behavior using teacher and peer report along four empirically identified dimensions: (a) Leadership, (b) Prosocial, (c) Aggressive-Disruptive, and (d) Sensitive-Isolated (Masten et al., 1985; Zeller et al., 2003). The RCP is administered in class at school. Children are told to imagine that they are the director of a play and their job is to choose the best peer in their class (with the aid of a class roster) for each role in the play. To reduce the possibility of gender-stereotyping in the roles and to increase the likelihood that the CLS participant would be nominated, the students and teacher participating in this study were asked to complete the RCP by nominating only students of one gender consistent with that of the CLS participant. RCP dimension scores were generated by first summing the number of nominations a child receives on each of the four behavioral dimensions, and then performing a z-score transformation so the child's score was standardized within his or her classroom.

These dimension scores have been demonstrated to be both internally consistent (peer Cronbach α 0.82 to 0.89; teacher Cronbach α 0.48 to 0.73) and stable through adolescence (Reiter-Purtill & Noll, 2003; Zeller et al., 2003). RCP scores also demonstrate convergent validity with peer acceptance measures (Zeller et al., 2003). Furthermore, several longitudinal studies have demonstrated both construct and predictive validity for the RCP measure as aggressive-disruptive and sensitive-isolated scores have been linked to subsequent emotional and behavioral problems (Hymel et al., 1990; Morison & Masten, 1991; Rubin, Hymel, & Mills, 1989). It should also be noted that 27% of the sample used to derive the current 4-factor structure was African American from the inner city.

2.2.3.2 Three Best Friends

The Three Best Friends task requires each child to write down the names of three classmates whom they consider to be their best friends (Bukowski & Hoza, 1989). This measure generates two indices of peer acceptance: a social preference score, based on the number of times each student was nominated as a best friend by classmates, and a mutual friendship score based on the number of reciprocated friendships for each child. This measure is thought to provide a stable and valid index of peer acceptance and friendship (Bukowski & Hoza, 1989; Gottman, Gonso, & Rasmussen, 1975).

2.2.3.3 Like Rating Scale

This instrument assesses social preference based on the degree to which each child in the class is liked or disliked by peers (Asher et al., 1979). The children rate each of their classmates on a 5-point Likert scale ranging from (1) *someone you do not like* to (5) *someone you like a lot* (Asher et al., 1979). For each child, an average social preference score is computed. This measure has been shown to be a reliable index of a child's relative social acceptance, with test-retest correlations of .81 to .86 over a 4-week interval (Asher et al., 1979; Ladd, 1981). This measure is thought to provide a stable and valid index of peer acceptance.

2.3 PROCEDURE

When CLS participants reached age 15, their parents were contacted and asked for permission for their child to participate in a neurocognitive assessment and for permission to contact their child's school regarding interest in a general friendship study. Demographic information was updated at this time and a testing session was scheduled. All neuropsychological testing took place in a single 3-4 hour session at a pediatric clinic located within the catchment area. Tests were given in a fixed order by a trained psychometrist or psychologist (for further details see Ris et al., 2004).

To schedule classroom data collection, the school principal was initially contacted and with his or her permission, the child's English teacher was contacted. The English classroom was selected because it is a required class and students are commonly assigned to this class based upon ability and level of interest. As a result, there is a greater probability that each youth's best friends would be in the class (Ollendick et al., 1990). All peers in the classroom who returned a completed consent form participated. Classroom visits were conducted by trained research personnel and lasted approximately 45 minutes during which the RCP, Like Rating Scale, and Three Best Friends measures were administered. The study was presented as a general study of children's friendships, and no mention was made of the CLS to avoid stigmatization of the target child.

2.4 DATA ANALYTIC STRATEGY

2.4.1 Attrition Analyses

Previous attrition analyses have been reported for CLS participants who failed to complete the 15-year neurocognitive assessment (Ris et al., 2004). Secondary attrition analyses were conducted to compare the CLS adolescents who participated in the 15 year neurocognitive assessment but did not have classroom data with the current sample, who had complete data, to determine if any group differences existed on demographic or neurocognitive variables.

2.4.2 Variable Construction

2.4.2.1 Neurocognitive Variables

Neurocognitive domain scores were generated by a data reduction of the variables yielded from the CLS neurocognitive testing (Appendix A.1). Prior to data reduction each neurocognitive variable was assessed for normality both graphically (by examining frequency distributions of each variable's z-scores, and by plotting the residuals to assess the presence of outliers), and by calculating skewness and kurtosis statistics for each variable. To facilitate combination of variables, z-score transformations were conducted. The transformed variables were used in the factor analysis (FA).

Following initial data checking, the same representative subgroup of neurocognitive measures selected by Ris et al. (2004; Appendix A.2) was subjected to a principle components FA with Varimax rotation and Kaiser normalization using only the teens where classroom data were obtained, extracting eigenvalues greater than 1.00. Given the striking similarity between the solution with a smaller pool of respondents (Appendix A.3) and the previously published solution with a larger sample, the previously published solution was utilized as a guideline for creating the neurocognitive domain scores.

The identified neurocognitive domains identified included: IQ-Achievement (IQA) attention, visual-spatial abilities, motor skills, and memory. The IQA factor represented block design and vocabulary scores from the WISC-III in addition to the reading, spelling, and mathematics scores from the WRAT-3. The attention factor consisted of a number of scores from the CPT including raw numbers of omissions and commissions, variability of Hit RT SE (PCVARSE), and variability of Hit RT across changing ISIs (Hit RT ISI Change). Such scores suggest the attention factor taps into both inattention and impulsivity, in addition to response consistency. The visual-spatial factor consisted of several scores from the ROCF including accuracy and organization scores from the copy condition, combined accuracy for structural elements, and incidental details for both immediate recall and delayed recall conditions, and the block design score from the WISC-III. Thus, the visual spatial factor appears to tap into visual-motor integration skills and visual-spatial memory abilities. The motor skills factor represented scores from both tests of fine motor ability, namely time to complete the grooved peg board (from the GPT) for each hand, and number of finger taps across 5 trials (from the FTT) for each hand, suggesting the motor skills factor includes both fine motor ability and dexterity. Finally, the memory factor was comprised of scores for immediate, short– and long- delay recall for the word list, recall consistency across trials, and ability to correctly discriminate items from the word list in a delayed recognition task. Thus, the memory factor represents verbal memory abilities.

Composite scores representing an individual's performance in each of these five domains were computed by summing an individual's z-scores for indicated variables. This approach of combining z-scores was thought to be more advantageous than unit-weighting approaches which argue for non-equal weighting of indicators within an identified factor, as the investigator believed a unit-weighting approach had limited generalizability and less clinical utility.

Because scores from the WCST did not map onto any of the other factors, nor did EF emerge as a distinct factor in the FA, a construct building approach was employed to explore what impact scores on this particular measure of EF might have on peer relationships (Capaldi & Patterson, 1991). The following WCST scores were selected: number of categories completed, perseverative errors, and failure to maintain set. Selected WCST variables were subjected to the following criteria and then combined:

1. The indicated variables must show internal consistency (Cronbach α .6 or higher; item total correlation of .2 or higher).
2. The indicated variables must converge with the other indicators designed to assess the construct (the factor loading for the solution > .3).
3. This process is done on half the sample and then replicated on the other half.

While the WCST is only one of many tests designed to measure EF and may not reflect all of the abilities that fall under this domain of cognitive functioning, for ease of discussion this WCST construct will henceforth be described as the EF construct.

2.4.2.2 Social Functioning Variables

Of the 11 social functioning outcome measures, three assessed peer acceptance (total best friends, reciprocated friendships, and average like-rating scores), four assessed social behavior (popular-leader, prosocial, aggressive-disruptive, and sensitive-isolated domains) from the perspective of peers (peer-report RCP), and four assessed social behavior from the perspective of teachers (teacher-report RCP).

Each social functioning variable was assessed for normality both graphically (by examining frequency distributions of each variable's z-scores, by plotting the residuals to assess the presence of outliers), and by calculating skewness and kurtosis statistics for each variable. Consistent with procedures of Masten et al. (1985) and Zeller et al. (2003), RCP factor scores and peer acceptance variables were subjected to z-score transformations to address issues related to unequal class size and/or low participation rates, resulting in RCP and peer acceptance scores standardized to have a mean of 0 and standard deviation of 1.00. These transformed variables were used in further analyses.

2.4.3 Exploratory Analyses

Multiple regressions were used to test the contribution of various neurocognitive domains to each social outcome variable and to test whether social behavior mediated the relationship between neurocognitive functioning and peer acceptance. To reduce nonessential multicollinearity, continuous predictor variables in all regression analyses were centered by subtracting the group mean from individual scores (Aiken & West, 1991). To assess the role of the potential covariates of gender and MPBLIFE, these variables were entered first, followed by IQA, then by the attention, motor skills, visual-spatial skills, memory, or EF construct score. The last factors that were entered were interactions of interest. Age and SES were not entered as potential covariates due to limited variability in these scores across the sample. Output was examined on the basis of statistical significance ($p < .05$) and incremental r^2. To evaluate the reliability and generalizability of the results, residual diagnostics (specifically DFFITS and DFBETAS) were examined to determine whether particular cases were influencing the overall regression equation (FITS) and, if so, on what variable(s) they were manifesting themselves (BETAS) (Fox, 1991). To protect against type I error, the alpha value was adjusted to .025, based on a series of power calculations that weighed the decrement in beta (type II error), against the increment in alpha (type I error). These calculations revealed that maintaining a p-value of .025 would still allow adequate power (.50) to detect small to medium effects ($R^2 = .09$), while also balancing the potential for type I error.

Finally, to determine whether any associations between neurocognitive variables and peer acceptance outcomes (total best friends, reciprocated friendships, like ratings) were mediated by RCP measures of social behavior, the assumptions of mediation were examined. For mediation to occur it was necessary for three paths to be significant: Path 1) between a neurocognitive variable and a peer acceptance outcome prior to controlling for the variance accounted for by any social behavior variables; Path 2) between a neurocognitive variable and a social behavior variable (the mediator); and Path 3) between a social behavior variable (the mediator) and a peer acceptance outcome (Baron & Kenny, 1988). A second assumption was that the magnitude of the Path 1 (between the neurocognitive variable and the peer acceptance variable) would be substantially diminished after accounting for the effects of the mediator (social behavior; Path 2; Baron & Kenny, 1988).

If the all assumptions of the mediational model were met, multiple regression analyses were to be used to test for mediation. First, a regression was to be run with the identified peer acceptance measure as the dependent variable and the identified neurocognitive domain score as the predictor, establishing that there was an effect that could be mediated. Next, a second regression was to be run, again using the neurocognitive domain score as a predictor, but with the identified RCP social behavior variable as the dependent variable (essentially treating the mediator as an outcome variable). Third, another regression was to be run using the peer acceptance measure as a dependent variable and both the neurocognitive and RCP social behavior variables as predictors (the neurocognitive domain score must be controlled to establish the effect of the mediator on the peer acceptance outcome variable). Fourth, if social behavior completely mediated the relationship between neurocognitive functioning and social behavior the effect of the neurocognitive domain on peer acceptance outcomes, when controlling for RCP social behavior would be zero. If all four of these steps were met, results would suggest that RCP social behavior fully mediated the relationship between neurocognitive functioning and peer acceptance. If the first three steps were supported but the fourth was not, then partial mediation would be suggested.

3.0 RESULTS

3.1 NEUROPSYCHOLOGICAL PERFORMANCE

Descriptive information about neuropsychological performance (Table 2) for participants who had completed both peer data collection and the neuropsychological assessment are provided. Standard scores are presented where available. For tests without standard scores see normative comparisons in Appendix B.

Table 2. Neurocognitive Scores for Participants (N = 111-114)

	M	SD
WISC-III Estimated IQ	74.73	14.45
Block Design Scaled Score	5.85	3.21
Vocabulary Scaled Score	5.51	2.79
WRAT-3		
Reading Standard Score	89.66	12.23
Math Standard Score	88.87	10.53
Spelling Standard Score	90.16	12.07
Conner's Continuous Performance Test (CPT)		
Raw Commission Errors	8.72	12.03
Raw Omission Errors	14.06	7.52
Response Speed Consistency t-score	59.03	12.56
Adaptation to Stimulus Presentation Speed t- score	62.30	13.52
Wisconsin Card Sorting Test (WCST)		
Categories Completed Raw Score	5.00	1.48
Perseverative Errors Raw Score	16.60	9.28

Failure to Maintain Set Raw Score	1.02	1.19
Rey Osterreith Complex Figure Test (ROCF)		
Copy Organization Score	8.57	2.94
Copy Accuracy and Structure Raw Scores	62.56	2.19
Immediate Recall Accuracy and Structure Raw Score	43.22	12.32
Delayed Recall Accuracy and Structure Raw Scores	46.11	11.22
Finger Tapping Test		
Score for Right Hand	40.56	6.13
Score for Left Hand	38.86	5.55
Grooved Pegboard		
Time for Right Hand	91.38	18.57
Time for Left Hand	79.19	11.82
California Verbal Learning Test		
List A Total Trials Raw Score	48.18	7.56
Short Delay Free Recall Raw Score	10.10	2.22
Long Delay Free Recall Raw Score	10.33	2.04
Percent Recall Consistency	80.31	8.56
Discrimination (Percent Correctly Recognized)	96.16	3.60

3.2 SOCIAL FUNCTIONING

Bivariate correlations between IQA and social functioning measures, and between neurocognitive domain scores and social functioning measures are presented in Tables 3 and 4.

3.2.1 Social Behavior (What is the child like?)

Average peer-reported RCP behavioral domain z-scores were as follows: popular-leadership, *M* = 0.06 (*SD* = 0.90), prosocial, *M* = 0.12 (SD = 1.04), aggressive-disruptive, *M* = 0.21 (*SD* = 0.97), and sensitive-isolated, *M* = -0.19 (*SD* = 0.73). For teacher-reported RCP behavioral domain scores were as follows: popular-leadership, *M* = 0.10 (*SD* = 0.99), prosocial, *M* = 0.12 (*SD* = 1.04), aggressive-disruptive, *M* = 0.15 (*SD* = 1.16), sensitive-isolated, *M* = -0.04 (*SD* = 1.03).

3.2.2 Social Acceptance (Is the child liked?)

Classroom data on peer acceptance indicated that, on average, participating adolescents received 2.03 best friend nominations from their classmates (*SD* = 1.60), with an average of 1.15 reciprocated friendships (*SD* = 0.88). Additionally, participating adolescents were noted to receive an average like rating score of 3.35 (*SD* = 0.96) on the scale of 1 (not well liked) to 5 (well-liked).

3.3 EXPLORATORY ANALYSES

3.3.1 Covariates

3.3.1.1 Average Childhood Lead Exposure

On average, childhood lead exposure (MBPLIFE) for participating adolescents was 11.91 micrograms per deciliter (*SD* = 5.36, range 4.66 - 37.25). Bivariate correlations revealed that cumulative childhood lead exposure was unrelated to any of the neurocognitive domain scores or social functioning measures. Instead of eliminating lead from subsequent regression models, childhood lead exposure was maintained as a covariate to rule out possible suppression of any of the effects of lead exposure. When entered as a covariate in the regression models, no significant main effect of childhood blood lead concentration was found for any of the peer acceptance or social behavior outcome measures.

3.3.1.2 Gender

One-way ANOVAs were conducted to compare boys and girls on both social functioning and neurocognitive measures. While boys and girls were not significantly different on measures of social functioning, significant differences were identified on attention and memory domain scores. Adolescent girls had significantly better performance in both attention, $F\ (1, 112) = 7.52$, $p < .01$, and memory domains, $F\ (1,112) = 11.70$, $p < .001$, relative to boys. These findings are consistent with previously reported psychometric research on the CVLT where girls demonstrate stronger memory abilities than boys (Delis, Kramer, Kaplan, & Ober, 1987; Kramer, Delis, Kaplan, O'Donnell, & Prifitera, 1997), and with some of the normative literature on CPT which suggests that girls are less likely to make omission and commission errors than boys (Conners et al., 2003). When entered as a covariate, a main effect of gender was also found for reciprocated friendships ($\beta = .215$, $p = .05$), such that girls were reported to have a greater number of reciprocated friendships. Gender was included as a covariate in all subsequent regression analyses.

3.3.2 Neurocognitive Functioning and Peer Relationships

3.3.2.1 IQ-Achievement

IQA scores were found to be significantly and positively associated with reciprocated friendship nominations ($r = .24$, $p < .05$; Table 3) with a small to medium effect size. When IQA was entered into a regression model including covariates (MPBLIFE and gender), the addition of

IQA into the model added significantly to the amount of variance explained (Table 4). These associations were not significant after controlling for experiment wide error.

Table 3. Association between IQA and Social Functioning Measure (N = 85-116)

	1	2	3	4	5	6	7	8	9	10	11	12
1. IQA	1.00											
2. Best Friend Nominations	0.10	1.00										
3. Like Ratings	0.07	0.59**	1.00									
4. Reciprocated Friendships	0.24*	0.68**	0.38**	1.00								
5. RCP Peer Popular-Leader	-0.03	0.51**	0.62**	0.30**	1.00							
6. RCP Peer Prosocial	0.13	0.29**	0.43**	0.09	0.30**	1.00						
7. RCP Peer Aggressive-Disruptive	-0.09	0.03	-0.12	0.10	-0.01	-0.50**	1.00					
8. RCP Peer Sensitive- Isolated	0.07	-0.30**	-0.41**	-0.26*	-0.43**	0.02	-0.15	1.00				
9. RCP Teacher Popular- Leader	0.06	0.20*	0.19	0.11	0.39**	0.27**	0.04	-0.20	1.00			
10. RCP Teacher Prosocial	0.10	0.14	0.21*	0.01	0.10	0.28**	-0.23*	-0.05	0.21*	1.00		
11. RCP Teacher Aggressive-Disruptive	-0.11	-0.04	-0.11	-0.12	-0.04	-0.30**	0.60**	0.08	-0.05	-0.14	1.00	
12. RCP Teacher Sensitive- Isolated	0.01	0.02	-0.06	-0.13	-0.13	-0.12	0.11	0.38**	-0.07	-0.01	0.24**	1.00

* $p < .05$, ** $p < .01$

Table 4. Summary of Hierarchical Regression Analyses Examining IQA as a Predictor of Adolescents' Reciprocated Friendships (N = 84)

	Unstandardized		Standardized	
Predictor Variable	*B*	*SE B*	B	Adjusted R^2 (Change in R^2)
Step 1				.012 (.036)
Gender	.316	.188	.184	
Lead	.009	.017	.057	
Step 2				.052 (.051*)
Gender	.315	.184	.184	
Lead	.010	.016	.063	
IQA	.054	.026	.225*	

* $p < .05$, two tailed

3.3.2.2 Attention, controlling for IQA

While bivariate correlations revealed no significant correlations between attention scores and any of the social functioning outcomes (Table 5), when entered into a regression model attention scores were found to be significantly and negatively related to peer ratings of popular-leadership behavior (Table 6). Children with poorer attentional abilities were less likely to be seen by their peers as popular-leaders. This association was of a small to medium effect, and remained statistically significant after controlling experiment wide error. Attention was unrelated to any of the other peer- or teacher- reported RCP domains, and unrelated to any of the peer acceptance measures.

Table 5. Associations between Neurocognitive Domain Scores and Social Functioning Measures (N = 86-116)

	1	2	3	4	5
1. Attention Score	1.00				
2. Visual-Spatial Score	0.06	1.00			
3. Motor Score	-0.05	0.11	1.00		
4. Memory Score	-0.03	0.18	0.15	1.00	
5. Executive Functioning Score	-0.02	0.11	0.08	0.22*	1.00
6. Best Friend Nominations	0.08	0.18	-0.09	0.05	0.02
7. Like Ratings	0.02	0.05	-0.13	0.02	0.02
8. Reciprocated Friendships	0.06	0.16	0.04	0.19	-0.06
9. RCP Peer Popular-Leader	-0.07	-0.06	0.04	0.05	0.06
10. RCP Peer Prosocial	0.11	0.13	0.01	0.18	0.12
11. RCP Peer Aggressive-Disruptive	-0.07	-0.03	-0.13	-0.21*	-0.02
12. RCP Peer Sensitive- Isolated	-0.02	0.08	-0.02	0.15	0.03
13. RCP Teacher Popular-Leader	-0.04	0.04	-0.01	0.05	0.02
14. RCP Teacher Prosocial	0.06	0.14	0.02	0.06	0.15
15. RCP Teacher Aggressive-Disruptive	-0.06	0.06	-0.18	-0.16	0.05
16. RCP Teacher Sensitive- Isolated	-0.06	0.19*	0.03	0.08	-0.01

* $p < .05$

Table 6. Summary of Hierarchical Regression Analyses Examining Attention as a Predictor of Adolescents' RCP Popular-Leadership Scores (N = 110)

	Unstandardized		Standardized	
Variable	*B*	*SE B*	β	Adjusted R^2 (Change in R^2)
Step 1 (Covariates)				-.017 (.001)
Step 2				-.026 (.000)
IQA	.005	.024	.022	
Step 3				-.021 (.014)
IQA	.006	.024	.024	
Attention	-.036	.029	-.124	
Step 4				.014 (.080)
IQA	.001	.034	.004	
Attention	-.111	.048	-.381*	
Gender x Attention	.103	.065	.275	
Lead x Attention	-.004	.007	-.060	
IQA x Attention	-.004	.010	.040	

* $p < .05$, two tailed

3.3.2.3 Visual-Spatial Skills, controlling for IQA

Bivariate correlations revealed a significant association between visual spatial skills and teacher-reported sensitive-isolated behavior, such that better visual-spatial scores were associated with increased teacher-reported sensitive-isolated behavior (Table 5). This association was non-significant after controlling experiment wide error. Regression analyses showed better visual-spatial scores were positively and significantly associated with teacher-reported sensitive-isolated behavior (Table 7) and best friend nominations (Table 8); however, these associations did not remain significant after controlling experiment wide error.

Table 7. Summary of Hierarchical Regression Analyses Examining Visual-Spatial Skills as a Predictor of Adolescents' RCP Teacher Sensitive-Isolated Scores (N = 107)

	Unstandardized		Standardized	
Variable	*B*	*SE B*	β	Adjusted R^2 (Change in R^2)
Step 1 (Covariates)				-.004 (.015)
Step 2				-.011 (.003)
IQA	-.013	.024	-.054	
Step 3				.020 (.040*)
IQA	-.037	.026	-.152	
Visual-Spatial	.059	.029	.222*	

* $p < .05$, two tailed

Table 8. Summary of Hierarchical Regression Analyses Examining Visual-Spatial Skills as a Predictor of Adolescents' Best Friend Nominations (N = 109)

	Unstandardized		Standardized	
Variable	*B*	*SE B*	β	Adjusted R^2 (Change in R^2)
Step 1 (Covariates)				-.009 (.009)
Step 2				-.004 (.014)
IQA	.031	.025	.121	
Step 3				.027 (.038*)
IQA	.006	.027	.023	
Visual-Spatial	.062	.030	.219*	

* $p < .05$, two tailed

3.3.2.4 Motor Skills, controlling for IQA

Bivariate correlations revealed no significant associations between motor skills and any of the peer outcomes (Table 5). When entered into a regression model, motor skills did not contribute significant variance to peer outcomes over and above the variance explained by IQA.

3.3.2.5 Memory, controlling for IQA

Bivariate correlations revealed a significant association between memory abilities and peer-reported aggressive-disruptive behavior such that children with poorer memory scores were seen by their peers as more aggressive-disruptive (Table 5). Additionally, a main effect of memory on peer-reported prosocial behavior emerged in regression analyses where better memory scores were associated with increased peer-reported prosocial behavior (Table 9). These associations were not significant after controlling for experiment wide error.

Table 9. Summary of Hierarchical Regression Analyses Examining Memory as Predictor of Adolescents' RCP Prosocial Scores (N = 112)

	Unstandardized		Standardized	
Variable	*B*	*SE B*	β	Adjusted R^2 (Change in R^2)
Step 1				-.018 (.001)
Step 2				-.006 (.021)
IQA	.031	.021	.144	
Step 3				.022 (.036*)
IQA	.023	.021	.104	
Memory	.041	.020	.203*	

* $p = .05$ two tailed

3.3.2.6 Executive Functioning, controlling for IQA

Exploratory analyses examining potential linkages between the EF construct and social functioning measures revealed no significant correlations (Table 5), and no main effects of EF on any of the peer acceptance or social behavior measures, after controlling for variance explained by IQA.

3.3.3 Moderation

Given the small number of significant main effects of neurocognitive domains on social functioning measures, additional exploratory analyses were conducted to determine whether any covariates were moderating the effects of the neurocognitive predictor variables. To test for moderation, a set of interactions were entered into regression models following covariates, IQA, and the neurocognitive predictor of interest. For each regression, covariates entered included gender X neurocognitive domain score, MBPLIFE X neurocognitive domain score, and IQA X neurocognitive domain score. Interaction terms that emerged as significant were subjected to further post-hoc probing to assess whether either simple slope emerging from the interaction was significantly different from zero (Aiken & West, 1991; Holmbeck, 2002).

3.3.3.1 Moderation by Gender

No significant gender interactions emerged as significant in the multiple regression analyses.

3.3.3.2 Moderation by Lead Exposure

Several interactions were found between childhood blood lead levels and neurocognitive measures. Specifically there was a lead x IQA interaction that contributed significantly to variance in peer-reported popular leadership (β = -.203, $p < .05$) and an interaction between childhood blood lead levels and visual-spatial functioning that contributed significantly to variance in teacher-reported aggressive-disruptive behavior (β = -.292, $p < .05$). Neither remained significant after correction for multiple comparisons. Finally, an interaction was demonstrated between childhood blood lead levels and memory abilities for teacher-reported aggressive-disruptive behavior (Figure 1). This interaction remained significant after controlling for multiple comparisons (β = -.228, $p \leq .01$). Post-hoc probing of this interaction suggested that while the relationship between memory and teacher-reported aggressive-disruptive behaviors differed for children with high versus low levels of lead exposure, neither of these regression equations were significantly different from zero (β = -.089, ns; β = .024, *ns*).

3.3.3.3 Moderation by IQA

Regression analyses revealed a significant interaction between IQA and motor skills for reciprocated friendships (β = -.334, $p < .01$). This interaction remained significant after corrections for multiple comparisons. Further post-hoc probing revealed a significant contribution of motor skills to reciprocated friendships, but only for adolescents with high IQA scores. Specifically, for children with high IQA, motor skills were found to be negatively associated with reciprocated friendships (β = -.21, $p <.05$); for children with low IQA, there was no relationship between motor skills and reciprocated friendships (β = .15, ns).

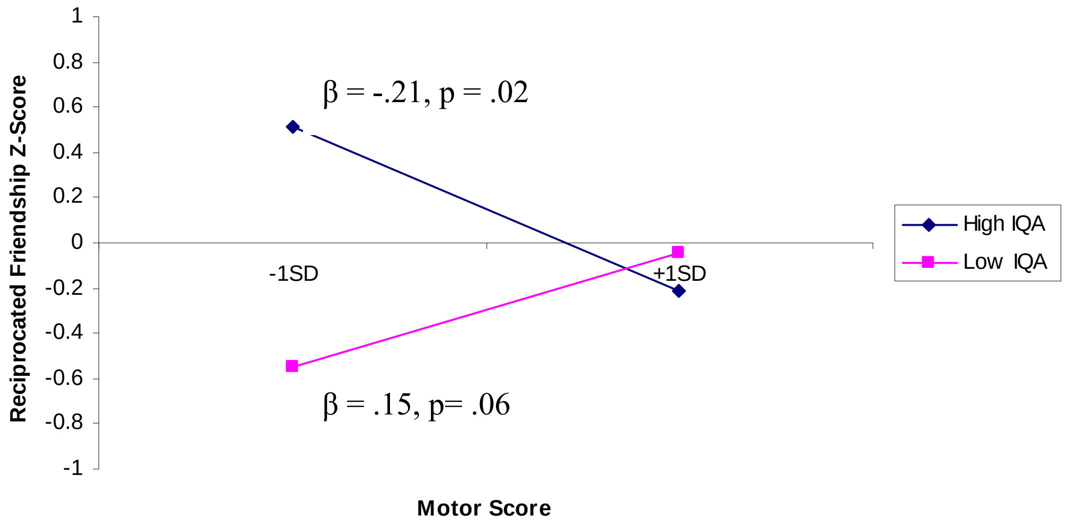

Figure 1. Motor X IQA Interaction for Reciprocated Friendship z-scores

Additionally, regression analyses revealed a significant interaction between IQA and memory scores with respect to teacher-reported aggressive-disruptive behavior (β = -.305, $p <$ .01) that remained significant after controlling for multiple comparisons (Figure 2). Post-hoc probing revealed that memory skills made a significant contribution to variance in teacher-reported aggressive-disruptive behavior for children with high IQA (β = -.120, $p <$ .01), but not for children with low IQA (β = .07, p = *ns*).

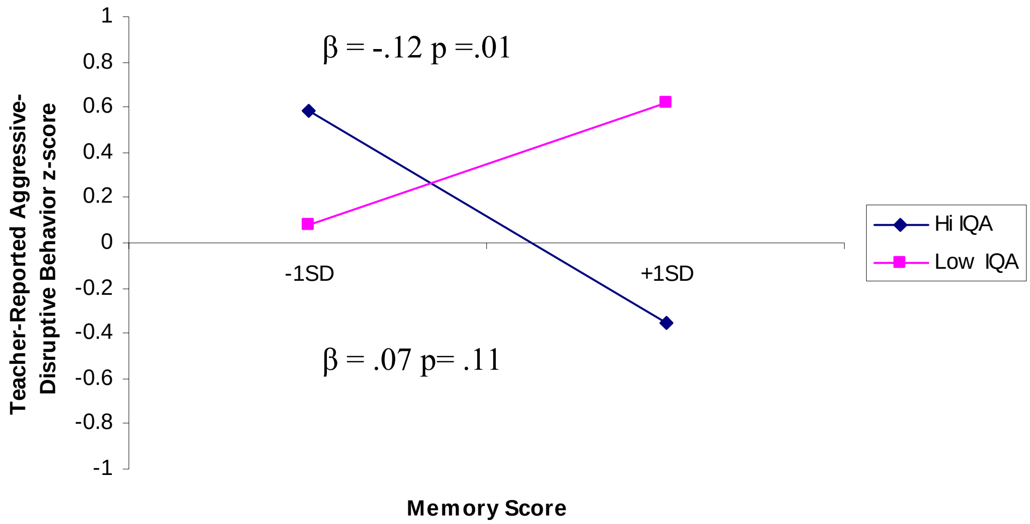

Figure 2. Memory X IQA Interaction for Teacher Reported RCP Aggressive-Disruptive z-scores

3.3.4 Mediation

Because no main effects of any neurocognitive variables on peer acceptance variables were found where there were also main effects of the neurocognitive variable on social behavior, mediation analyses could not be conducted.

4.0 DISCUSSION

The current study was a secondary analysis of an existing data set that utilized an extensive, individually-administered neuropsychological battery and independent collection of data on social behavior and peer acceptance in school classrooms to explore potential associations between cognitive functioning and peer relationships in a sample of low SES, urban African American adolescents. Given previously reported relationships between general cognitive and peer functioning, one aim of the current study was to extend existing research on general cognitive functioning and peer relationships to a low income, African American sample, potentially increasing external validity of previously reported associations. A second aim of the study was to explore whether specific domains of cognitive functioning contributed to variation in peer relationships over and above the effects of general cognitive functioning within this sample. There is a paucity of research exploring how these specific domains of cognitive ability may contribute to social behavior, particularly in urban, low-SES, minority samples. It was hoped that exploring the contribution of these factors might shed light both on associations between general cognitive functioning and social behavior, as well as on mechanisms underlying these potential associations.

4.1 IS GENERAL COGNITIVE FUNCTIONING RELATED TO ADOLESCENT'S PEER RELATIONSHIPS IN AN URBAN, LOW-SES, AFRICAN AMERICAN SAMPLE?

With respect to the first aim of the study, IQA was only weakly associated with one of the 11 social functioning outcome variables examined. This finding was contrary to previously reported associations between better cognitive functioning and more adaptive peer relationships (Bellanti & Bierman, 2000; Hymel, 1983; Ladd & Troop-Gordon, 2003; Masten et al., 1985; Morison & Masten, 1991; Mostow et al., 2002; Olson & Lifgren, 1988; Woodward & Fergusson, 2000). When integrating the current results into existing literature it is striking that IQA scores did not explain variance in social outcomes.

Descriptive information on social functioning measures indicates that the failure to find main effects of cognitive functioning on a greater number of social functioning outcome variables was not due to limited variability or truncated range in the social functioning scores as there appeared to be sufficient variability in these measures. Measurement of cognitive functioning was also considered as a potential explanation for a failure to detect main effects. In the present study, general cognitive performance was substantially lower than would be predicted based on existing norms. For example, the mean IQ score for the sample was 74.73 (SD = 14.45). This is nearly two standard deviations below published norms for the WISC-III. When examining the range of IQ scores, no scores were above 103, while 21% of the scores (N = 24) were below 60. On the individual IQ subtests, 15% of the sample (N = 17) obtained the lowest possible score (i.e., 1) for the block design subtest. Achievement scores were also lower than published norms, though these discrepancies were more modest. The truncated upper range of IQ and achievement scores, in combination with the high percentage of individuals scoring in the lower quartile of these ranges suggests floor effects may be affecting power to understand potential linkages between cognitive functioning and peer relationships.

It is important to note that the present study also combines IQ and achievement data to create the IQA domain score. While this approach was employed to maintain consistency with the methodology utilized in other work with this sample (Ris et al., 2004), this measurement strategy had not been previously used in this literature. To facilitate a comparison with previous work, all analyses examining potential linkages between cognitive functioning and peer relationships were completed a second time utilizing estimated IQ in place of IQA. Findings from these analyses were similar to those employing the IQA domain score.

Given the discrepancy between the current findings and existing literature it is important to consider the context of existing samples. Some of the existing studies did not utilize diverse samples (Hymel et al., 1990; Woodward & Fergusson, 2000); others did not explore specific racial group differences (Masten et al., 1985; Morison & Masten, 1991), or were underpowered to detect significant racial group differences (Mostow et al., 2002). Our failure to detect a significant association between either estimated IQ or IQA and peer relationships in African Americans does not necessarily reflect a significant departure from existing literature, given this question has not received a great deal of attention; however, it calls into question the generalizability of previous research to African American samples. The difference between current findings and existing literature is particularly striking when considering standardized effect sizes demonstrated. For example, when comparing the effect size of the association between IQA and peer-reported sensitive-isolated behavior documented in the present study (r = .06), with the same effect reported in existing literature (e.g., Masten et al., 1985, r = -.52), the demonstrated effect was considerably different, and substantially weaker (z = -4.12, p <.001, two-tailed). This further undermines our ability to draw conclusions about the significance of the one demonstrated association between general cognitive abilities and peer relationships in this sample.

Given the evidence from the current study that fails to support a relationship between IQA and peer relationships it is important to consider the potential impact of contextual factors including: race, SES, and age. When considering racial context it is important to revisit the tenuous status of existing neuropsychological norms and dearth of psychometric research investigating the reliability and validity of these measures in African American populations. These factors make it difficult to understand the meaning of scores on these neurocognitive measures for African American adolescents.

A number of investigators have reported that cultural variations in cognitive test scores do exist (Anastasi, 1988; Heath, 1997, 1999; Wong, Strickland, Fletcher-Janzen, Ardila, & Reynolds, 2002). Because culture may dictate what is relevant and significant in a particular situation or context, and what an individual believes is worth learning (Ardila, 2005), it is possible that these neurocognitive measures may not be sensitive to the social and cultural context of the current sample. This may be particularly important when considering the testing environment. While great effort was devoted to carefully administering the neuropsychology battery in a quiet setting, one-to-one, these specific conditions and strategies may not be familiar to many African American adolescents and they may violate some accepted cultural norms (Ardila, 2005). Specifically, certain aspects of the testing environment such as the one-to-one relationship, the background authority associated with the role of the examiner, assumptions of best performance, the isolated environment, the importance of speed, and so on may have been sensitive to the socioeconomic or racial context of the current sample. These discrepancies may be further compounded when considering the ways in which the peer culture of the current sample could differently value certain behaviors including academic achievement. As such, the failure to find a relationship between cognitive functioning and peer relationships may reflect, in part, differences in the value systems that underlie the neuropsychological testing and measures.

4.2 ARE SPECIFIC DOMAINS OF COGNITIVE ABILITY RELATED TO PEER RELATIONSHIPS FOR AN URBAN, LOW-SES, AFRICAN AMERICAN SAMPLE, AFTER CONTROLLING FOR GENERAL COGNITIVE FUNCTIONING?

When specific domains of cognitive functioning were examined, few main effects of these individual domains on peer acceptance or social behavior were found. Of the main effects that emerged, only one was retained after correction for multiple comparisons. Specifically, results suggested that better attentional abilities were associated with peer reports of more leadership behaviors, after accounting for variance explained by general cognitive functioning. This finding is consistent with literature suggesting that better attentional abilities are associated with more advantageous peer functioning, and complements literature describing greater peer difficulties for children with ADHD (Blachman & Hinshaw, 2002; Carlson et al., 1987; Diamantopoulou et al., 2005; Hoza et al., 2005; Hoza et al., 2005). When considering the findings of Bellanti and Bierman (2000) who reported an association between weaker attentional abilities and less adaptive peer relationships (e.g., less well liked, less prosocial) present results are somewhat similar in that better attentional abilities appear to be associated with more adaptive peer relationships. However, it is important to note that the current study found no differences in peer acceptance, and the effect of attention on peer relationships was related to popular-leadership behavior, rather than prosocial behavior. In isolation, these findings might support an argument for the contribution of attentional abilities to social functioning in an older, inner-city minority sample, when utilizing a clinically-validated neuropsychological measure of attention. However, because no main effects of attention were found on any other RCP domains, or for any peer acceptance measures, general support for the role of attention in explaining social outcomes for these adolescents was rather weak.

The failure to detect significant relationships between domains of cognitive functioning and peer relationships precipitated further exploratory analyses to assess whether interactions between the covariates or neurocognitive domains accounted for variance in our measures of peer functioning. These analyses suggested the presence of several interactions. Specifically teachers reported less aggressive-disruptive behavior for teenagers with better memory abilities, but only in individuals with higher IQA scores. While there is no existing literature explicitly examining the relationship between memory and peer relationships, it should be noted that the variables comprising our memory factor represented scores from the CVLT-C. Psychometric research on the adult CVLT has consistently demonstrated a large general verbal learning factor (Delis et al., 1988; Millis, 1995; Schear & Craft, 1989). Furthermore, a study by Keenan et al. (Keenan, Ricker, Lindamer, Jiron, & Jacobson, 1996) demonstrated that 13% of the variance in adult CVLT scores could be accounted for by the vocabulary score on an adult measure of IQ, suggesting the CVLT taps into more general verbal ability in addition to specific verbal memory. To the extent that memory scores from the present study represent adolescents' general verbal abilities, it may be that stronger verbal abilities in the context of generally higher cognitive functioning relative to peers' contributes positively to teacher's perceptions of an adolescent's peer relationships. Within this inner city setting, brighter, more verbally skilled youth may be viewed by teachers as being less disruptive.

Unfortunately, this fails to completely explain why the relationship would be different for adolescents of high IQA, versus low IQA. One possible explanation is that individuals with low IQA in this setting have so many deficits that improved memory abilities cannot compensate. Alternatively, when groups were split into high IQA versus low IQA a relatively small number of individuals in the low IQA group had high memory scores. Median splits were used to divide the sample into 4 groups: high IQA - high memory (N = 36, 32 %), high IQA - low memory (N = 20, 18 %), low IQA - high memory (N = 20, 18 %), and low IQA - low memory (N = 37, 32 %). A chi-square test revealed that there were significantly fewer individuals in both the low-IQA-high memory, and high-IQA- low memory groups than would be expected, $\chi^2(1, N = 113) = 9.63$, $p < .01$. This post hoc probing suggests there may not have been enough variability in "memory" abilities for individuals in the low IQA group to detect a significant effect of "memory" abilities. The suggestion of a main effect of "memory" is echoed when revisiting regression analyses that indicated a main effect of memory on peer-reported aggressive-disruptive behavior that did not survive the correction for experiment wide error.

The second interaction identified suggested an effect of motor skills on reciprocated friendships for individuals with relatively higher IQA scores such that stronger fine motor skills for these individuals were associated with fewer reciprocated friendships, whereas for individuals with lower IQA scores there was no relationship between fine motor skills and reciprocated friendships. This finding is contrary to predictions and inconsistent with existing literature supporting a relationship between better motor abilities and more adaptive peer relationships (Cummins et al., 2005; Dewey et al., 2002; Kanioglou et al., 2005; Rydell, 1993; Skinner & Piek, 2001; Smyth & Anderson, 2000).

When integrating this finding into existing literature it should be noted that most studies examining associations between motor skills and social functioning have focused on populations with DCD. Such diagnostic grouping may be sensitive to specific motor impairments, however, the diagnosis of DCD also reflects rather non-specific delays in developmental milestones that may be related to more broad based problems than specific weaknesses in motor functioning. For example, an individual with mental retardation (MR) can qualify for a diagnosis of DCD so long as his or her motor difficulties are in excess of those usually associated with an MR diagnosis. Additionally, scant evidence was found demonstrating significant correlations between fine motor skills and the type of gross motor skills that would be associated with athletic competence outside the DCD population. Thus it is possible that the anticipated relationship between motor abilities and social functioning based on literature utilizing DCD populations may have been misguided as the deficits manifested by individuals with DCD reflect more pervasive global deficits that could negatively impact social functioning, as opposed to relative weaknesses in the more circumscribed domain of fine motor ability. Finally, it should be noted that a close examination of scatterplots of the relationship between motor skills and reciprocated friendships for both the low-IQA group and the high-IQA group suggested that outliers may have been driving the association between weaker motor skills and reciprocated friendships demonstrated in the high-IQA group.

4.3 LIMITATIONS

While there were numerous strengths related to this investigation (i.e., individually administered neuropsychological battery; independent data from the peer group; relatively large sample of minority youth), several methodological problems limit the ability to draw firm conclusions. First, some of the neuropsychological measures selected for this work (i.e., ROCF, WCST, GPT, and FTT) had not been widely utilized in child or adolescent populations, or in African American samples. Even for measures that had been widely utilized (i.e., WISC-III, WRAT-3, CPT), scores obtained by this sample of teenagers were typically well below national norms (Appendix B). For several measures (i.e., WISC-III, CPT), a significant cluster (greater than 10%) of the participating adolescents received the lowest score possible on specific sub-tests. These problems for this sample reflect broader issues of measurement of neurocognitive functioning of African American youth (i.e., Dickens & Flynn, 2006, 2006; Rushton & Jensen, 2006).

A second limitation was related to statistical power. While a liberal alpha adjustment for experiment wide error was employed ($p \leq .025$) to preserve some statistical power, many initial findings did not remain significant after controlling for multiple comparisons. While the liberal correction was selected to maximize the potential to uncover associations in a relatively untapped domain of inquiry, the number of analyses and volume of predictors entered into regression models obviously compromised power, while simultaneously increasing the potential for Type I error. Given the small number of significant findings, and the modest effect sizes demonstrated (average R^2 across regressions = 0.09), the existing findings seem rather robust for detection of large and medium effect sizes. It seems very feasible that small, and small to medium effect sizes may not have been detected.

Third, one key assumption for this investigation was that specific neuropsychological measures tap into specific domains of cognitive ability, and moreover the additional specificity afforded by this measurement strategy would have numerous advantages over approaches that rely on broad and diffuse diagnostic groups (i.e., ADHD, LD, DCD). Utilization of such a measurement strategy was to be a step in a direction that focuses on more precise measurement and definitions. However, it should be noted that, as a field, neuropsychology has been criticized for asserting that (a) neuropsychologists know what specific tests are actually measuring, and (b) different tests reflect more than just method variance (Dodrill, 1997, 1999). These assumptions are a matter of continued debate (Bell & Roper, 1998; Russell, 2001; Tremont, Hoffman, Scott, & Adams, 1998). The approach to this dilemma employed by our research group (Ris et al., 2004) was to subject our neuropsychological battery to an empirical data reduction strategy (i.e., a principle components FA) and to examine whether the factor solution demonstrated conceptually and mathematically distinct (orthogonal) factors that represented the neurocognitive domains of interest. Unfortunately, several of the extracted factors (memory, attention) represented scores from only one test, raising the possibility that these factors may only reflect method variance. Additionally, the EF factor did not emerge as conceptually distinct in the FA, and our general intelligence factor was an amalgam of IQ and achievement test scores. Thus, it appears that the ability of our neuropsychological battery of tests to measure specific domains of cognitive functioning with this population, and to further explain variance in social functioning outcome measures beyond more general cognitive abilities is far weaker than anticipated.

While our goal of utilizing a comprehensive 3+ hour neuropsychological assessment was to illuminate specific aggregates of cognitive functioning (i.e., expressive language, receptive language, visual spatial skills, memory, attention) that could possibly represent underlying neural systems and brain functions, our data suggest that scores on the measures in this battery reflected source variance (i.e., specific test) for this sample of inner city African American youth. This problem could reflect the lack of diversity of age, SES, and racial groups represented in our sample, or this could represent potentially broader measurement problems for neuropsychologists who work with children. For example, scores on a test measuring fine motor skills might also be high as a result of motivation, or history of doing fine motor tasks (e.g., drawing, playing videogames). Historical figures including Luria, and Piaget, as well as contemporary experts including Sattler have warned that there are many reasons a child may do well or poorly on any given test, and these reasons need to be considered carefully.

Finally, the measurement of both social behavior and acceptance in the current study may have been compromised as a result of participation rates that were somewhat lower than would be desired. Oftentimes when researchers arrived at the school to begin classroom data collection there were many individuals absent from the class. These data were collected in the winter or spring. Many of the teens had missed over 60 days of school. Also, there were a significant number of adolescents who did not return signed consent forms. The lower participation rates detract from power of the peer measures to capture a representative picture of a child's peer relationships. Additionally, some research suggests that African American children have larger networks of friends than European American children and are two times more likely to have a close friend outside of school (DuBois & Hirsch, 1990). In a more recent study, Way and Chen (Way & Chen, 2000) described a similar phenomenon in a sample of African American adolescents from low-income families that reported only 24.5 % of adolescents attended the same school as their closest friend. Similarly, Clark and Ayers (Clark & Ayers, 1991) reported that African American children have more contact with friends outside of school, whereas white children have more in-school contact with friends. Thus, it is possible the more extended social network of African American children, and a relatively smaller number of close friends within the classroom could be contributing to a failure to adequately describe adolescent's social functioning.

4.4 STRENGTHS

Despite considerable shortcomings, the current study is thought to add to existing studies in several ways. First, a comprehensive neuropsychological battery of tests was individually administered to each adolescent in a controlled environment by an expert tester under the direct supervision of a board certified pediatric neuropsychologist. Second the data were obtained from a minority sample of adolescents who represented an impoverished, inner-city population. Third, information about peer relationships was obtained from the child's peer group, without data collection procedures that focused on the specific CLS child, using psychometrically sound measures, and information was also obtained from the child's teacher. These data were obtained independently of the neuropsychological data. This author could not locate any earlier work that has completed comprehensive neuropsychological batteries on adolescents and obtained data from peers about social relationship for any sample of children or adolescents.

Our measurement strategies permitted us to assess the contribution of multiple, data-driven domains of cognitive functioning (some of which were previously unexamined in the literature), over and above the effect of general intelligence. Additionally, the use of a low-SES African American population enabled an initial descriptive understanding of the relationship between cognitive functioning and social functioning in a non-European American population.

4.5 IMPLICATIONS AND FUTURE DIRECTIONS

The focus of the current investigation was to explore the potential links between neurocognitive functioning and social outcomes in adolescents. It was assumed that cognitive ability would be directly related to social behavior and/or peer acceptance. Results suggested the associations between cognitive functioning and peer relationships for this sample were modest. While subsequent studies utilizing larger, diverse samples that can test for between group differences (e.g., racial group differences, SES differences, developmental differences) and possibly employ even more sensitive and focused measures of cognitive functioning are important, it may be necessary to revisit the mediational model presented earlier, as it may be more productive to consider other factors that could influence social behavior and contribute to individual differences in peer acceptance. The social cognitive model advanced by Dodge et al. (Dodge, Bates, & Pettit, 1990; Dodge, Pettit, McClaskey, & Brown, 1986) represents a thoughtful consideration of social cognition as a more proximal determinant of social functioning. While Dodge's initial work has begun to investigate these potential linkages, more work relating social cognition to peer relationships is needed. It may be interesting to delineate the relationship between neurocognitive abilities and social cognitive abilities to explore additional mechanisms whereby more general cognitive abilities may be influencing the pathway to social outcomes. Simultaneously examining neurocognitive and social cognitive abilities would allow for an appreciation not only of the relationship between these two aspects of cognitive functioning, but also for a comparison of the relative contribution of each domain to peer functioning.

Notably, recent work has begun to explore the role of emotion in motivating social behavior, and influencing cognition. This perspective provides a second promising area to explore in attempting to understand the nature of individual differences in social functioning. A growing body of research illustrates that emotions can be a powerful motivator of behavior, particularly during social interaction, and that emotions may have even greater influence on cognition during situations of social conflict (Beer, Mitchell, & Ochsner, 2006; Ochsner & Gross, 2005). For example, the behavioral and physiological arousal generated by the limbic system (i.e., emotions) mediates a reflexive and powerful response that is not easily regulated by the cortical systems that support more sophisticated cognitive processing (Davidson, 2002). Thus, a potentially powerful influence on social behavior, emotion, is missing from current approaches that focus primarily on cognition. Moreover, recent studies suggest that there is substantial overlap between the neural systems that mediate basic emotional responses (e.g. anger, fear, disgust) and more complex social behaviors (e.g. rejection) (Eisenberger & Lieberman, 2004; Eisenberger, Lieberman, & Williams, 2003; Spinrad et al., 2004). A recent study from our research group (Sterry, 2004) suggested that a significant proportion of variance in a measure of peer acceptance and peer-reported sensitive-isolated behavior was explained by parent-reported measures of child temperament, which has been strongly linked to basic emotional processes and personality (Whittle, Allen, Lubman, & Yucel, 2006). Thus, tapping into aspects of personality and temperament, using available psychometrically valid probes that are more closely related to emotional arousal and regulation, may provide stronger predictive links to peer relationship, and may also explain our failure to demonstrate significant effects of neurocognitive functioning on peer relationships, particularly if such cognitive abilities are significantly altered by the stress of social interaction. Thus, it seems that considering an emotional quotient (EQ) may be as important as, if not more important than our measures of cognitive functioning (including IQ) when considering individual differences in social functioning.

While a hope of the present study was that identifying specific cognitive domains associated with social functioning could increase our ability to determine groups or subgroups of children and/or adolescents at risk for negative problematic peer relationships and associated maladaptive developmental outcomes, results would suggest that indices of neurocognitive functioning explored in the current study do not hold significant predictive power for identifying at-risk individuals in this population of urban, low-SES African American teenagers. Variability in social functioning was demonstrated for the current sample, but it was not linked to our measures of cognitive functioning. Our data suggest that when considering interventions for adolescents who are doing poorly socially, focusing on these broad domains of neurocognitive functioning within this context may not be as important as targeting other domains perhaps including social skills and/or emotional functioning.

When considering findings as a whole, the absence of many significant findings suggests that, in the current sample, neurocognitive functioning did not contribute significantly to variance in multiple measures of adolescent's social functioning. While replication is needed, results highlight the need for thoughtful, methodologically rigorous studies that consider contextual factors (e.g., race, SES, age). Such work will help advance our understanding of the determinants of children's peer relationships, and the mechanisms by which individual differences in social functioning arise and unfold across development.

APPENDIX A

FACTOR ANALYSES

A.1 NEUROCOGNITIVE VARIABLES ENTERED INTO FACTOR ANALYSIS

WISC-III: Block Design Raw Score, Vocabulary Raw Score

WRAT-3: Standard Score for Reading, Standard Score for Mathematics, Standard Score for Spelling

Conner's CPT: Raw Number of Omissions, Raw Number of Commissions, Variability of Standard Errors (within respondent response speed consistency across test), Inter-stimulus Interval Hit Reaction Time Change (adaptation to stimulus presentation speed across test)

ROCF: Combined Immediate Recall Score (immediate recall structural accuracy score plus immediate recall incidental accuracy score), Combined Delayed Recall Score (delayed recall structural accuracy score plus delayed recall incidental accuracy score), Combined Copy Score (copy structural accuracy score plus copy incidental accuracy score), Copy Organizational Score

FTT: Number of Taps (Right Hand), Number of Taps (Left Hand)

GPT: Time to Complete (Right Hand), Time to Complete (Left Hand)

WCST: Perseverative Errors, Number of Categories Completed, Failure to Maintain Set

CVLT: List A Total Trials Raw Score, List A Short Delay Free Recall, List A Long Delay Free Recall, Percent Recall Consistency (proportion of words recalled on one of the first four trials that are also recalled on the very next trial), Discriminability (correct recognition hits weighed against false positives)

A.2 PREVIOUSLY PUBLISHED FACTOR SOLUTION

From Ris et al., 2004, N = 195

Variable	IQA	Attention	Visual-Spatial	Motor	Memory
WRAT-3					
Standard Score for Reading	.90				
Standard Score for Spelling	.84				
Standard Score for Math	.69				
WISC-R					
Block Design Raw Score	.42		.45		
Vocabulary Raw Score	.72				
Conner's CPT					
Raw Omissions		.82			
Raw Commissions		.85			
Variability of SE t-score		.89			
Hit RT ISI Change t-score		.84			
ROCF					
Immediate Recall			.65		
Delayed Recall			.74		
Copy Accuracy			.65		
Copy Organizational			.62		
Grooved Peg Board					
Time for Right Hand				.47	

Time for Left Hand	.63	
Finger Tapping		
Raw Score for Right Hand	.79	
Raw Score for Left Hand	.82	
CVLT-C		
List A Total Trials Raw		.81
List A SD Free Recall		.78
List A LD Free Recall		.78
% Recall Consistency		.68
Discrimination		.67

A.3 FACTOR SOLUTION FROM CURRENT SAMPLE

N=116

Variable	IQA	Attention	Visual-Spatial	Motor	Memory
WRAT-3					
Standard Score for Reading	0.87				
Standard Score for Spelling	0.83				
Standard Score for Math	0.58				
WISC-3					
Block Design Raw Score	0.34		0.58		
Vocabulary Raw Score	0.64				
Conner's CPT					
Raw Omissions		0.84			
Raw Commissions		0.46			
Variability of SE t-score		0.88			
Hit RT ISI Change t-score		0.83			
ROCF					
Immediate Recall			0.73		
Delayed Recall			0.73		
Copy Accuracy			0.61		
Copy Organizational			0.72		

Grooved Peg Board		
Time for Right Hand	-0.52	
Time for Left Hand	-0.55	
Finger Tapping		
Raw Score for Right Hand	0.72	
Raw Score for Left Hand	0.72	
CVLT-C		
List A Total Trials Raw		0.79
List A SD Free Recall		0.84
List A LD Free Recall		0.87
% Recall Consistency		0.67
Discrimination		0.69

APPENDIX B

NEUROCOGNITIVE TEST SCORES FOR CURRENT SAMPLE

B.1 ATTENTION

Primary Behavioral Indices Assessed (N = 113-114)	Mean *t* - score (*SD*)[1†]
Inattention	
Percent Omission Errors[†]	3.11 (5.54)
Average Speed of Correct Responses	39.27 (15.28)
Relative Response Speed Consistency	64.65 (16.43)
Within Respondent Response Speed Consistency	59.63 (14.19)
Relative Adaptation to Stimulus Presentation Speed	63.81 (16.55)
Adaptation to Stimulus Presentation Speed Across Test	58.48 (12.89)
Impulsivity	
Percent Commission Errors[†]	39.06 (20.88)
Commission Errors	48.22 (10.61)
Average Speed of Correct Responses	39.27 (15.28)
Cautious Response Style	63.81 (19.05)
Vigilance	
Change in Reaction Time Across Test	54.54 (13.75)

Change in Response Consistency Across Trials	55.01 (12.21)
Perceptual Sensitivity	53.44 (12.34)

[1] *t*- scores are standardized to have a mean of 50 (SD = 10); † Scores presented as percentage, rather than t-score

B.2 VISUAL-SPATIAL

ROCF Scores for Current Sample (N =114) and existing norms for 14-year olds using Developmental Scoring System (N = 40; Bernstein & Waber, 1996)

	Published Norms	Current Sample	
	14-year Olds, N = 40	14-year Olds, N = 31	Whole Sample, N = 114
	M (*SD*)	*M* (*SD*)	*M* (*SD*)
Figure Copy			
Organization	11.34 (2.54)	8.57 (2.94)	8.57 (2.94)
Structural Elements			
Accuracy	24.80 (0.50)	24.59 (1.05)	24.59 (1.05)
Incidental Elements			
Accuracy	39.00 (2.50)	39.97 (1.73)	37.99 (1.61)
Total Errors[§]	0, 0-2	1, 0-6	1, 0-13
Figure Recall			
Organization	9.51 (3.93)	6.65 (3.81)	6.65 (3.81)
Structural Elements			
Accuracy	22.70 (5.60)	19.59 (5.29)	19.59 (5.19)
Incidental Elements			
Accuracy	27.00 (9.00)	23.63 (8.57)	23.63 (8.57)
Total Errors[§]	1, 0-4	2, 0-10	2, 0-10

[§]Values represent Median, Range.

B.3 FINE MOTOR

Fine Motor Performance for Current Sample (N =114) and meta norms for 15-25 year olds (Spreen & Strauss, 2005)

	Published Meta Norms		Current Sample	
	M	*SD*	*M*	*SD*
Grooved Peg Board (time in seconds)				
Dominant Hand	57.95	8.32	80.48	13.72
Nondominant Hand	63.64	9.40	91.17	18.94
Finger Tapping Test (# taps/10 seconds)				
Males				
Dominant Hand	54.41	4.60	42.81	6.43
Nondominant Hand	50.00	4.84	41.40	4.81
Females				
Dominant Hand	50.07	4.66	38.85	5.82
Nondominant Hand	46.31	4.74	36.71	4.64

B.4 EXECUTIVE FUNCTIONING

WCST Scores for Current Sample (N = 111 - 114) and 15-year olds from Normative Sample (Heaton et al, 1993)

Scales where lower scores represent better performance:	Published Norms *M* (*SD*)	Current Sample *M* (*SD*)
Total Errors	27.03 (18.12)	36.58 (20.31)
Perseverative Responses	13.25 (7.08)	18.17 (10.63)
Perseverative Errors	12.28 (6.36)	16.60 (9.28)
Non-perseverative Errors	14.75 (13.25)	19.32 (12.64)
Failure to Maintain Set	0.66 (1.18)	1.02 (1.19)
Scales where higher scores represent better performance:	**Published Norms *M* (*SD*)**	**Current Sample *M* (*SD*)**
Percent Conceptual Response	68.69 (15.66)	61.01 (18.52)
Categories Completed	5.33 (1.22)	5.00 (1.48)
Learning to Learn	-0.92 (2.98)	-2.98 (8.97)

B.5 MEMORY

Raw and Scaled Scores for Current Sample (N = 114) for Recall of the CVLT 15-item Word List (Delis, Kramer, Kaplan, 1994)

Memory Index	Raw Scores *M* (*SD*)	z-scores *M* (*SD*)
Immediate Memory		
Total Recall Across 5 Trials	48.18 (7.76)	
Trial 1 Free Recall	6.61 (1.65)	-0.21 (0.86)
Trial 5 Free Recall	11.65 (1.62)	-0.51 (0.93)
Percent Recall Consistency Across Trials	80.31 (8.56)	-0.36 (0.88)
Distracter List Free Recall	5.86 (1.62)	-0.57 (0.83)
Memory following Delay		
Short Delay		
Free recall	10.10 (2.22)	-0.57 (0.89)
Cued recall	10.53 (1.95)	-0.49 (0.79)
Long Delay		
Free recall	10.33 (2.04)	-0.43 (0.80)
Cued recall	10.96 (1.86)	-0.31 (0.74)
Correct Recognition Hits	14.11 (1.25)	-0.03 (0.75)
Percent Correctly Discriminated	96.16 (3.60)	-0.21 (0.66)

Memory Errors		
Perseverations	7.37 (6.73)	0.36 (1.29)
Intrusions		
Free Recall	2.11 (2.74)	0.06 (0.65)
Cued Recall	1.10 (3.77)	0.08 (1.10)
Total	3.20 (5.00)	0.07 (0.95)
False Positives	0.84 (1.19)	0.00 (0.78)

APPENDIX C

DSM-IV-TR CRITERIA

C.1 ATTENTION DEFICIT HYPERACTIVITY DISORDER (314.01)

A. Either (1) or (2) is present:

(1) *Inattention:* six (or more) of the following symptoms of inattention have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

(a) often fails to give close attention to details or makes careless mistakes in schoolwork, work, or other activities

(b) often has difficulty sustaining attention in tasks or play activities

(c) often does not seem to listen when spoken to directly

(d) often does not follow through on instructions and fails to finish school work, chores, or duties in the workplace (not due to oppositional behavior or failure to understand instructions)

(d) often has difficulty organizing tasks and activities

(e) often avoids, dislikes, or is reluctant to engage in tasks that require sustained mental effort (such as schoolwork or homework)

(f) often loses things necessary for tasks or activities (e.g., toys, school assignments, pencils, books, or tools)

(g) is often easily distracted by extraneous stimuli

(h) is often forgetful in daily activities

(2) *Hyperactivity-Impulsivity:* six (or more) of the following symptoms of hyperactivity-impulsivity have persisted for at least 6 months to a degree that is maladaptive and inconsistent with developmental level:

Hyperactivity:

(a) often fidgets with hands or feet or squirms in seat

(b) often leaves seat in classroom or in other situations in which remaining seated is expected

(c) often runs about or climbs excessively in situations in which it is inappropriate (in adolescents or adults, may be limited to subjective feelings of restlessness)

(d) often has difficulty playing or engaging in leisure activities quietly

(e) is often "on the go" or often acts as if "driven by a motor"

(f) often talks excessively

Impulsivity

(a) often blurts out answers before questions have been completed

(b) often has difficulty awaiting turn

(c) often interrupts or intrudes on others (e.g., butts into conversations or games)

B. Some hyperactive-impulsive or inattentive symptoms that caused impairment were present before age 7 years.

C. Some impairment from the symptoms is present in two or more settings (e.g., at school [or work] and at home).

D. There must be clear evidence of clinically significant impairment in social, academic, or occupational functioning.

E. The symptoms do not occur exclusively during the course of a Pervasive Developmental Disorder, Schizophrenia, or other Psychotic Disorder and are not better accounted for by another mental disorder (e.g., Mood Disorder, Anxiety Disorder, Dissociative Disorders, or a Personality Disorder).

Code based on type:

314.01 Attention-Deficit/Hyperactivity Disorder, Combined Type: if both Criteria A1 and A2 are met for the past 6 months

314.00 Attention-Deficit/Hyperactivity Disorder, Predominantly Inattentive Type: if Criterion A1 is met but Criterion A2 is not met for the past 6 months

314.01 Attention-Deficit/Hyperactivity Disorder, Predominantly Hyperactive-Impulsive Type: if Criterion A2 is met but Criterion A1 is not met for the past 6 months

Coding note: For individuals (especially adolescents and adults) who currently have symptoms that no longer meet full criteria, "In Partial Remission" should be specified.

C.2 DEVELOPMENTAL COORDINATION DISORDER (315.4)

A. Performance in daily activities that require motor coordination is substantially below that expected given the person's chronological age and measured intelligence. This may be manifested by marked delays in achieving motor milestones (e.g., walking, crawling, sitting), dropping things, "clumsiness," poor performance in sports, or poor handwriting.

B. The disturbance in Criterion A significantly interferes with academic achievement or activities of daily living.

C. The disturbance is not due to a general medical condition (e.g., cerebral palsy, hemiplegia, or muscular dystrophy) and does not meet criteria for a Pervasive Developmental Disorder.

D. If Mental Retardation is present, the motor difficulties are in excess of those usually associated with it.

Coding note: If a general medical (e.g., neurological) condition or sensory deficit is present, code the condition on Axis III.

BIBLIOGRAPHY

Aiken, L. S., & West, S. G. (1991). Multiple Regression: Testing and Interpreting Interactions. Newbury Park, CA: Sage.

Anastasi, A. (1988). Psychological testing (6 ed.). New York: Macmillan Publishing.

APA. (2000). Diagnostic and Statistical Manual of Mental Disorders; DSM-IV-TR (4th edition, text revision). Washington, DC: American Psychiatric Association.

Ardila, A. (2005). Cultural values underlying psychometric cognitive testing. Neuropsychology Review, 15(4), 185-195.

Asher, S., Singleton, L., & Tinsley, B. (1979). A reliable sociometric measure for preschool children. Developmental Psychology, 15, 443-444.

Bagwell, C. L., Molina, B. S., Pelham, W. E., Jr., & Hoza, B. (2001). Attention-deficit hyperactivity disorder and problems in peer relations: predictions from childhood to adolescence. Journal of the American Academy of Child and Adolescent Psychiatry, 40(11), 1285-1292.

Baron, R. M., & Kenny, D. A. (1988). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic and statistical considerations. Journal of Personality and Social Psychology, 51, 1173-1182.

Beebe, D. W., Ris, M. D., Brown, T. M., & Dietrich, K. N. (2004). Executive functioning and memory for the Rey-Osterreith complex figure task among community adolescents. Applied Neuropsychology, 11(2), 91-98.

Beer, J. S., Mitchell, J. P., & Ochsner, K. N. (2006). Special issue: Multiple perspectives on the psychological and neural bases of social cognition. Brain Res, 1079(1), 1-3.

Bell, B. D., & Roper, B. L. (1998). "Myths of neuropsychology": Another view. Clinical Neuropsychologist, 12(2), 237-244.

Bellanti, C. J., & Bierman, K. L. (2000). Disentangling the impact of low cognitive ability and inattention on social behavior and peer relationships. Conduct Problems Prevention Re search Group. Journal of Clinical Child Psychology, 29(1), 66-75.

Bennett-Levy, J. (1984). Determinants of performance on the Rey-Osterrieth Complex Figure Test: an analysis, and a new technique for single-case assessment. British Journal of Clinical Psychology, 23 (Pt 2), 109-119.

Blachman, D. R., & Hinshaw, S. P. (2002). Patterns of friendship among girls with and without attention-deficit/hyperactivity disorder. Journal of Abnormal Child Psychology, 30(6), 625-640.

Blakemore, S. J., & Choudhury, S. (2006). Development of the adolescent brain: implications for executive function and social cognition. Journal of Child Psychology and Psychiatry, 47(3-4), 296-312.

Bonino, S., & Cattelino, E. (1999). The relationship between cognitive abilities and social abilities in childhood: A research on flexibility in thinking and co-operation with peers. International Journal of Behavioral Development, 23(1), 19-36.

Bradley, R. H., Caldwell, B. M., Rock, S. L., Ramey, C. T., Barnard, K. E., Cray, C., et al. (1989). Home environment and cognitive development in the first three years of life: A collaborative study involving six sites and three ethnic groups in North America. Developmental Psychology, 25, 217-235.

Brooks-Gunn, J., Klebanov, P. K., & Duncan, G. J. (1996). Ethnic Differences in Children's Intelligence Test Scores: Role of Economic Deprivation, Home Environment, and Maternal Characteristics. Child Development, 67(2), 396-408.

Buhrmester, D. (1996). Need fulfillment, interpersonal competence, and the developmental contexts of early adolescent friendship. In W. M. Bukowski & W. W. Hartup (Eds.), The company they keep: Friendship in childhood and adolescence (pp. 158-185). New York: Cambridge University Press.

Bukowski, W. M., & Hoza, B. (1989). Popularity and friendship: issues in theory, measurement, and outcomes. In T. Berndt & G. Ladd (Eds.), Contributions of Peer Relationships to Children's Development (pp. 15-45). New York: Wiley.

Capaldi, D. M., & Patterson, G. R. (1991). Relation of parent transitions to boys' adjustment problems: I. A linear hypothesis. II. Mothers at risk for transitions and unskilled parenting. Developmental Psychology, 27, 489-504.

Carlson, C. L., Lahey, B. B., Frame, C. L., Walker, J., & Hynd, G. W. (1987). Sociometric status of clinic-referred children with attention deficit disorders with and without hyperactivity. Journal of Abnormal Child Psychology, 15(4), 537-547.

Carr, E. K., & Lincoln, N. B. (1988). Inter-rater reliability of the Rey figure copying test. British Journal of Clinical Psychology, 27 (Pt 3), 267-268.

Casey, J. E., Rourke, B. P., & Picard, E. M. (1991). Syndrome of nonverbal learning disabilities: age differences in neuropsychological, academic, and socioemotional functioning. Development and Psychopathology, 3, 329-345.

Clark, M. L., & Ayers, M. (1991). Friendship similarity during early adolescence: Gender and racial patterns. Journal of Psychology, 126, 393-405.

Coie, J. D., Lochman, J. E., Terry, R., & Hyman, C. (1992). Predicting early adolescent disorder from childhood aggression and peer rejection. Journal of Consulting and Clinical Psychology, 60, 783-792.

Conderman, G. (1995). Social status of sixth- and seventh-grade students with learning disabilities. Learning Disabilities Quarterly, 18, 13-24.

Conners, C. (1995). Conners' Continuous Performance Test. San Antonio, Texas: Psychological Corporation.

Conners, C. K., Epstein, J. N., Angold, A., & Klaric, J. (2003). Continuous performance test performance in a normative epidemiological sample. Journal of Abnormal Child Psychology, 31(5), 555-562.

Crick, N. R., & Dodge, K. A. (1996). A review and reformulation of social information processing mechanisms in children's social adjustment. Psychological Bulletin, 115, 74-101.

Csikszentmihalyi, M., & Larson, R. (1984). Being Adolescent. New York: Basic.

Cummins, A., Piek, J. P., & Dyck, M. J. (2005). Motor coordination, empathy, and social behaviour in school-aged children. Developmental and Medical Child Neurology, 47(7), 437-442.

Davidson, R. J. (2002). Anxiety and affective style: role of prefrontal cortex and amygdala. Biological Psychiatry, 51(1), 68-80.

Delis, D. C., Freeland, J., Kramer, J. H., & Kaplan, E. (1988). Integrating clinical assessment with cognitive neuroscience: construct validation of the California Verbal Learning Test. Journal of Consulting and Clinical Psychology, 56(1), 123-130.

Delis, D. C., Kramer, J. H., & Kaplan, E. (1994). California Verbal Learning Test - Children's Version. San Antonio, TX: Psychological Corporation.

Delis, D. C., Kramer, J. H., Kaplan, E., & Ober, B. A. (1987). The California Verbal Learning Test - Research Edition. New York: Psychological Corporation.

Dewey, D., Kaplan, B. J., Crawford, S. G., & Wilson, B. N. (2002). Developmental coordination disorder: associated problems in attention, learning, and psychosocial adjustment. Human Movement Science, 21(5-6), 905-918.

Diamantopoulou, S., Henricsson, L., & Rydell, A.M. (2005). ADHD symptoms and peer relations of children in a community sample: Examining associated problems, self-perceptions, and gender differences. International Journal of Behavioral Development, 29(5), 388-398.

Dickens, W. T., & Flynn, J. R. (2006). Black Americans Reduce the Racial IQ Gap: Evidence From Standardization Samples. Psychological Science, 17(10), 913-920.

Dickens, W. T., & Flynn, J. R. (2006). Common ground and differences. Psychological Science, 17(10), 923-924.

Dietrich, K. N., Berger, O. G., & Succop, P. A. (1993). Lead exposure and the motor developmental status of urban six-year-old children in the Cincinnati Prospective Study. Pediatrics, 91(2), 301-307.

Dietrich, K. N., Berger, O. G., Succop, P. A., Hammond, P. B., & Bornschein, R. L. (1993). The developmental consequences of low to moderate prenatal and postnatal lead exposure: intellectual attainment in the Cincinnati Lead Study Cohort following school entry. Neurotoxicology and Teratology, 15(1), 37-44.

Dietrich, K. N., Krafft, K. M., Bornschein, R. L., Hammond, P. B., Berger, O., Succop, P. A., et al. (1987). Low-level fetal lead exposure effect on neurobehavioral development in early infancy. Pediatrics, 80(5), 721-730.

Dietrich, K. N., Ris, M. D., Succop, P. A., Berger, O. G., & Bornschein, R. L. (2001). Early exposure to lead and juvenile delinquency. Neurotoxicology and Teratology, 23(6), 511-518.

Dietrich, K. N., Succop, P. A., Berger, O. G., Hammond, P. B., & Bornschein, R. L. (1991). Lead exposure and the cognitive development of urban preschool children: the Cincinnati Lead Study cohort at age 4 years. Neurotoxicology and Teratology, 13(2), 203-211.

Dikmen, S. S., Heaton, R. K., Grant, I., & Temkin, N. R. (1999). Test-retest reliability and practice effects of expanded Halstead-Reitan Neuropsychological Test Battery. Journal of the International Neuropsychological Society, 5(4), 346-356.

Dishion, T. J., & Owen, L. D. (2002). A longitudinal analysis of friendships and substance use: bidirectional influence from adolescence to adulthood. Developmental Psychology, 38(4), 480-491.

Dodge, K. A., Bates, J. E., & Pettit, G. S. (1990). Mechanisms in the cycle of violence. Science, 250(4988), 1678-1683.

Dodge, K. A., Lansford, J. E., Burks, V. S., Bates, J. E., Pettit, G. S., Fontaine, R., et al. (2003). Peer rejection and social information-processing factors in the development of aggressive behavior problems in children. Child Development, 74(2), 374-393.

Dodge, K. A., Pettit, G. S., McClaskey, C. L., & Brown, M. M. (1986). Social competence in children. Monographs of the Society for Research in Child Development, 51(2), 1-85.

Dodge, K. A., & Price, J. M. (1994). On the relation between social information processing and socially competent behavior in early school-aged children. Child Development, 65, 1385-1397.

Dodrill, C. B. (1997). Myths of neuropsychology. Clinical Neuropsychologist, 11(1), 1-17.

Dodrill, C. B. (1999). Myths of neuropsychology: Further considerations. Clinical Neuropsychologist, 13(4), 562-572.

Donders, J. (1999). Structural equation analysis of the California Verbal Learning Test - Children's Version in the standardization sample. Developmental Neuropsychology, 15, 395-406.

DuBois, D. L., & Hirsch, B. J. (1990). School and neighborhood friendship patterns of blacks and whites in early adolescence. Child Development, 61(2), 524-536.

Eisenberger, N. I., & Lieberman, M. D. (2004). Why rejection hurts: a common neural alarm system for physical and social pain. Trends in Cognitive Science, 8(7), 294-300.

Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An FMRI study of social exclusion. Science, 302(5643), 290-292.

Elevag, B., & Goldberg, T. E. (2000). Cognitive impairment in schizophrenia is the core of the disorder. Critical Reviews in Neurobiology, 14(1), 1-21.

Ewart, C. K., & Jorgensen, R. S. (2004). Agonistic interpersonal striving: social-cognitive mechanism of cardiovascular risk in youth? Health Psychology, 23(1), 75-85.

Farmer, T. W., Estell, D. B., Bishop, J. L., O'Neal, K. K., & Cairns, B. D. (2003). Rejected bullies or popular leaders? The social relations of aggressive subtypes of rural African American early adolescents. Developmental Psychology, 39(6), 992-1004.

Fordham, S., & Ogbu, J. U. (1986). Black students' school success: Coping with the "burden of 'acting White." The Urban Review, 18(3), 176-206.

Fox, J. (1991). Regression Diagnostics. Thousand Oaks, CA: Sage Publications.

Frazier, T. W., Adams, N. L., Strauss, M. E., & Redline, S. (2001). Comparability of the Rey and Mack forms of the Complex Figure Test. Clinical Neuropsychologist, 15(3), 337-344.

Furman, W., & Buhrmester, D. (1985). Children's perceptions of the qualities of sibling relationships. Child Development, 56, 448-461.

Furman, W., & Buhrmester, D. (1992). Age and sex differences in perceptions of networks of personal relationships. Child Development, 63, 103-115.

Gardner, H. (1983). Frames of mind: The theory of multiple intelligences. New York: Basic Books.

Gest, S. D., Graham-Bermann, S. A., & Hartup, W. W. (2001). Peer experience: Common and unique features of number of friendships, social network centrality, and sociometric status. Social Development, 10(1), 23-40.

Gill, D. M., Reddon, J. R., Stefanyk, W. O., & Hans, H. S. (1986). Finger tapping: effects of trials and sessions. Perceptual and Motor Skills, 62(2), 675-678.

Gottman, J., Gonso, J., & Rasmussen, B. (1975). Social interaction, social competence, and friendship in children. Child Development, 46(3), 709-718.

Greenham, S. L. (1999). Learning disabilities and psychosocial adjustment: a critical review. Child Neuropsychology, 5(3), 171-196.

Hatch, T., & Gardner, H. (1993). Finding cognition in the classroom: an expanded view of human intelligence. In G. Salomon (Ed.), Distributed Cognitions: Psychological and educational considerations. Cambridge: Cambridge University Press.

Hatzichristou, C., & Hopf, D. (1993). Students with learning disabilities: academic and psychosocial aspects of adaptation. School Psychology International, 14, 43-56.

Hay, D. F., Payne, A., & Chadwick, A. (2004). Peer relations in childhood. Journal of Child Psychology and Psychiatry, 45(1), 84-108.

Heath, S. B. (1997). Culture: Contested realm in research on children and youth. Applied Developmental Science, 1, 113-123.

Heath, S. B. (1999). The learner as cultural member. Baltimore, MD: Paul H. Brookes.

Heaton, R. K. (1981). Wisconsin Card Sorting Test Manual. Odessa, Florida: Psychological Assessment Resources.

Heaton, R. K., Chelune, J. G., Talley, L. J., Kay, G. G., & Curtiss, G. (1993). Wisconsin Card Sorting Test Manual, revised and expanded. Odessa, TX: Psychological Assessment Resources.

Heiman, T. (2005). An Examination of Peer Relationships of Children With and Without Attention Deficit Hyperactivity Disorder. School Psychology International, 26(3), 330-339.

Hervey, A. S., Epstein, J. N., Curry, J. F., Tonev, S., Arnold, L., Conners, C., et al. (2006). Reaction time distribution analysis of neuropsychological performance in an ADHD sample. Child Neuropsychology, 12(2), 125-140.

Hodges, E. V., Boivin, M., Vitaro, F., & Bukowski, W. M. (1999). The power of friendship: protection against an escalating cycle of peer victimization. Developmental Psychology, 35(1), 94-101.

Hollingshead, A. B. (1985). Four-Factor Index of Social Status. New Haven, CT: Author.

Holmbeck, G. N. (2002). Post-hoc Probing of Significant Moderational and Mediational Effects in Studies of Pediatric Populations. Journal of Pediatric Psychology, 27(1), 87-96.

Hoza, B., Gerdes, A. C., Mrug, S., Hinshaw, S. P., Bukowski, W. M., Gold, J. A., et al. (2005). Peer-assessed outcomes in the multimodal treatment study of children with attention deficit hyperactivity disorder. Journal of Clinical Child and Adolescent Psychology, 34(1), 74-86.

Hoza, B., Mrug, S., Gerdes, A. C., Hinshaw, S. P., Bukowski, W. M., Gold, J. A., et al. (2005). What aspects of peer relationships are impaired in children with attention-deficit/hyperactivity disorder? Journal of Consulting and Clinical Psychology, 73(3), 411-423.

Humphries, T., Koltun, H., Malone, M., & Roberts, W. (1994). Teacher-identified oral language difficulties among boys with attention problems. Journal of Developmental and Behavioral Pediatrics, 15(2), 92-98.

Hymel, S. (1983). Preschool children's peer relations: Issues in sociometric assessment. Merrill-Palmer Quarterly, 29(3), 237-260.

Hymel, S., Rubin, K. H., Rowden, L., & al., E. (1990). Children's peer relationships: longitudinal prediction of internalizing and externalizing problems from middle childhood. Child Development, 61, 2004-2021.

Kalff, A. C., De Sonneville, L. M., Hurks, P. P., Hendriksen, J. G., Kroes, M., Feron, F. J., et al. (2005). Speed, speed variability, and accuracy of information processing in 5 to 6-year-old children at risk of ADHD. Journal of the International Neuropsychological Society, 11(2), 173-183.

Kanioglou, A., Tsorbatzoudis, H., & Barkoukis, V. (2005). Socialization and behavioral problems of elementary school pupils with developmental coordination disorder. Perceptual and Motor Skills, 101(1), 163-173.

Kavale, K. A., & Forness, S. R. (1996). Social skill deficits and learning disabilities: a meta-analysis. Journal of Learning Disabilities, 29(3), 226-237.

Keenan, P. A., Ricker, J. H., Lindamer, L. A., Jiron, C., & Jacobson, M. W. (1996). Relationship between WAIS--R vocabulary and performance on the California Verbal Learning Test. Clinical Neuropsychologist, 10(4), 455-458.

Klove, H. (1963). Clinical Neuropsychology. Medical Clinics of North America, 47, 1647-1658.

Kramer, J. H., Delis, D. C., Kaplan, E., O'Donnell, L., & Prifitera, A. (1997). Developmental sex differences in verbal learning. Neuropsychology, 11(4), 577-584.

Kwate, N. O. A. (2001). Intelligence or Misorientation? Eurocentrism in the WISC-III. Journal of Black Psychology, 27(2), 221-238.

La Greca, A. M., & Prinstein, M. J. (1999). The Peer group. In W. K. Silverman & T. H. Ollendick (Eds.), Developmental issues in the clinical treatment of children and adolescents (pp. 171-198). Needham Heights, MA: Allyn & Bacon.

Lacourse, E., Nagin, D., Tremblay, R. E., Vitaro, F., & Claes, M. (2003). Developmental trajectories of boys' delinquent group membership and facilitation of violent behaviors during adolescence. Development and Psychopathology, 15(1), 183-197.

Ladd, G. W. (1981). Effectiveness of a social learning method for enhancing children's social interaction and peer acceptance. Child Development, 52(1), 171-178.

Ladd, G. W., Birch, S. H., & Buhs, E. S. (1999). Children's social and scholastic lives in kindergarten: related spheres of influence? Child Development, 70(6), 1373-1400.

Ladd, G. W., & Troop-Gordon, W. (2003). The role of chronic peer difficulties in the development of children's psychological adjustment problems. Child Development, 74(5), 1344-1367.

Lansford, J. E., Criss, M. M., Pettit, G. S., Dodge, K. A., & Bates, J. E. (2003). Friendship quality, peer group affiliation, and peer antisocial behavior as moderators of the link between negative parenting and adolescent externalizing behavior. Journal of Research on Adolescence, 13(2), 161-184.

Lezak, M. D., Howieson, D. B., Loring, D. W., Hannay, H., & Fischer, J. S. (2004). Neuropsychological assessment (4th ed.). London: Oxford University Press.

Loveland, K. A., Fletcher, J. M., & Bailey, V. (1990). Verbal and nonverbal communication of events in learning-disability subtypes. Journal of Clinical and Experimental Neuropsychology, 12(4), 433-447.

Masten, A. S., Morison, P., & Pellegrini, D. S. (1985). A revised class play method of peer assessment. Developmental Psychology, 21(3), 523-533.

Matthys, W., Cuperus, J. M., & Van Engeland, H. (1999). Deficient social problem-solving in boys with ODD/CD, with ADHD, and with both disorders. Journal of the American Academy of Child and Adolescent Psychiatry, 38(3), 311-321.

Miller-Johnson, S., Costanzo, P. R., Coie, J. D., Rose, M. R., Browne, D. C., & Johnson, C. (2003). Peer Social Structure and Risk-Taking behaviors Among African American Early Adolescents. Journal of Youth and Adolescence, 32(5), 375-384.

Millis, S. R. (1995). Factor structure of the California Verbal Learning Test in moderate and severe closed-head injury. Perceptual and Motor Skills, 80(1), 219-224.

Mitrushina, M., Boone, K. B., Razani, J., & D'Elia, L. F. (2005). Handbook of Normative Data for Neuropsychological Assessment (2 ed.): Oxford University Press.

Monks, C. P., Smith, P. K., & Swettenham, J. (2003). Aggressors, Victims, and Defenders in Preschool: Peer, Self-, and Teacher Reports. Merrill-Palmer Quarterly, 49(4), 453-469.

Morison, P., & Masten, A. S. (1991). Peer reputation in middle childhood as a predictor of adaptation in adolescence: a seven-year follow-up. Child Development, 62(5), 991-1007.

Mostow, A. J., Izard, C. E., Fine, S., & Trentacosta, C. J. (2002). Modeling emotional, cognitive, and behavioral predictors of peer acceptance. Child Development, 73(6), 1775-1787.

Myklebust, H. R. (1975). Progress in Learning Disabilities (Vol. 1). New York: Grune & Stratton.

Nabuzoka, D., & Smith, P. K. (1993). Sociometric status and social behaviour of children with and without learning difficulties. Journal of Child Psychology and Psychiatry, 34(8), 1435-1448.

Naglieri, J. A., & Das, J. P. (1997). Cognitive Assessment System. Itasaca, IL: Riverside Publishing Company.

Naglieri, J. A., & Rojahn, J. (2001). Evaluation of African-American and White Children in Special Education Programs for Children with Mental Retardation Using the WISC-III and Cognitive Assessment System (CAS). American Journal of Mental Retardation, 106, 359-367.

Newcomb, A. F., Bukowski, W. M., & Pattee, L. (1993). Children's peer relations: a meta-analytic review of popular, rejected, neglected, controversial, and average sociometric status. Psychological Bulletin, 113(1), 99-128.

Nixon, E. (2001). The social competence of children with Attention Deficit Hyperactivity Disorder: A review of the literature. Child and Adolescent Mental Health, 6(4), 172-180.

Nuechterlein, K. H., Barch, D. M., Gold, J. M., Goldberg, T. E., Green, M. F., & Heaton, R. K. (2004). Identification of separable cognitive factors in schizophrenia. Schizophrenia Research, 72(1), 29-39.

O'Brien, S. F., & Bierman, K. L. (1988). Conceptions and perceived influence of peer groups: Interviews with preadolescents and adolescents. Child Development, 59(5), 1360-1365.

Ochoa, S. H., Olivarez, A., Jr. (1995). A meta-analysis of peer rating sociometric studies of pupils with learning disabilities. Journal of Special Education, 29, 1-19.

Ochoa, S. H., & Palmer, D. J. (1991). Sociometric analysis of between-group differences and within-group status variability of Hispanic learning disabled and non-handicapped pupils in academic and play contexts. Learning Disabilities Quarterly, 14, 208-218.

Ochsner, K. N., & Gross, J. J. (2005). The cognitive control of emotion. Trends in Cognitive Science, 9(5), 242-249.

Ollendick, T. H., Greene, R. W., Weist, M. D., & Oswald, D. P. (1990). The predictive validity of teacher nominations: a five-year follow-up of at-risk youth. Journal of Abnormal Child Psychology, 18(6), 699-713.

Olson, S. L., & Lifgren, K. (1988). Concurrent and longitudinal correlates of preschool peer sociometrics: Comparing rating scale and nomination measures. Journal of Applied Developmental Psychology, 9(4), 409-420.

Orr, A. J. (2003). Black-White Differences in Achievement: The Importance of Wealth. Sociology of Education, 76, 281-304.

Ozols, E. J., & Rourke, B. P. (1985). Dimensions of social sensitivity in two types of learning-disabled children. In B. P. Rourke (Ed.), Neuropsychology of learning disabilities. New York: Guilford.

Parker, J. G., & Asher, S. R. (1987). Peer relations and later personal adjustment: are low-accepted children at risk? Psychological Bulletin, 102(3), 357-389.

Peterson-Lewis, S., & Bratton, L. M. (2004). Perceptions of "Acting Black" Among African American Teens: Implications of Racial Dramaturgy for Academic and Social Achievement. Urban Review, 36(2), 81-100.

Petti, V. L., Voelker, S. L., Shore, D. L., & Hayman-Abello, S. E. (2003). Perception of nonverbal emotion cues by children with nonverbal learning disabilities. Journal of Developmental and Physical Disabilities, 15(1), 23-36.

Quraishi, S., & Frangou, S. (2002). Neuropsychology of bipolar disorder: a review. Journal of Affective Disorders, 72(3), 209-226.

Rabiner, D. L., Coie, J. D., Miller-Johnson, S., Boykin, A. S., & Lochman, J. D. (2005). Predicting the persistence of aggressive offending of African American males from adolescence into young adulthood: the importance of peer relations, aggressive behavior, and ADHD symptoms. Journal of Emotional and Behavioral Disorders, 13 (3), 131-140.

Rapport, L. J., Charter, R. A., Dutra, R. L., Farchione, T. J., & et al. (1997). Psychometric properties of the Rey-Osterrieth complex figure: Lezak-Osterrieth versus Denman scoring systems. Clinical Neuropsychologist, 11(1), 46-53.

Reitan, R. M., & Wolfson, D. (1992). Conventional intelligence measurements and neuropsychological concepts of adaptive abilities. Journal of Clinical Psychology, 48(4), 521-529.

Reiter-Purtill, J., & Noll, R. B. (2003). Peer Relationships of Children with Chronic Illness. In M. C. Roberts (Ed.), Handbook of pediatric psychology (3 ed., pp. 176-197). New York, NY: Guilford Press.

Rey, A., & Osterrieth, P. A. (1944). Translations of excerpts from Andre Rey's Psychological examination of traumatic encephalopathy and P. A. Osterrieth"s The Complex Figure Copy Test. Clinical Neuropsychologist, 7(1), 4-21.

Ris, M. D., Dietrich, K. N., Succop, P. A., Berger, O. G., & Bornschein, R. L. (2004). Early exposure to lead and neuropsychological outcome in adolescence. Journal of the International Neuropsychological Society, 10(2), 261-270.

Risi, S., Gerhardstein, R., & Kistner, J. (2003). Children's classroom peer relationships and subsequent educational outcomes. Journal of Clinical Child and Adolescent Psychology, 32(3), 351-361.

Rodkin, P. C., Farmer, T. W., Pearl, R., & Van Acker, R. (2000). Heterogeneity of popular boys: antisocial and prosocial configurations. Developmental Psychology, 36(1), 14-24.

Rourke, B. P. (1985). Neuropsychology of learning disabilities: essentials of subtype analysis. New York: Guilford Press.

Rourke, B. P., & Fuerst, D. R. (1991). Learning disabilities and psychosocial functioning: a neuropsychological perspective. New York: Guilford Press.

Rourke, B. P., Young, G. C., & Leenaars, A. A. (1989). A childhood learning disability that predisposes those afflicted to adolescent and adult depression and suicide risk. Journal of Learning Disabilities, 22(3), 169-175.

Rubin, K. H., Hymel, S., & Mills, R. S. (1989). Sociability and social withdrawal in childhood: stability and outcomes. Journal of Personality, 57(2), 237-255.

Rushton, J. P., & Jensen, A. R. (2006). The Totality of Available Evidence Shows the Race IQ Gap Still Remains. Psychological Science, 17(10), 921-922.

Russell, E. W. (2001). Toward an explanation of Dodrill's observation: high neuropsychological test performance does not accompany high IQs. Clinical Neuropsychologist, 15(3), 423-428.

Rydell, A. M. (1993). New morbidity-problems and peer relations in a sample of Swedish primary school children: a follow-up from the first to the third grade. Scandinavian Journal of Psychology, 34(3), 212-222.

Sattler, J. M. (2001). Assessment of children: Cognitive applications (4 ed.). San Diego, CA: Jerome M. Sattler.

Schear, J. M., & Craft, R. (1989). Examination of the concurrent validity of the California Verbal Learning Test. Clinical Neuropsychologist, 3(2), 162-168.

Seidel, W. T., & Joschko, M. (1990). Evidence of difficulties in sustained attention in children with ADHD. Journal of Abnormal Child Psychology, 18, 217-229.

Shenal, B. V., Harrison, D. W., & Demaree, H. A. (2003). The neuropsychology of depression: a literature review and preliminary model. Neuropsychological Review, 13(1), 33-42.

Skinner, R. A., & Piek, J. P. (2001). Psychosocial implications of poor motor coordination in children and adolescents. Human Movement Science, 20(1-2), 73-94.

Smyth, M. M., & Anderson, H. I. (2000). Coping with clumsiness in the school playground: Social and physical play in children with coordination impairments. British Journal of Developmental Psychology, 18(3), 389-413.

Spinrad, T. L., Eisenberg, N., Harris, E., Hanish, L., Fabes, R. A., Kupanoff, K., et al. (2004). The relation of children's everyday nonsocial peer play behavior to their emotionality, regulation, and social functioning. Developmental Psychology, 40(1), 67-80.

Spreen, O., & Strauss, E. (1998). A compendium of Neuropsychological Tests (2 ed.). New York: Oxford University Press.

Sterry, T. W. (2004). Temperament as a predictor of children's social behavior and peer acceptance. Unpublished doctoral dissertation, University of Cincinnati, Cincinnati, OH.

Strang, J. D., & Rourke, B. P. (1983). Concept-formation/non-verbal reasoning abilities of children who exhibit specific academic problems with arithmetic. Journal of Clinical Child Psychology, 12, 33-39.

Sullivan, T. N., Farrell, A. D., & Kliewer, W. (2006). Peer victimization in early adolescence: Association between physical and relational victimization and drug use, aggression, and delinquent behaviors among urban middle school students. Development and Psychopathology, 18, 119-137.

Tremont, G., Hoffman, R. G., Scott, J. G., & Adams, R. L. (1998). Effect of intellectual level on neuropsychological test performance: A response to Dodrill (1997). Clinical Neuropsychologist, 12(4), 560-567.

Van der Oord, S., Van der Meulen, E. M., Prins, P. J., Oosterlaan, J., Buitelaar, J. K., & Emmelkamp, P. M. (2005). A psychometric evaluation of the social skills rating system in children with attention deficit hyperactivity disorder. Behavioral Research and Therapy, 43(6), 733-746.

Waber, D., & Holmes, J. (1986). Assessing children's memory productions of the Rey-Osterrieth complex figure. Journal of Clinical and Experimental Neuropsychology, 8, 563-580.

Wall, A. E., Reid, G., & Paton, J. (1990). The syndrome of physical awkwardness. In G. Reid (Ed.), Problems in Movement Control (pp. 283 - 316). New York: Elsevier Science Pub. Co.

Way, N., & Chen, L. (2000). Close and general friendships among African American, Latino, and Asian American Adolescents from low-income families. Journal of Adolescent Research, 15(2), 274-301.

Wechsler, D. (1991). Wechsler Intelligence Scale for Children-III. San Antonio, Texas: Psychological Corporation.

Wentzel, K. R., & Caldwell, K. (1997). Friendships, peer acceptance, and group membership: Relations to academic achievement in middle school. Child Development, 68(6), 1198-1209.

Whishaw, I. Q., & Kolb, B. (2003). Fundamentals of Human Neuropsychology (5 ed.). New York: Freeman-Worth.

White, J. L., Moffitt, T. E., & Silva, P. A. (1992). Neuropsychological and socio-emotional correlates of specific-arithmetic disability. Archives of Clinical Neuropsychology, 7(1), 1-16.

Whittle, S., Allen, N. B., Lubman, D. I., & Yucel, M. (2006). The neurobiological basis of temperament: towards a better understanding of psychopathology. Neuroscience and Biobehavioral Reviews, 30(4), 511-525.

Wiener, J., & Harris, P. (1993). Social relations in subgroups of children with learning disabilities. Enfance, 47(3), 295-316.

Wiener, J., Harris, P. J., & Shirer, C. (1990). Achievement and social-behavioral correlates of peer status in LD children. Learning Disability Quarterly, 13, 114-127.

Wilkinson, G. (1993). Wide Range Achievement Test-3.Wilmington, Delaware: Wide Range Inc.

Wong, T. M., Strickland, T. L., Fletcher-Janzen, E., Ardila, A., & Reynolds, C. R. (2002). Theoretical and practical issues in the neuropsychological assessment of culturally dissimilar patients. In E. Fletcher-Janzen, T. L. Strickland & C. R. Reynolds (Eds.), The handbook of cross-cultural neuropsychology (pp. 3-18). New York: Plenum.

Woodward, L. J., & Fergusson, D. M. (2000). Childhood peer relationship problems and later risks of educational under-achievement and unemployment. Journal of Child Psychology and Psychiatry, 41(2), 191-201.

Xie, H., Farmer, T. W., & Cairns, B. D. (2003). Different forms of aggression among inner-city African-American children: gender, configurations, and school social networks. Journal of School Psychology, 41, 335-375.

Zeller, M., Vannatta, K., Schafer, J., & Noll, R. B. (2003). Behavioral Reputation: A Cross-Age Perspective. *Developmental Psychology, 39*(1), 129-139.