Neuropsychological Functioning in Subgroups of Children With and Without Social Perception Deficits and/or Hyperactivity–Impulsivity

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Objective: The purpose of this study is to ascertain whether there are differences among groups of children based on their social perception skills in visual perception and fluid reasoning to assist in more effective intervention planning. Method: A total of 80 children were grouped on the basis of their performance on a social perception measure (Child and Adolescent Social Perception) and the presence or absence of hyperactive–impulsive behaviors. They were administered a battery of tests to determine whether the groups differed in their visual perceptual skills and fluid reasoning abilities. Results: The groups with poor social perception significantly differed from groups with intact social perception on the Rey-O and Fluid Reasoning but not on the Judgment of Line Orientation or the Developmental Test of Visual Motor Integration. Conclusion: A subgroup of children with ADHD demonstrates poor social perception skills and accompanying deficits in complex visual perception and fluid reasoning. (J. of Att. Dis. XXXX; XX(X) xx-xx)

Keywords: social perception; attention; attention deficit disorder; social skills

Children’s social competence has been an area of considerable concern for parents and educators. Of particular concern is the social competence in children with learning and/or attention difficulties. Some studies have found only modest gains after social skills interventions (Bullis, Walker, & Sprague, 2001; Cartledge, 2005; Gresham, Sugai, & Horner, 2001), whereas others have found poor gains (Kavale & Forness, 1996). One difficulty is likely methodological in nature with little differentiation among causes of social competence deficits, measurement errors, and implementation of the targeted intervention (Gresham, Cook, & Crews, 2004). Similarly, Maheady and Maitland (1982) defined social perception as “the ability to immediately identify, recognize, and interpret the meaning and significance of the behavior of others” (p. 363). They suggested that research should take into account where in the process a breakdown in social perception occurred and whether deficits were in perception or performance of social skills.

There are many possible explanations for the inefficacy of social skills programs. Several researchers in the area of social skills (Dodge, 1986; Gresham & Reschly, 1987) have indicated children’s social skill deficits may result from difficulties at different levels in the understanding of social situations and the enactment of social skills. For example, although some children may have difficulty correctly interpreting a given social situation, other children may interpret a situation accurately but have difficulty performing the necessary social behavior. Given the varied difficulties children with social competence deficits may have, it seems reasonable that targeted (rather than general) interventions would be necessary to encourage social competence growth.

Models of Social Competence

A comprehensive model of social competence has been outlined by Dodge (1986). His multifaceted social
information processing model of social competence posits that children come to a social situation with a biological predisposition for responses, memories based on past experiences, and the environmental input of social cues. The information-processing model is composed of five steps. The first is the encoding process in which the child senses, perceives, and selectively attends to stimuli. The representation process is the second step. This step is a reiterative process with the first step and includes integration of social cues with the individual’s memories, application of decision rules, and interpretation of the social cue. In the third step, the individual generates possible responses and applies response rules. The fourth step is the decision-making process in which the individual evaluates possible consequences of solutions and selects a response. The final step involves enactment of the individual’s chosen response and includes utilizing protocols and scripts of behavior, monitoring of the enactment, and self-regulation. All of these steps result in the observed behavioral response. Dodge’s theory allows for those working with children to more specifically determine where a breakdown in social competence may occur. His acknowledgment of biological and experiential variables is also important, as it emphasizes that each child will come to identical social situations with a unique set of predispositions and experiences.

Voeller (1994) described subtypes of children with social competence deficits. In her review of techniques for measuring social competence in children, she included hypothesized subtypes of social impairment, emphasizing that an understanding of these subtypes will help relate social competence deficits to current explanations in the fields of learning disabilities (LDs) and psychiatry. Voeller described the first type of children with social difficulties as being too aggressive, hostile, and nasty (Type 1). She described these children as manipulative and as taking advantage of others. Type 1 children correspond to conduct disorder or oppositional defiant disorder, without co-occurring ADHD.

Type 2 children were described as lacking the ability to read social cues, resulting in an inability to perceive the feelings of others. Voeller (1994) described Type 2 children as withdrawn, passive, and lacking in aggression. According to Voeller, Type 2 children often correspond to a diagnosis of the Diagnostic and Statistical Manual of Mental Disorders (DSM; American Psychiatric Association, 1994) of pervasive developmental disorder, not otherwise specified. Voeller also noted that some Type 2 children may be diagnosed with anxiety, depression, obsessive–compulsive disorder, schizotypal or schizoid disorder, nonverbal LD (NLD), or socioemotional LD. Voeller described these Type 2 children as having their most striking deficit in the area of socioemotional processing. However, she also described them as frequently having LD patterns including deficits in visuospatial skills, attention, and arithmetic. Voeller emphasized her belief that these skills are dissociable and that it is possible for children to have Type 2 social deficits even though they exhibit intact math and/or visuospatial skills.

A third type of children with social competence deficits was described as aware of the feelings of others but unable to regulate their own behaviors. These children were described as having relatively intact social cognition but as failing to use this information effectively. Voeller (1994) described Type 3 children as children with deficits in executive function. She noted that these children overlap to some extent with the attention deficit hyperactivity group. Voeller described these children as “typically noisy, unintentionally disruptive, and disorganized, which in itself contributes to impaired relationships with peers” (p. 544).

**Social Competence and Learning or Behavioral Disabilities**

To date, most research studies on social skills deficits in children with LDs or behavioral difficulties have utilized heterogeneous groups of children with LDs or ADHD and examined parent and/or teacher ratings of the children’s social competence. Most studies have found that, as a group, children with LDs do have significantly poorer social competence than do normally achieving children (Kavale & Forness, 1996). However, recent literature focusing on subtypes of LDs has suggested that children with right hemisphere–based LDs (e.g., math LDs) are at greater risk for socioemotional difficulties (Rourke, 1988; Semrud-Clikeman & Hynd, 1990).

Denckla (1983) conducted a study to determine the neuropsychology of what she labeled “social–emotional learning disabilities.” She defined social–emotional LDs as consisting of a triad of deficits in the areas of arithmetic, visual–spatial construction, and social skills. Denckla emphasized that we must use what we know about the adult brain to guide us in attempting to more accurately describe how this disorder may present in children.

Goldberg and Costa’s (1981) model of the neurolanatomical organization of the cerebral hemispheres can be utilized as a starting point in exploring the function of the brain in the developing child. Their model suggests that the “right hemisphere plays a critical role in initial stages of acquisition, whereas the left hemisphere is superior at utilizing well-routinized codes” (p. 144).
Thus, under Goldberg and Costa’s model, novel information processing occurs in the right hemisphere and switches to the left hemisphere with increased competence. In accordance with this theory, damage to the right hemisphere in children may produce more varied deficits, depending on which skills may already have shifted to the left hemisphere. With developmental disabilities, one might hypothesize that children with right hemisphere damage may have more difficulties with novel tasks in general.

Rourke et al. (2002) have continued to investigate the white matter hypothesis in NLDs. Current studies have indicated that some disorders (traumatic brain injury, hydrocephalus, neurofibromatosis) have white matter disruptions. In this disorder, the disturbances of the long myelinated fibers in the right hemisphere appear to be more pronounced and to accompany NLDs. In other disorders without NLDs, the white matter disruption was not found to be as pronounced.

Based on several studies, Rourke concluded that although some children with LDs suffer from socioemotional disturbance, most do not; that there is not a single, unitary pattern of social incompetence displayed by children with LDs; and that the NLD pattern of LDs results in socioemotional disturbance characterized by internalizing psychopathology, which tends to worsen over time. Casey, Rourke, and Picard (1991) emphasized that children with NLD have socioemotional disturbances that are the direct result of their primary deficits (e.g., in visual perception and learning novel material). Specifically, children with NLD were reported to have significant deficits in social perception, social judgment, and social interaction skills, resulting in a tendency toward developing internalizing disorders. Although Rourke and his colleagues consistently include socioemotional deficits as part of NLD, they have defined the diagnosis of NLD purely on the basis of discrepancies between and within cognitive and achievement measures, relying on parent report to determine whether there are co-occurring difficulties with social competence. As a result of this emphasis on cognitive and achievement discrepancies for diagnosis of NLD, there has been confusion as to whether socioemotional disturbance is a necessary component of NLD, as conceptualized by Rourke.

Semrud-Clikeman and Hynd (1990) exhaustively reviewed the literature on right hemispheric dysfunction and its relation to socioemotional development and its contribution to specific LDs. They reviewed a number of disorders with varying names (e.g., left hemisindrome, nonverbal perceptual-organization-output disabled, and developmental Gerstmann’s syndrome) and determined the similarities were greater than the differences. Each of the syndromes included deficits in visual–spatial skills and social skills. Although the disorders reviewed were quite similar, the variability in diagnostic criteria and the varied names of the disorders further indicate that the fields of psychology and psychiatry have not clearly defined a pattern of deficits many clinicians and researchers have observed. Until broadly accepted diagnostic criteria are determined for disorders now most commonly labeled NLDs, the generalizability of research in this area will be questionable.

Within the past decade, a great deal of research evaluating brain functioning in social cognition has been conducted. Although this research is not specific to NLD and social competence disorders, it does inform about possible mechanisms underlying social understanding. The following section briefly discusses neurocognitive aspects of social cognition.

**Neuroscience and Social Cognition**

Social neuroscience studies the foundations of our neural networks for understanding social interactions. The development of functional magnetic resonance imaging has allowed for real-time analysis of cognitions particularly involved in the understanding of self and others and for the perception and recognition of social cues (Todorov, Harris, & Fiske, 2006). It has been found that specific structures are related to facial interpretation (Anderson, Christoff, Panitz, De Rosa, & Gabrieli, 2003; Pessoa, McKenna, Gutierrez, & Ungerleider, 2002), emotional expression (Kilts, Egan, Gideon, Ely, & Hoffman, 2003), and perspective taking ( Tomasello, Carpenter, Call, Behne, & Moll, 2005). Studies have found right hemispheric activation on tasks that involve understanding of goal-directed actions and an understanding of movement in context. These skills are important in deciphering nonverbal communications—a skill often difficult for children with NLD or autistic spectrum disorders. Studies have found that when there is a mismatch between an action and a target (a light is flashed on a screen and the child looks in the other direction) typically developing children ages 7 to 10 show activation in the posterior right temporal regions. For children with autism, this activation is not present (Morris, Pelphrey, & McCarthy, 2005).

Another area that may be of interest is the prefrontal cortex, particularly in the areas of emotional perspective taking and empathy. The ventral medial prefrontal cortex has been implicated in these skills in normal adults (Gallagher & Frith, 2003). These areas have not been directly evaluated in children with social competence.
disorders. Some studies are now developing paradigms to evaluate reasoning about mental state and human social cognition. Constructs such as joint attention, in which each participant attends to similar environmental aspects, are studied using neuroimaging. Areas of the dorsal prefrontal cortex appear to be prime candidates for this study and have been implicated in studies evaluating a person’s ability to monitor another person’s actions as well as his or her own (Jackson, Brunet, Meltzoff, & Decety, in press; Mitchell, Neil Macrae, & Banaji, 2005). This is an important area of research that is developing, and the ability to integrate these findings with clinical experiences will be important in the future (Ochsner, 2004).

ADHD and Social Competence

Children with ADHD are at significant risk for difficulty in socialization, with estimates of between 50% and 75% having problems relating to others (Guevermont & Dumas, 1994; Sheridan, Dee, Morgan, McCormick, & Walker, 1996). Social problems have been linked to poor outcome in adulthood, particularly for children with ADHD, and include increased risk for substance abuse, family conflict, school problems, and vocational disadvantage (Erhardt & Hinshaw, 1994; Greene, Biederman, Faraone, Sienna, & Garcia-Jetton, 1997). Although these difficulties are acknowledged in the field, direct research in this area is sparse.

Children with ADHD have been found to engage in behaviors that are found by others to be irritating and frustrating, which results in a higher proportion of negative social interchanges than for children without ADHD experience (Pelham & Bender, 1982). These behaviors change the social and emotional experience of the child with ADHD and lead to an experience that may, in turn, change expectations of the next social and emotional encounter. In many cases, the child with ADHD does not intend to annoy or bother others, and frequently he or she does not understand why others react the way they do.

Many researchers in the field have hypothesized that children with ADHD likely have performance rather than acquisition deficits (Barkely, 2006; Dodge, 1986; Sprouse, Hall, Webster, & Bolen, 1998; Voeller, 1994). Frederick and Olmi (1994) reviewed the literature on social skills deficits in children with ADHD. They concluded that children with ADHD have difficulties with impulsivity, hyperactivity, disruptive behavior, and appropriate levels of attention, which lead to the display of poor social skills and the ensuing impaired interactions with and rejection by peers. Frederick and Olmi encouraged future researchers to utilize more direct measures of children’s social functioning rather than relying on parent and teacher ratings. Hall, Peterson, Webster, Bolen, and Brown (1999) compared children with ADHD only, children with ADHD with LD, and non-diagnosed children on a social perception rating scale (completed by a teacher) and on a social perception task (completed by the children). The children with ADHD and ADHD-LD completed the social perception task both on and off medication. Similar to Sprouse et al. (1998), they found that children with ADHD-LD were rated by their teachers as having poorer social perception than the non-diagnosed group. However, children with ADHD only were not rated by their teachers as having significantly poorer social perception. Furthermore, the ADHD-only group did not demonstrate poorer performance on the social perception task either on or off medication.

This study examines social competence deficits in children not based on their specific LD diagnosis but based on their primary social competence difficulty. Three subtypes of children with social competence deficits were examined, based on Voeller’s (1994) typology and supplemented by Dodge’s social information processing theory. This study defines children with social perception difficulties based on their performance on a direct measure of social perception rather than relying on teacher and parent reports. Children with impulsivity and hyperactivity are categorized based on parent and teacher reports of behavior because it is the display of specific behaviors that defines this group.

Method

Participants

Participants for this study were solicited in several ways. First, school psychologists and diagnosticians from a large urban school district received training about common characteristics of students with social competence weaknesses and were asked to request parental permission of affected students to identify students for the study. A second method of obtaining participants for this study involved asking teachers and/or school administrators to nominate participants to be in the study, including normally achieving students and students who were exhibiting social competence difficulties. The third method of obtaining participants for this study involved referrals from the community.

Students who had parental consent and student assent for the project completed a standard battery of measures. The battery of tests was individually administered by a trained doctoral student, supervised by a licensed psychologist on faculty (M.S.C.), and took approximately...
4 hours. Breaks were given as needed. If achievement and/or intelligence testing had been completed within the previous year, those scores were utilized and achievement and/or intelligence testing were not repeated. The measures included in the standard batteries are outlined below.

All children for this study had verbal and/or nonverbal intelligence in at least the low-average range as measured by a standard score greater than or equal to 80 on one or both of the subtests of the Kaufman Brief Intelligence Test (K-BIT; Kaufman & Kaufman, 1990) or the subtests from the Wechsler Intelligence Scale for Children–Third Edition (WISC-III; Psychological Corporation, 1991). Alternatively, a student was included if he or she had received a standard score of at least 80 for verbal or nonverbal abilities on another individually administered test of cognitive abilities within the previous 3 years. Because a majority of the measures are available solely in English, only predominantly English-speaking students were included in this study. In addition, to be included in this study, the child must have had no acquired neurological deficit (e.g., traumatic brain injury), no specific neurological pathology such as a seizure disorder or brain tumor, and no symptoms of a thought disorder (e.g., psychosis).

The four groups were defined as follows:

**Group 1:** This group of children was a control group (n = 21). Children met criteria for Group 4 if (a) they did not have a history of special education referrals, (b) their Emotion and Social Cues scores on the Child and Adolescent Social Perception (CASP) were within 1.25 standard deviations of the mean for their age, (c) they did not meet diagnostic criteria for ADHD on the Structured Interview for the Diagnosis of Affective Disorders in Children (SIDAC), and (d) they had never been prescribed medication to address behavioral or emotional difficulties. This group will be referred to as typically developing controls (TYPs).

**Group 2:** This group of children was defined as exhibiting significant deficits of social perception and intact social perception (LSP) group. Primary clinical diagnoses of children in this group included NLDs, ADHD, primarily inattentive type, and Asperger’s disorder.

**Group 3:** This group of children was defined as exhibiting significant deficits in social perception and significant symptoms of hyperactivity–impulsivity (ISP+H). Primary clinical diagnosis of children in this group was ADHD combined type or hyperactive–impulsive type.

**Group 4:** This group of children was defined by social perception deficits that could not be accounted for by hyperactivity (n = 20). Children met criteria for classification in Group 1 if (a) either their Emotion or Social Cues scores on the CASP (Magill-Evans, Koning, Cameron-Sadava, & Manyk, 1996) were greater than or equal to 1.5 standard deviations below the mean score for their age and (b) they were not rated as hyperactive and/or impulsive on the SIDAC, as defined by five or fewer endorsed hyperactivity–impulsive symptoms. They were not disqualified for other learning or behavioral problems. This group is referred to as the low social perception (LSP) group. Primary clinical diagnoses of children in this group included NLDs, ADHD, primarily inattentive type, and Asperger’s disorder.

For the sample, ethnicity was relatively evenly distributed across groups (see Table 1). All students were primarily English speaking. The groups did not differ on age. Although gender was relatively even across the experimental groups, there were significantly more females in the control group. Students taking medication to address attention difficulties and/or hyperactivity–impulsivity were evaluated off medications.
Table 1

Demographic Variables by Group

<table>
<thead>
<tr>
<th></th>
<th>TYP</th>
<th>ISP+H</th>
<th>LSP+H</th>
<th>LSP−H</th>
</tr>
</thead>
<tbody>
<tr>
<td>Caucasian</td>
<td>18</td>
<td>18</td>
<td>12</td>
<td>17</td>
</tr>
<tr>
<td>Hispanic</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>African American</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Asian</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Male</td>
<td>10</td>
<td>19</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Female</td>
<td>11</td>
<td>2</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

Note: TYP = typically developing controls; ISP+H = intact social perception with hyperactivity–impulsivity; LSP+H = low social perception with hyperactivity–impulsivity; LSP−H = low social perception without hyperactivity–impulsivity.

Because the TYP group included substantially more females than the experimental groups, an ANOVA to determine whether or not the males and females in the TYP group differed on any of the dependent variables in the study was completed. There were no significant differences on the performance between the males and females in the TYP group on any of the dependent variables (p > .4 for all dependent variables).

Measures

Independent Measures

**CASP (Magill-Evans et al., 1996).** The CASP is a measure presented in videotape format that was utilized to determine a child’s or adolescent’s ability to perceive and interpret nonverbal cues. The video includes 10 short vignettes in which children and adolescents are depicted in situations with emotional content. Although voice intonation is clear, the verbal portion of the video has been filtered such that the words are not decipherable. This aspect ensures the student is utilizing nonverbal cues to interpret the emotional content of the scene rather than relying on the words spoken to infer meaning.

The student is asked to tell what each character was feeling in the story and how he or she could tell the characters were feeling that way. The developers of the CASP specifically wanted a task in which the student was to generate the responses independently rather than choosing from a list of possible answers. In this way, a more naturalistic method of determining how a student perceives social interactions can be obtained. Validity and reliability are acceptable by psychometric standards.

Social Skills Rating Scales (SSRS): Parent Form, Teacher Form, Student Form. The SSRS (Gresham & Elliott, 1990) is a behavioral checklist that has the parent, teacher, and student rate behaviors related to social skills. This standardized measure was developed to determine a student’s social skills by focusing on prosocial behaviors that can be targeted for intervention in the educational setting. The measure includes three domains: social skills, problem behaviors, and academic competence. The standardization sample for the SSRS included 4,000 children from preschool through Grade 12.

**BASC.** The BASC (Reynolds & Kamphaus, 1992) is a behavior checklist with teacher, parent, and self-report forms. The measure includes clinical behaviors and adaptive behaviors. Scores are reported with T-scores, in which scores of 65 or greater are considered significant on the Clinical scales and scores of 35 or less are considered significant on the Adaptive Behavior scales. The standardization sample included 3,065 Teacher Rating scales, 3,065 Parent Rating scales, and 9,861 Self-Reports of Personality. The sample was stratified based on age, gender, race, and geographic region based on 1990 U.S. census data. The BASC was utilized to determine hyperactivity ratings from parents and teachers when information from the SIDAC was not available. In addition, the Social Skills and Social Stress scales are examined to determine parent, teacher, and self-rating correlations with the CASP.

**SIDAC.** The SIDAC is a diagnostic interview based on DSM-IV criteria to determine the presence of affective disorders. A shortened version was administered to the parent or guardian of the student participant by a trained member of the research team to determine the presence of specific co-occurring psychopathology. Data from the interview were used for diagnosis of ADHD.

**K-BIT.** The K-BIT (Kaufman & Kaufman, 1990) includes two subtests to estimate cognitive ability. The Vocabulary subtest includes a picture vocabulary portion and a word knowledge section. The Matrices subtest is a test of nonverbal reasoning ability in which the participant must point to the correct response given several choices. The K-BIT has been found to correlate between .61 and .88 to Wechsler full scale intelligence quotient. The normative sample included 2,022 individuals ages 4 to 90. The sample was stratified according to U.S. census data on gender, region, socioeconomic status, and race/ethnicity. For the current study, either the Vocabulary or the Matrices subtest had to result in a standard score of 80 or greater for inclusion in this study.

**WISC-III.** The WISC-III (Psychological Corporation, 1991) is an individually administered test of cognitive abilities. The WISC-III norms were derived from a standardization sample that was representative of the U.S. population of children stratified for age, gender, race/ethnicity, geographic region, and parent education. The standardization sample included 2,200 children.
from ages 6 to 16 years. The Vocabulary subtest was administered as an estimate of verbal intelligence. The Vocabulary subtest has a test–retest reliability of .89. The Block Design subtest was administered as an estimate of nonverbal intelligence and has a test–retest reliability of .77. Scaled scores are obtained, with a mean of 10 and a standard deviation of 3.

Dependent Measures

Judgment of Line Orientation (JLO). The JLO (Benton, Varney, & Hamsher, 1978) is a measure of visual perception in which the participant is presented with line segments at different angles. The participant must then visually match the line segment to 1 of an array of 11 line segments at varying angles. The participant may not utilize his or her hands; the task must be completed visually with an oral response of numbers 1 through 10. Five training items are first presented, followed by 30 test items. The JLO has been found to be sensitive to right hemisphere lesions in adults (Benton, Hamsher, Varney, & Spreen, 1983). Norms for children ages 7 to 14 were collected by Lindgren and Benton (1980). A total of 221 children were included in the sample. The means and standard deviations at each age interval and for each gender were provided.

Rey-Osterrieth Complex Figure Test (ROCFT). The copy condition of the ROCFT was administered to each participant. This task did not have a time limit and required the participant to look at a model and copy a figure. Order of copying parts of the figure and organization of the figure was tracked by having the child switch colors approximately every 45 to 60 seconds. The copy of the figure was scored utilizing the Taylor scoring criteria. Norms are provided in Spreen and Strauss (1998). The normative sample includes 1,552 healthy schoolchildren between the ages of 9 and 14. Raw scores were converted to z scores based on the means and standard deviations provided in the norms.

Developmental Test of Visual Motor Integration—4th revised edition (VMI). The VMI (Beery, 1997) is a measure of visual motor integration. The test is composed of 24 geometric forms in clearly delineated boxes that the child is required to copy directly below the stimulus. The test is discontinued after three consecutive failures. Each figure is scored as passing or failing based on well-defined criteria provided in the scoring manual. The normative sample included 3,090 children between the ages of 2 years 11 months and 14 years 6 months. Standard scores are obtained utilizing the normative tables provided within the test manual.

Woodcock Johnson Tests of Cognitive Ability–Revised, Analysis Synthesis and Concept Formation subtests. The Analysis Synthesis and Concept Formation tasks (Woodcock & Johnson, 1990) were described as measures of fluid reasoning by Woodcock and Mather (1989). They emphasized that these tasks are novel and do not rely on “previously acquired knowledge or earlier-learned problem-solving procedures” (p. 13). Reliability coefficients were strong (.80 or higher).

Results

This study utilized a direct measure of social perception (CASP). Correlations among the BASC, the SSRS, and the CASP and the p values are listed in Table 2. Results found the parent report (both on the BASC and SSRS) of social skills significantly correlated with the CASP Emotions score (BASC r = .262, p = .019; SSRS r = .338, p = .002). Although the SSRS parent report of social skills significantly correlated with the CASP Nonverbal Cues score (r = .282, p = .012), the Social Skills scale on the BASC did not significantly correlate with the Nonverbal Cues score (r = .127, p = .230). A similar pattern was seen with teacher reports of social skills, though only the SSRS Social Skills scale was significantly correlated with the CASP Emotions score (r = .243, p = .043), whereas the BASC Teacher Social Skills score was not significantly correlated with either the Emotions score (p = .063) or the Nonverbal Cues score (p = .664).

As expected, the child self-reports of social skills on the SSRS and of social stress on the BASC were not significantly related to scores from the CASP Emotions score (p = .271, p = .803, respectively) or the CASP Nonverbal Cues score (p = .657, p = .626, respectively). Means and standard deviations for the performance of the four groups on selection variables, preliminary analyses, and dependent variables are displayed in Table 2. To determine whether or not cognitive abilities accounted for any significant differences among groups, an ANOVA was conducted to determine whether or not the groups varied significantly on intelligence. The groups did not significantly differ on their Composite Intelligence estimate, \( F(3, 76) = 2.179, p = .097 \). The groups also did not differ on their estimate of Verbal Intelligence, which was utilized based on either the participant’s K-BIT or WISC-III Vocabulary score, \( F(3, 76) = 0.958, p = .417 \). The groups did significantly differ on their estimate of nonverbal intelligence (based on the participant’s K-BIT Matrices or WISC-III Block Design score), \( F(3, 76) = 6.319, p = .001 \). However, this difference was not unexpected, given the literature suggesting that children with social perception deficits often demonstrate lower nonverbal cognitive abilities.
Table 2
Means and Standard Deviations for Selection and Dependent Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>TYP</th>
<th>ISP+H</th>
<th>LSP+H</th>
<th>LSP-H</th>
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<tr>
<td></td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
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<tr>
<td>Selection variables and</td>
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<tr>
<td>preliminary analysis</td>
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<tr>
<td>WISC-III estimate or K-BIT</td>
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<tr>
<td>subtest (standard score)</td>
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<tr>
<td>Verbal/vocab</td>
<td>108.4</td>
<td>11.86</td>
<td>107.0</td>
<td>17.66</td>
</tr>
<tr>
<td>Perf/matrices</td>
<td>106.0</td>
<td>12.56</td>
<td>112.3</td>
<td>11.99</td>
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<tr>
<td>Composite</td>
<td>107.5</td>
<td>10.62</td>
<td>111.0</td>
<td>12.91</td>
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<tr>
<td>SIDAC (# symptoms)</td>
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<tr>
<td>Inattention</td>
<td>0.71</td>
<td>0.96</td>
<td>7.57</td>
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</tr>
<tr>
<td>Hyperactivity</td>
<td>0.38</td>
<td>0.74</td>
<td>4.33</td>
<td>1.32</td>
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<tr>
<td>Impulsivity</td>
<td>0.14</td>
<td>0.48</td>
<td>2.71</td>
<td>0.56</td>
</tr>
<tr>
<td>Total</td>
<td>1.19</td>
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<td>1.93</td>
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<tr>
<td>CASP (z scores)</td>
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<tr>
<td>Emotions</td>
<td>0.77</td>
<td>0.98</td>
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<td>0.98</td>
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<tr>
<td>Nonverbal cues</td>
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<td>Visual–perception analyses</td>
<td></td>
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<td></td>
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<tr>
<td>JLO (z score)</td>
<td>0.13</td>
<td>0.74</td>
<td>–0.16</td>
<td>1.38</td>
</tr>
<tr>
<td>VMI (stand score)</td>
<td>101.5</td>
<td>10.6</td>
<td>97.5</td>
<td>17.0</td>
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<tr>
<td>Rey-O (z score)</td>
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<td>0.77</td>
<td>–0.12</td>
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<td>114.1</td>
<td>15.20</td>
<td>108.3</td>
<td>11.68</td>
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</table>

Note: TYP = typically developing controls; ISP+H = intact social perception with hyperactivity–impulsivity; LSP+H = low social perception with hyperactivity–impulsivity; WISC-III = Wechsler Intelligence Scale for Children–Third Edition; K-BIT = Kaufman Brief Intelligence Test; SIDAC = Structured Interview for the Diagnosis of Affective Disorders in Children; CASP = Child and Adolescent Social Perception; JLO = Judgment of Line Orientation; VMI = Developmental Test of Visual Motor Integration.

Visual Perception Analyses

Three measures, including a visual perceptual component, were analyzed for differences across the groups. A Bonferroni adjustment was conducted for the visual perception group of ANOVAs to minimize Type I error probability. With the Bonferroni adjustment, an alpha level of .017 was adopted for visual–perceptual analyses. The most basic measure of visual perception included in this study is the JLO. Although the means are in the expected direction (see Table 2), with lower scores in the groups of participants with impaired social perception, the differences are not statistically significant, \( F(3, 76) = 1.871, p = .142 \).

The second measure including a visual perceptual component is the VMI. The VMI task required each participant to copy a figure in the space directly below it. Thus, the task includes a substantial motor component in conjunction with the visual perception component. Again, the means are in the expected direction, with students in the impaired social perception groups demonstrating lower means than those with intact social perception. However, the groups do not significantly differ in their performance on this measure, \( F(3, 76) = 0.972, p = .410 \).

The final measure utilized to test the hypothesis that visual perceptual skills are more impaired in groups of participants with poor social perception was the ROCFT. This measure requires each participant to copy a complex figure and includes not only visual perceptual skills but also motor skills and planning skills. As predicted by the hypothesis, groups with impaired social perception demonstrated significantly worse performance on the Rey-O compared to groups with intact social perception, \( F(3, 76) = 6.587, p = .001 \). Because the \( p \) value was significant, post hoc comparisons utilizing Fisher’s least significant difference (LSD) were performed, and statistical differences were found between the TYP group and the LSP (\( p < .0001 \)) and LSP+H (\( p = .008 \)) groups. The ISP+H group did not statistically differ from the TYP group (\( p = .597 \)), suggesting that hyperactivity–impulsivity is not a driving factor in poor performance on this task. Thus, the results of this complex measure of visual perception
including planning and organizational skills support the hypothesis that students with poor social perception also demonstrate poorer complex visual perception.

**Fluid Reasoning**

It was hypothesized that on measures of fluid reasoning, groups with impaired social perception and/or hyperactivity–impulsivity would demonstrate poorer performance than the control group. Results from the ANOVA for fluid reasoning were significant, $F(3, 76) = 2.719, p = .05$. Review of the post hoc analyses (utilizing the Fisher LSD method) indicates that the LSP ($p = .041$) and the LSP+H ($p = .010$) groups demonstrated significantly poorer fluid reasoning abilities than did the control group. However, the ISP+H group did not significantly differ from any of the other groups.

**Discussion**

This study utilized a direct complex measure of children’s social perception (the CASP) to define children with social perception deficits. Correlation results between the CASP and the various parent-, teacher-, and self-report measures suggest that a direct measure of social perception provides unique information. Perhaps most striking was the low correlation between self-report measures of social skills with actual social perception skills. Perhaps it should not be surprising that children with poor social perception are not very good judges of their deficits in social skills.

The first hypothesis explored visual perception functioning in each of the groups. Rourke (1995) has hypothesized that visual perception is a primary deficit in children with NLDs and that visual perception deficits contribute to social perception difficulties. The first two measures of visual perception (JLO and VMI) did not demonstrate any significant differences between the groups. However, the means were in the predicted direction, with lower mean scores on both measures in the groups with low social perception. The effect sizes for the JLO and VMI ($\eta^2 = .069$ and .037, respectively) indicated that the differences between the groups were largely accounted for by error variance. The JLO is the most direct measure of visual perception in this study in that it does not contain a motor or planning component. That the groups did not significantly vary on this task suggests that impaired social perception is not necessarily a product of a primary basic visual perception deficit. The groups did significantly differ on the ROCFT. The effect size was medium ($\eta^2 = .206$). Clinically, the ROCFT is often used as a measure of complex visual perception and motor planning skills. As hypothesized, the groups with social perception deficits demonstrated significantly poorer performance on this measure than did the groups with intact social perception. Planning skills deficits are often associated with ADHD, and it was unexpected that hyperactivity and impulsivity alone did not significantly affect performance on this measure. Furthermore, the LSP+H group did not perform more poorly than the LSP group, again reinforcing that hyperactivity–impulsivity alone does not contribute to difficulties with tasks emphasizing visual perception and motor planning. Instead, it appears that factors underlying the required visual perception, planning, and motor output for the ROCFT are also required for social perception. It appears that the complex skills required in performing the ROCFT are also required in tasks of social perception.

As is often true when working with clinical populations, deficits on the narrowest task of visual perception did not significantly differentiate groups, whereas performance on the more complex task did significantly differentiate groups. Although it would have been more elegant to conclude that poor basic visual perception is a direct contributor to poor social perception, it is not surprising that it is the more complex task that includes both visual perception and planning that is significantly lower in groups with poor social perception.

Indeed, the CASP itself is a complex measure of social perception. Previous research (Denckla, 1983; Maheady & Maitland, 1982; Sprouse et al., 1998) has had difficulty identifying significant deficits in clinical groups of children on very basic tasks of social perception (e.g., identification of facial emotion). Unlike adults, children are less likely to exhibit specific brain lesions that affect only one specific subskill. Thus, although emotion perception has been dissociated from visual perception in adults (Bowers, Bauer, & Heilman, 1993), these very specific deficits are most often less apparent in children. Because it is often the integration of multiple skill areas that is difficult for children, evaluation of more complex skills in children should not be avoided.

The second hypothesis regarding fluid reasoning was partially confirmed, with the groups with social perception deficits demonstrating lower fluid reasoning than the ISP groups. However, the effect size was small ($\eta^2 = .09$). Previous research has suggested that students with ADHD also demonstrate executive functioning or fluid reasoning deficits (Aman, Roberts, & Pennington, 1998; Voeller & Heilman, 1988), but in this study the ISP+H group did not significantly differ from the control group. This finding is consistent with more recent research suggesting that executive functioning may not be related to...
the primary symptoms of ADHD (e.g., Jonsdottir, Bouma, Sergeant, & Scherder, 2006).

In general, the findings of this study were consistent with the overall hypothesis that students with social perception impairments are more likely to exhibit deficits on tasks associated with right hemisphere and executive functioning. However, the more simplistic visual perception tasks were not found to be sensitive to the difficulties these students exhibit. Social perception is clearly a complex skill that likely includes the integration of complex visual perceptual skills, planning, and fluid reasoning or executive functioning. Furthermore, students with general social perception deficits are more likely to have associated right hemisphere deficits, such as with math reasoning and math calculation skills.

Perhaps one of the more interesting findings of this study is that there appears to be a group of students with hyperactivity–impulsivity who also exhibit social perception deficits. This finding contradicts many theories that suggest that students with ADHD are able to acquire social skills but simply have difficulty appropriately executing these skills because of their hyperactivity and impulsivity. Instead, this study suggests that although there is an ISP+H group of students, there is also a group of hyperactive–impulsive students who have significant social perception deficits. The group of hyperactive–impulsive students with social perception deficits did not demonstrate more hyperactive or impulsive symptoms than did students with intact social perception, so this finding is not related to the severity of the ADHD. Instead, there appears to be a separate group of students with ADHD who perform more similarly to the group of students with no significant hyperactivity–impulsivity and poor social perception. Thus, it would be misleading to simply classify a student as ADHD without attending to social perception skills.

Because parent reports were utilized to make the diagnosis of hyperactivity–impulsivity, it is possible that a subset of these children are perceived as having hyperactivity–impulsivity that is actually of a different quality than that found in those with ADHD who have intact social perception. However, the fact remains that ADHD is a clinical diagnosis that is made by observation of symptoms associated with hyperactivity–impulsivity. If the student exhibits hyperactive and impulsive behavior that is not better explained by an emotional (e.g., depression or anxiety) or medical (e.g., sleep apnea) condition, then he or she is typically diagnosed with ADHD. To ignore these behavioral differences and not address the behaviors would seem to fail to address a significant problem area for these children.

The finding in this study of a subgroup of students with hyperactivity–impulsivity who also demonstrate poor social perception may explain the varying results in studies examining the social skills of students with ADHD. Although some studies suggest that a majority of students with ADHD have social skills problems, other studies have not found students with ADHD to demonstrate social skills acquisition deficits. Indeed, the findings of this study indicate that both findings are likely true. A substantial portion of the ADHD population likely does have social perception deficits, whereas the remaining students may exhibit general social skills difficulties because of impulsivity–hyperactivity but are able to easily learn appropriate social skills relatively. This finding has important intervention implications. Clinical lore suggests that ADHD involves only performance deficits for social skills. However, this study suggests that a subgroup of ADHD students will likely benefit from more intense programs emphasizing social perception skills. Furthermore, it does not appear possible to identify this subgroup by parent or teacher report of social skills. Instead, a direct measure of social perception such as the CASP would be necessary to appropriately classify these students.

A final exploratory question for this study was to determine the level of correlation between parent and teacher report of social skills versus direct assessment of social perception via the CASP. The CASP includes two scores, one that evaluates the student’s ability to identify emotions in a scene (Emotions score) and one that evaluates the student’s ability to identify the nonverbal cues (Nonverbal Cues score) that led to their identification of the emotion. The identification of the nonverbal cues seems to be a more involved and difficult task that would be harder to rate by behavioral observation. The correlation matrix suggests that parent and teacher ratings on the SSRS and parent ratings of social skills on the BASC do significantly correlate with the CASP Emotions score. However, the correlations with the CASP Nonverbal Cues score are lower.

Although the correlations are significant for the parent and teacher ratings of social skills on the SSRS, neither the parent nor the teacher ratings on the BASC Social Skills scale significantly correlate with the Nonverbal Cues score. Thus, the BASC Social Skills scale seems to be less sensitive to social perception than the SSRS. The significant correlations suggest that there is some overlap between the measures, but less than 10% of the variance on the CASP is explained by any one of the parent or teacher ratings of social skills. Thus, the CASP seems to provide a unique measure of social perception that cannot
be obtained simply by parent or teacher report. This finding suggests that when a child is referred for social competence difficulties, it is important not only to assess parent and teacher behavior ratings of social skills but to also include a direct assessment of social perception.

**Implications for Clinical Practice**

Although children’s social skills are a significant concern for many parents, teachers, and professionals, social skills intervention programs have largely been found ineffective (Kavale & Forness, 1996). Because social competence deficits can arise for a number of reasons, it seems apparent that an effective program would need to address the specific deficit area. For example, students identified as demonstrating significant social perception difficulties would seem to require a different intervention program than do students with social skills performance deficits.

The results of this study indicate that mental health professionals should not assume that all students with ADHD require only instruction and practice in performing social skills they already know. Instead, the results of this study indicate that there is a substantial subgroup of children with ADHD who will also likely benefit from instruction and practice in social perception tasks (e.g., correctly interpreting nonverbal cues). Furthermore, a direct measure of social perception (vs. reliance on parent or teacher report) appears necessary to correctly classify students who demonstrate social perception deficits.

A debate within the clinical community has surrounded the diagnosis of NLDs. There is no clear consensus on which deficit areas define a diagnosis of NLDs. Questions include whether social perception deficits, math skills deficits, or visual–spatial deficits are the defining features of the syndrome. Seemingly arbitrary definitions of the syndrome have been suggested by Rourke and include a split between Verbal and Performance Scales on the WISC-III. However, results of this study suggest that it may be more clinically useful to identify the specific deficit areas (e.g., social perception) rather than attempting to arbitrarily place students into a diagnostic category that results in little understanding of what the diagnosis means. For example, would a student with impaired math skills and visual–spatial skills but intact social perception and social competence skills elicit a diagnosis of NLD? Similarly, would a student with social perception difficulties but intact math and visual–spatial skills warrant a diagnosis of NLD? If both of these groups of children warrant the same diagnosis, how does the diagnosis guide our understanding of treatment?

This study examined group differences and found that students with social perceptual deficits demonstrated statistically poorer performance on related right hemisphere and fluid reasoning/executive functioning tasks. However, the differences between the groups as a whole were often not clinically significant. This suggests that although as a group, students with social perception deficits appear to demonstrate differences, these differences cannot necessarily be reliably observed in individuals within the groups because there is a substantial amount of overlap between the groups. Nonetheless, the findings of this study suggest a number of areas for future research.

**Limitations and Directions for Future Research**

There are several limitations in the current study. A primary limitation is the inclusion of more females in the control group than in the clinical groups. Although most analyses did not change substantially when only the males in the study were examined, the results would be more easily generalized if the groups were equivalent in the numbers of males and females. An area for further research would be to determine whether males and females in each of the clinical groups significantly differ on the dependent variables (visual perception, fluid reasoning, and math skills). This study was able to recruit too few females in the clinical groups to conduct such analyses. Clinically fewer females are generally found in these groups, and although the sample makeup does limit the generalizability to females, it is more representative of clinical samples than an evenly balanced sample would be.

A further limitation of the present study is the relatively limited sample size. With larger samples, it is possible that more subtle differences in means (e.g., on the JLO) among groups would have reached statistical significance. Nonetheless, the sample size of approximately 20 students per group was large enough to detect significant differences on a number of dependent variables.

The current study was conducted to determine whether group differences in related neuropsychological variables would be apparent based on a student’s performance on a particular social perception measure. Many of the hypothesized differences were confirmed. Future research should determine whether there are clinically significant correlates of social perception in individuals. If such differences were found, performance on particular measures could determine more consistent diagnoses. However, examination of the means in the current study indicates that although the groups with social perception deficits demonstrated poorer performance on many measures, their performance as a group remained in the
average range on the dependent variables. Thus, there appears to be great variability within each of the groups. This variability contributed to the relatively small effect sizes found for each of the variables and suggests that it is imprudent to make assumptions of performance in individuals based on their performance on the social perception task. In other words, although the students differed as a group, the overlap among the groups would preclude a diagnosis based on performance on one measure.

An area for further research would be to determine whether performance on the social perception measure significantly differs when the student has taken stimulant medication prior to completing the task compared to when the student has not taken stimulant medication. This would more firmly determine whether poor performance on the CASP in students with hyperactivity–impulsivity is related to impulsive responding and failure to attend to details versus a true social perception deficit. The results of the current study suggest that the social perception deficit in a subgroup of students with ADHD is primary, but this cannot be absolutely confirmed without exploring performance on the measure on and off stimulant medication.

Social perception is currently not typically evaluated by direct measure such as the CASP, largely because research on direct social perception measures is limited. Although the CASP proved to be a useful tool in this study, a limitation of the CASP is its lengthy administration time (approximately 40 minutes). Future research to determine the reliability and validity of a shortened version of the CASP would be beneficial so that the CASP could be more easily included in an assessment battery for students with social competence deficits. Additional measures of complex social perception should also be explored as alternatives to the CASP. The CASP is a desirable measure because it evaluates students’ social perception within a realistic context of video portrayals of real-life scenarios. Many measures of social perception have attempted to look at narrower areas of social perception, such as facial emotion or prosody in isolation. As with narrow measures of visual perception, significant differences among groups have proven more difficult to find in these narrow assessments of social perception. This difficulty is likely because, in children, specific lesions that affect one area of functioning (e.g., emotion recognition) are rare. Rather, it is the integrative skills that are necessary in everyday life that lead to significant difficulties in social competence.

Finally, this is an exciting time with the advent of methods for evaluating social cognition. Emerging evidence suggests that the right hemisphere is involved in perspective taking and empathy, particularly in the frontal lobe. Evaluating these skills in children with social competence disorders would contribute to our understanding of the neurological underpinnings present in social cognition (Semrud-Clikeman, 2007). Areas that have been implicated include the amygdala, the superior temporal sulcus, and the fusiform gyrus (Baron-Cohen, Ring, & Wheelwright, 1999; Pelphrey, Adolphs, & Morris, 2004; Wang, Dapretto, & Hauri, 2004). It would be helpful to study these regions and relate them to social–cognitive measures in children with NLD and autistic spectrum disorders.

For children with ADHD, the relationship of these structures to social processing is an important step that has not been well developed at this time. Studies have found differences in response to success and failure in children with ADHD compared to children without ADHD. Plizska et al. (2006) found that children with ADHD did not respond in the same manner to failure as typically developing children. This response may well indicate a higher threshold that needs to be present for the child with ADHD to understand his or her mistakes. Areas that were implicated include the anterior cingulate and the dorsal lateral prefrontal cortex. Structural analysis also found that the anterior cingulate differed in children with ADHD from those who were typically developing (Semrud-Clikeman, Plizska, Liotti, Higgins, & Lancaster, 2006). In these cases, difficulties with understanding success or failure likely affects the ability to change responding and fluid reasoning often seen in children with autism spectrum disorders and/or ADHD. Our understanding of these processes is just at the “tip of the iceberg” of the neuroscience underlying social cognition in typically developing individuals, let alone those with developmental disabilities.

References


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