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Visual Perceptual Processing Errors in Children with Nonverbal Learning Disabilities (NVLD)

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Visual Perceptual Processing Errors in Children with Nonverbal Learning Disabilities (NVLD)

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Visual Perceptual Processing Errors in Children with Nonverbal Learning Disabilities (NVLD)

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Children with NVLD possess intact or enhanced verbal abilities in the presence of significant deficits in visual perceptual processing. These children also have social skills deficits that many researchers believe are a function of the child's misinterpretations of information presented through a visual channel. The purpose of this study was to explore the processes by which children with NVLD interpret visual stimuli by using specific measures of the Rorschach Inkblot Test. It was hypothesized that, when faced with visual stimuli, children with NVLD would show four specific cognitive perceptual processing errors: visual distortion (*X-%*), failure of integration *(DQ+*), limited social attribution (*M)* and social distortion (*M*-). Children with NVLD often have coexisting Attention

Deficit/Hyperactivity Disorder, Predominately Inattentive Type (ADHD/PI). However, researchers investigating NVLD have failed to consider the role of inattention in the NVLD presentation. Therefore, the second purpose of this study was to compare Rorschach responses of children with NVLD +ADHD/PI to children with ADHD/PI and a control group.

Fifty-four students comprising three groups (n = 18 per group) participated in the study. Participants were identified as being right handed, primarily English speaking and free of gross neurological, sensory, language and psychotic disorders as well as co-existing diagnoses of Conduct Disorder, Major Depressive Disorder, and severe anxiety disorders. Participants completed the Vocabulary and Block Design subtests of the Wechsler Intelligence Scale-Third Edition (WISC-III), the Developmental Test of Visual-Motor Integration, the Rey-Osterreith Complex Figure Drawing and the Structural Interview for Diagnostic Assessment for Children for DSM-IV.

The Kruskal Wallis technique was used to test for an overall difference between groups. Post hoc pairwise comparisons were conducted using Mann Whitney U. The results showed significant differences between the NVLD+ADHD/PI group relative to the ADHD/PI group and the control for *X-%* ($p < .001$), *DQ+* ($p < .01$), and *M* ($p < .05$), but not for *M-* ($p = .96$). These findings provide empirical validation that children with NVLD demonstrate three distinct perceptual processing errors that 1) cannot be attributed to inattention and 2) likely contribute to misinterpretations of the child's physical and social world.

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CHAPTER I: INTRODUCTION

During the past several decades, educators and psychologists have vigorously pursued the study of teaching and learning. Although the emphasis was originally placed on *what* to teach, Myklebust (1975) noted that after the early 1970's researchers shifted their focus to the *process* of learning itself. This shift was influential in directing attention to the concept of individual differences and it is now assumed that some children do not learn normally even though they have no impairment of hearing or vision, have average intelligence and are not emotionally disturbed. The term "learning disability" (LD) was applied to these children in 1963 (Pennington, 1991), and since that time the lion's share of research and educational interventions have focused on verbally-based learning problems affecting reading, expressive vocabulary and writing. More recently, researchers have focused their efforts on subgroup classifications that acknowledge the role of nonverbal deficits affecting the learning process (Badian, 1992; Cornoldi, Rigoni, Tressoldi & Rio, 1999; Dimitrowsky, Spector, Levy-Shiff & Vakil, 1998; Fisk & Rourke, 1979; Johnson, 1987; Semrud-Clikeman & Hynd, 1990; Tanguay, 2002).

Interest in nonverbal processing grew, in part, as a result of the work of Johnson and Myklebust (1964). These authors were among the first researchers to write compelling case presentations of children who have intact verbal skills and average to above average intellectual functioning but show severe problems processing and gleaning information from nonverbal stimuli. These children have

difficulty comprehending concepts such as time and distance and fail to grasp the meaning of gestures, facial expressions, caresses and tone of voice. Described as concrete in their thinking, many of these children fail to develop higher-level cognitive abilities including abstract reasoning, concept formation and complex problem solving. This particular constellation of nonverbal processing deficits has been described as a syndrome of early right hemisphere maldevelopment termed nonverbal learning disabilities (NVLD) (Myklebust, 1964). Because NVLD is a relatively new construct, it is not currently represented in the Diagnostic Statistical Manual of Mental Disorders, 4th edition (DSM-IV; American Psychiatric Association, 1994) as a separate diagnostic entity. Pennington (1991) has estimated that NVLD occurs in 1-10% of the population.

Although children with NVLD suffer numerous cognitive and academic deficits, perhaps the most devastating aspect of the disorder for the child and his or her family is social incompetence. Thus, a critical need for these children is interventions designed to enhance their social skills. Existing social skills programs designed for children with "garden variety LD" or emotional dysfunction are ineffective or insufficient because children with NVLD suffer from visual perceptual and interpretive deficits, whereas most current social interventions intercede at the skills level (e.g., McIntosh, Vaughn & Zaragoza, 1991; Pfiffner & McBurnett, 1997; Spafford & Grosser, 1993; Waters & Srouffe, 1983). For example, many social skills programs are designed to modify the child's response to a given social situation (i.e., improve the child's skill in *managing* the situation). Such an intervention approach assumes the child

comprehends the situation, but fails to engage an appropriate response. However, there is substantial anecdotal evidence to suggest children with NVLD do not understand social situations, which leads them to frequently misinterpret the actions and intentions of others. The misinterpretations appear to be so severe that children with NVLD may appear to have impaired reality testing, although they are not believed to suffer from psychosis or a true thought disorder. Because these children have intact vision, researchers suspect the nature of the child's misinterpretations is operational – that is, the systems involved in correctly *perceiving* and *comprehending* visual stimuli are not working correctly (Rourke & Fisk, 1988).

There is ample evidence to suggest children with NVLD make errors in perceiving and comprehending visual stimuli; however an examination of the nature of these errors has not been addressed in the literature. Therefore, the current study was designed to explore the processes by which children with NVLD translate visual stimuli into meaning to determine the nature of the misinterpretations (i.e., what visual perceptual errors are occurring?). The Rorschach Inkblot Test (Rorschach, 1994) was selected to explore these processes because it is uniquely designed to provide a well-rounded picture of how an individual perceives and organizes visual perceptions. In this study it was hypothesized that, when faced with ambiguous visual stimuli, children with NVLD would demonstrate four specific cognitive perceptual errors. These errors and the associated Rorschach variables to investigate them include visual

distortion (*X-%*), lack of visual synthesis and integration (*DQ+*), limited social attribution (*M*), and social distortion (*M-*).

Although the primary focus of this study was the cognitive processes associated with NVLD, a secondary focus was to determine the role attention plays in these processes. Children with NVLD often show symptoms characteristic of Attention Deficit/Hyperactivity Disorder, Predominately Inattentive Type (ADHD/PI); however, researchers have failed to consider the potential role of inattention in the NVLD presentation. In this study, Rorschach responses on the variables of interest were compared between children with NVLD + ADHD/PI to (a) children with ADHD/PI and (b) children from a control group.

The remainder of this document is divided into four additional chapters. The first of Chapter II's five sections focuses on the leading neurodevelopmental theory regarding NVLD proposed by Rourke (1982). Section One includes a brief discussion of Piagetian developmental theory as a contextual background from which to consider the developmental presentation of NVLD. In Section Two, a review of the observational data of children who are purported to have NVLD and data regarding their performances on standardized measures of visual-perceptual functioning is provided. This review also includes information regarding social perceptual abilities. This section serves to establish the pattern of cognitive perceptual errors that are hypothesized to be characteristic of NVLD in this study. Because comparisons between NVLD and ADHD/PI were important aspects of this study, the third section of Chapter II includes a review of the behavioral,

neurocognitive, etiological and emotional characteristics shared between NVLD and ADHD/PI. The Fourth Section includes a brief discussion of the Rorschach Inkblot Test, descriptions of the instrument's scoring variables, and a review of the Rorschach research with children with LD, NVLD and ADHD. In the fifth and final section of Chapter II, the statement of the problem and the five research hypotheses for this study are presented.

Chapter III is divided into three major sections. Section One includes demographic information, study procedures, and group criteria. In the second section, a review of the independent and dependent measures used in this study and their associated psychometric properties is provided. The third section of Chapter III includes the nonparametric techniques selected to test the hypotheses. Chapter IV includes a preliminary analysis and the results of the study. In Chapter V, a summary and discussion of the results, implications and limitations, and directions for future research will be presented.

CHAPTER II: LITERATURE REVIEW

NVLD Syndrome

ETIOLOGY

Determining the etiology of any learning problem is complex because children can experience failures of learning for a number of educational, instructional, social and emotional reasons. Within the last 30 years, the emergence of the field of neuropsychology has helped to establish that when children have intact sensory abilities and adequate opportunities for learning, their deficiency may also be explained by a dysfunction of the brain (Myklebust, 1975). In 1982, Rourke proposed the first comprehensive etiological model of NVLD as a developmental brain disorder of the right hemisphere. His model was based on evidence from numerous sources that have demonstrated that information processing is carried out differently in the right hemisphere (RH) versus the left hemisphere (LH) (Goldberg and Costa, 1981; Milner, 1980; Sperry, 1982). Through an analysis of studies investigating neuroanatomical substrates of the brain, Goldberg and Costa hypothesized that the right hemisphere has more association areas and is specialized in processing multisensory, nonverbal stimuli. Gur and colleagues (1980) have shown that the RH has a higher concentration of white matter (i.e., increased myelination) than the LH. Goldberg and Costa concluded that the long myelinated fibers of the RH are best suited for interregional connections, which are involved in processing of multiple modes of sensory representation simultaneously within a single task. In contrast, the short

fibers of the LH are designed for intra-regional connections, which are best suited for sequential processing and fixation on a single mode of representation. Thus, while it is commonly known that both hemispheres work together to accomplish most tasks of the brain (Mesulam, 1981; Tucker, 1981), the organization and structure of the RH allows for greater capacity to deal with informational complexity and to process information in a more global manner (Weintraub, 1980).

The aforementioned findings originally led Rourke to presume that deficits in nonverbal processing characteristic of NVLD were associated with impaired RH systems. However, similar nonverbal deficits have been noted in diseases that are known to specifically affect the white matter areas of the brain. These diseases include callosal agenesis (Smith & Rourke, 1995), hydrocephalus (Fletcher, Brookshire, Bohan, Brandt, & Davidson, 1995), metachromatic leukodystrophy, multiple sclerosis and toxic encephalopathies (Rourke, 1995). Based on this evidence, Rourke modified his original hypothesis and concluded that RH myelination provided the link between NVLD and other disorders and diseases with deficient nonverbal processing sequelae, shifting his etiological emphasis from deficits of the RH *systems* to the inability to *access* the RH due to deficits of white matter (Rourke & Fuerst, 1995). Roman (1998) points out that while the right hemisphere versus white matter hypotheses represent separate theoretical developmental models, they both yield accurate predictions regarding the presentation of the NVLD syndrome.

Of particular importance to the conceptualization of NVLD is the role of the RH in processing novel material. Goldberg and Costa (1981) noted that the RH has a crucial role in the initial stages of the *acquisition* of new information, whereas the LH plays a more active role once information has become automatized and assimilated into a meaningful construct or schema. The prelinguistic child is constantly confronted with novel stimuli for which they have no existing schema, and the stimuli are presented primarily through visual and tactile modalities. Thus, researchers have concluded that deficits of the RH may be especially detrimental at early stages of neuropsychological development (Semrud-Clikeman & Hynd, 1990). Unlike adults who lose previously intact nonverbal processes after RH damage or disease, the developing child who suffers maldevelopment of the RH may fail to *acquire* nonverbal processing abilities (Weintraub & Mesulam, 1980).

The conceptualization of NVLD as a developmental disorder is important when one considers that the bulk of the literature regarding RH processing is derived from studies of adult split brain patients (Rie, 1980) or by examining adult functioning after RH damage or disease (Benton & Tranel, 1993). Because brain injury may have different consequences for development at various ages (Hynd & Willis, 1988), researchers are cautioned about extrapolating and generalizing information from adult studies to hypotheses regarding child functioning. With this caveat in mind, the study of adult functioning provides a useful framework to investigate disorders of childhood such as NVLD.

CLINICAL FEATURES

Through a series of intensive clinical examinations and empirical studies (e.g., Casey, Rourke, & Picard, 1991; Harnadek & Rourke, 1994; Rourke and Fuerst, 1991) researchers have characterized the principal clinical features of NVLD. These features include:

1. Bilateral tactile-perceptual deficits, usually more pronounced on the left side of the body, leading to problems dealing with complex tactile input.
2. Bilateral psychomotor coordination deficiencies, more pronounced on the left side of the body. Complex psychomotor skills, especially when required within a novel framework, tend to worsen relative to age-based norms.
3. Outstanding deficiencies in visual-spatial-organizational abilities.
4. Extreme difficulty in adapting to novel and otherwise complex situations. An over-reliance on prosaic, rote and often-inappropriate behaviors in such situations.
5. Marked deficits in nonverbal problem solving, cause and effect reasoning, concept formation, hypothesis testing and the capacity to benefit from positive and negative informational feedback in novel or complex situations.
6. Distorted sense of time.
7. Well-developed rote verbal capacities, including extremely well-developed rote verbal memory skills.

8. Much verbosity of a repetitive, straightforward, rote nature. Content disorders of language and poor psycholinguistic pragmatics. Little or no speech prosody.
9. [1]Relative deficits in mechanical math relative to reading and spelling.
10. Significant deficits in social perception, social judgment and social interaction skills. There is considerable risk for the development of psychosocial disturbance, especially in internalized forms of psychopathology, in older childhood and adulthood (Rourke & Fuerst, 1988, page 405).

While Myklebust (1962) coined the term NVLD to capture the constellation of features noted, nomenclature to describe these features has also included right hemisphere dysfunction (Semrud-Clikeman & Hynd, 1990; Weintraub & Mesulam, 1983), right hemisphere syndrome (Voeller, 1986), left hemisyndrome (Denckla, 1978) and developmental right hemisphere syndrome (Gross-Tsur, Shalev, Manor, & Amir, 1995). Other disorders that are conceptually similar to NVLD include Pervasive Developmental Disorder (PDD) and Asperger Syndrome (AS). The similarities have led researchers to suggest that nonverbal learning disabilities exist on a continuum of autistic spectrum disorders with Autism and PDD as the most severe and AS and NVLD as less severe (Klin, Volkmar, Sparrow, Cicchetti, & Rourke, 1995; Wing, 2000). Given the numerous

[1] Semrud-Clikeman & Hynd (1990) suggest math deficits may likely be due to problems in visual-spatial skills.

similarities between NVLD and AS, many question whether they represent separate diagnostic entities (Klin, Volkmar & Sparrow, 2000). While they share many social and cognitive features, they also differ in that children with Asperger Syndrome engage in unusual preoccupations (Barnhill, 2001). Research on AS and NVLD is at relatively early stages and the overlap between these disorders and those affecting RH processing represent a promising area of future research yielding meaningful information as to the etiology and developmental expression of developmental disorders (Wing, 2000).

NEURODEVELOPMENTAL MODEL

Rourke (1988) has developed a neurodevelopmental model that incorporates aspects of stage developmental theory. Rourke's model seeks to explain how and why these features would become more pronounced over time and lead to specific cognitive, academic and socioemotional deficits. Although it has not been empirically validated, the model provides a useful framework for examining the progression and evolution of NVLD symptoms. An adaptation of Rourke's (1994) model is presented in Figure 1.

Rourke's model represents the dimensions of NVLD as involving primary, secondary and tertiary neuropsychological assets and deficits. Primary deficits are thought to involve visual-perceptual-organizational abilities, complex psychomotor skills, and tactile perception as well as difficulty dealing with novelty. These deficits are expected to lead to secondary deficits of disordered tactile, visual attention and stunted exploratory behavior. In turn, problems with

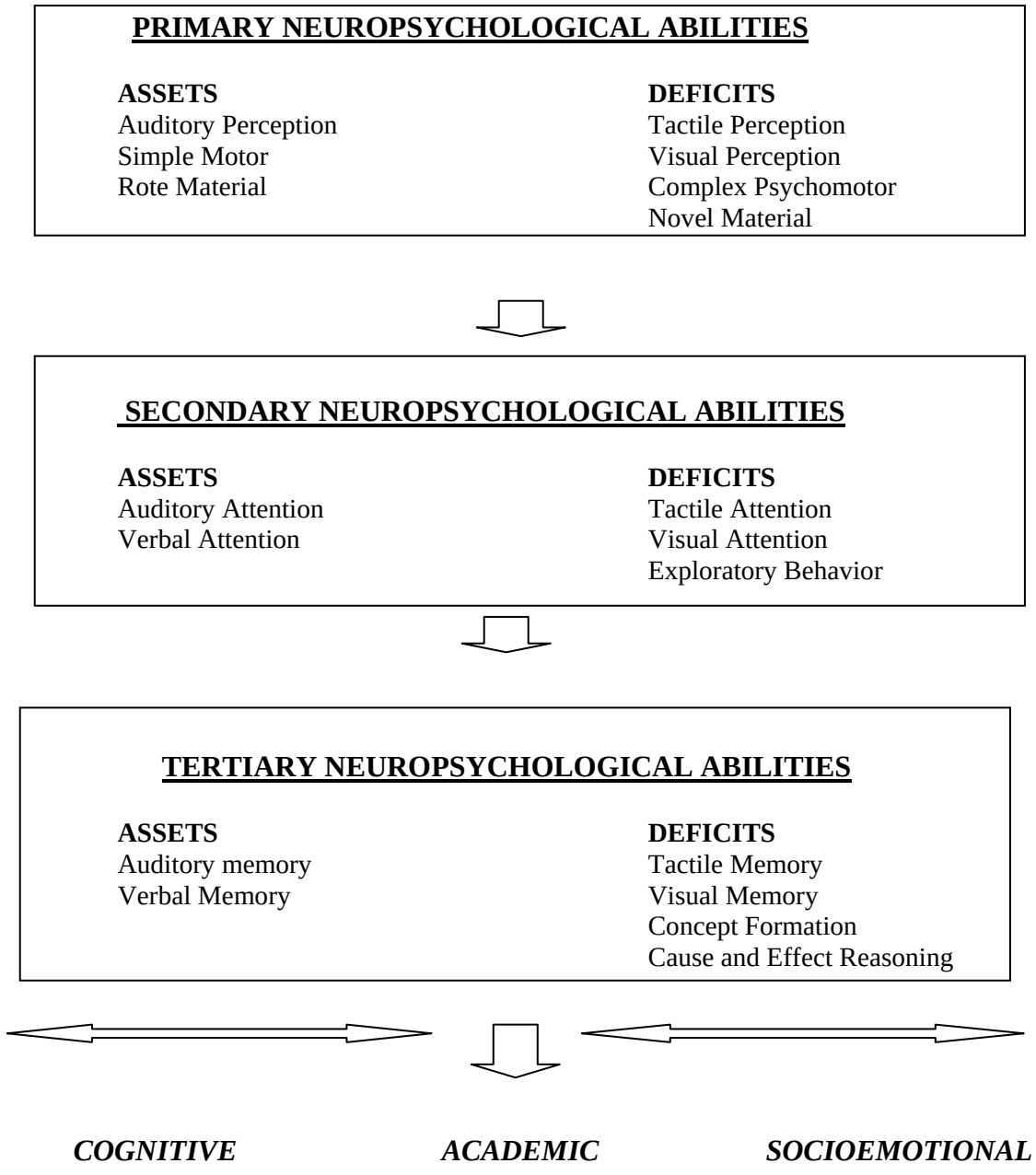

Figure 1: Neurodevelopmental Model of NVLD

memory for material delivered through the tactile and visual modalities as well as concept formation and problem solving are expected to ensue (Rourke, 1988, 1989, 1995; Rourke & Fuerst, 1991). An essential aspect of this model is Rourke's assertion that the manifestation of cognitive, academic and socioemotional deficits are the direct result of the interaction of the primary, secondary and tertiary assets and deficits within a hierarchical developmental context.

DIAGNOSIS

Even with clinicians and diagnosticians who are aware of NVLD and know how to diagnose it, there is an inconsistency in the definition across researchers and differences of opinion regarding choice of an appropriate test battery. Furthermore, as with all complex developmental disorders, there is no formal consensus on the number or the severity of symptoms necessary to make the diagnosis (Roman, 1998). Studies have differed in the way they determine NVLD status with some basing their diagnosis on VIQ/PIQ split (Rourke & Fuerst, 1991; Weintraub & Mesulam, 1983), care taker ratings (Casey et al., 1991) or simply motor delays with VMI and motor weakness in neurological measures (Lyytinen & Ahonen, 1989). Finally, many researchers have noted inconsistencies in NVLD presentation with some children failing to show all of the symptoms previously discussed. In 1994, Harnadek and Rourke examined the identifying features of NVLD to determine which features were the most discriminative. These authors determined that intact verbal skills in the presence of deficits in visual-perceptual organizational psychomotor coordination and

complex tactile perceptual skills appear to be the most representative of the NVLD syndrome in children examined.

SENSORIMOTOR FUNCTIONING

Consistent with Piagetian theory, Rourke (1979) identifies sensorimotor functioning as essential to cognitive development. A child first experiences the world through touch, feel and movement and through a process of organization, synthesis and analysis; these sensorimotor experiences serve as building blocks for higher-level cognitive abilities (e.g., concept formation, cause and effect reasoning, abstract thinking) (Rourke & Tsatsanis, 2000). Processing novel nonverbal stimuli requires visual attention, psychomotor manipulation, tolerance for ambiguity, and memory for what has been seen and experienced (Flavell, Miller, & Miller, 1985). Described by their parents as inattentive and lethargic, very young children with NVLD are reportedly reluctant to visually and physically explore their environment (Johnson, 1987; Myklebust, 1975; Rourke, 1988; Weintraub & Mesulam, 1983). Instead, these children rely almost exclusively on language versus play-based activities as the principal means of information gathering and come to "…prefer to hear about the world rather than to see or touch it" (Rourke & Fuerst, 1991, 407).

Rourke (1988) suggests that the preference for verbal versus nonverbal information is important when one considers that language is delivered to the child through passive means by caregivers. In contrast, he suggests that play-based activities offer experiences dealing with novelty and require the child's active participation. Rourke and Fuerst (1991) contend that because children with

NVLD frequently gain little useful information from manipulating their environment, they seldom do so on their own initiative. In this way, the lack of exploration and play-based interaction is secondary to the primary deficits of visual and tactile perception. By incorporating experiential factors into his model, Rourke departs from strict Piagetian theory. Rather than assuming the child will develop cognitively by simply *moving* through developmental stages, Rourke acknowledges that cognitive development is highly dependent on the child's active engagement with his physical and social environment.

SOCIOEMOTIONAL FUNCTIONING

As Rourke's model illustrates, socioemotional dysfunction, which is defined as poor social skills and increased level of psychopathology, is considered a *dependent* variable of NVLD. Unlike children with autism, children with NVLD long for friendships and companionship, but because they miss crucial subtleties embedded in nonverbal cues, they are perceived as socially inept and are often on the periphery of their social system (Weintraub & Mesulam, 1983). These children lack social competence and their social processing deficits appear to occur at the acquisition versus performance level. According to Gresham (1992), individuals with social deficits at the acquisition level do not possess a particular social skill while individuals with social performance deficits simply fail to perform a particular social skill that is within their ability. Rourke (1988) contends that, because of their perceptual deficits, children with NVLD fail to acquire many of the underlying competencies that govern social interactions

crucial to social competence such as the ability to interpret facial expression, body language and tone of voice.

Many researchers consider socioemotional deficits an inherent aspect of any learning disability (Nussbaum, Bigler, & Koch, 1986); however, Porter and Rourke (1985) looked at subtypes of LD and demonstrated that children with nonverbal processing deficits are more likely to evidence problems with socioemotional functioning than were children with verbal learning problems. In their (1989) study, Rourke, Young and Leenaars suggest children with NVLD not only have more socioemotional deficits; the neuropsychological underpinnings of the NVLD syndrome may actually predispose them toward serious emotional disturbance and suicidal behavior.

While Rourke's investigations of children with NVLD have focused on visual perceptual deficits as directly affecting socioemotional functioning, other researchers have considered alternative explanations for the increased level of social deficits and psychopathology (Semrud-Clikeman et. al, 1990; Voeller, 1986). For example, Semrud-Clikeman et al., in their discussion of the children's early social perception, suggest that right hemisphere deficits in the prelinguistic child have serious potential implications for the relationship between mother and child that may help explain the child's socioemotional deficits. They suggest that if the infant has difficulty retaining an image of mother, the mother-infant relationship may be altered. Thus, if the toddler has visual-perceptual problems (has difficulty understanding nonverbal emotional cues from his mother) and deficient visual-spatial organizational and tactile-perceptual problems (finds

exploring the environment difficult or confusing), they may find their world confusing and stressful, leading to still more emotional difficulties.

SUMMARY

This section has presented the clinical features and the leading etiological model of the NVLD syndrome. Rourke (1979) contends that NVLD is defined as a specific constellation of neuropsychological assets and deficits that develop as a direct result of disrupted or impaired visual-perceptual-tactile processes. The focus of this study will be specifically on visual-perceptual processes in an effort to determine how children with NVLD translate visual stimuli into meaningful information. In the following section, observational data of children purported to have NVLD and their performances on standardized measures of visual-perceptual functioning will be reviewed. This section will also consider the difficulties children with NVLD experience when faced with processing socially meaningful stimuli. It is important to note that in most studies, researchers who have investigated deficits in social perception and social skills have not focused on subgroups and have, instead, considered LD as a homogenous group. In 1991, Semrud-Clikeman & Hynd pointed out that while deficits in social perception are commonly noted in children with NVLD, most evaluations of children with this disorder do not include a direct measure of this process but rely primarily on behavioral observations and inferences from developmental studies to determine the child's social perceptual abilities. More recent NVLD studies have failed to correct this oversight (Cornoldi, Rigoni, Tressodi & Vio, 1999; Foss, 1991; Nowicki & Carton, 1997). Consequently, the literature base is quite limited.

Therefore, the review of social processing in NVLD will be augmented by research on Asperger Syndrome and studies of adults that have suffered RH damage or disease.

Visual Perceptual Processing

PERCEPTUAL ACCURACY

One essential question for this study is whether children with NVLD perceive accurately? Do they see as others see? Evidence would suggest the answer to this question is yes *and* no. Johnson (1987) analyzed the records of over 20 preschoolers who showed primary nonverbal learning disabilities as defined by a Verbal Intelligence Quotient (VIQ) greater than Performance Intelligence Quotient (PIQ) discrepancy of 15-52 points on the Wechsler Intelligence Scale for Children – Revised (WISC-R; Wechsler, 1974). She found these children scored below average on picture vocabulary tests even though they had significantly above average verbal abilities. For example, one six year old referred to a picture of a key as a "6," a rural mailbox as a "piece of toast," and a pair of reading glasses as an "8". Johnson's observations mirrored those presented earlier by Myklebust (1975). In his seminal work where he first introduced NVLD, Myklebust examined the performances of numerous students over a 5-15 year period that had significant nonverbal deficits and verbal assets on standardized measures of neuropsychological, psychoeducational and emotional functioning. In terms of perceptual accuracy, these children could not correctly identify a pictorial representation even though they all possessed knowledge of each of the

images presented and the corresponding verbal label. The author described a 9 year-old boy who, when showed a picture of a house on fire, exclaimed, “"It's a birthday party, see the candles?" Though the child was not able to recognize the overall gestalt, he could accurately name each aspect of the picture (the hose, the firemen, the house).

Benton and Tranel (1993) suggest that recognizing a meaningful picture is complex and calls on numerous abilities including visual integration, verbal encoding and verbal fluency. Thus, a failure in recognition can occur for numerous reasons. Bauer (1993) writes: “Recognition represents the final common path of many separate components, thus the answer to the question ‘Did the patient recognize…?’ depends on what response is required of the patient in a given task situation” (page 218). Myklebust (1975) reasoned that children with NVLD were able to accurately identify and recognize many common objects. Therefore, he concluded these children did not have a perceptual disorder, per se. The problem, he reasoned, was due to failure to integrate aspects of individual objects into a meaningful whole concept. His hypothesis is consistent with Wolpert’s notion of “integrated apprehension” which is defined as a problem of “…visual processing which prevents one from grasping the import of a complex stimulus even though each detail in it was recognized” (Benton & Tranel, 1993, page 155).

VISUAL INTEGRATION

Studies investigating the performances of children with NVLD on measures of standardized neuropsychological measures reveal that failures of

integration are most evident on tasks requiring motor responses (e.g., those measuring constructional praxis). Benton & Tranel (1993) define constructional praxis as any type of performance in which physical parts or pieces are combined or organized to form an object or concept. The most commonly used tests purported to measure specific aspects of constructional praxis in children include the Object Assembly and Block Design subtests of the WISC-III (Wechsler, 1994). Performances on these subtest measures are routinely noted by researchers investigating NVLD to be significantly below average and, in many cases, within the significantly impaired range (Foss, 1991; Johnson, 1987; Roman, 1998; Rourke & Fisk, 1989; Weintraub & Mesulam, 1983). These findings suggest that children with NVLD, regardless of performance modality (verbal/visual versus sensory/motor responses), appear to experience failures of integration and, in some cases, perceptual distortion that hinders their ability to organize visually presented material into meaningful whole concepts.

There is evidence to suggest organizational and integration problems are not unique to children with NVLD, but are characteristic of children with any learning disability (Brumback, 1990). However, because most studies investigating LD have failed to differentiate between verbal versus nonverbal subtypes, determining whether integration problems exist in both groups has been difficult. More recently, researchers have designed studies comparing children with NVLD and children with verbal learning disabilities (VLD). The results of the studies suggest that both subtypes experience failures of integration, but each do so for different reasons. Foss (1991) compared children with NVLD to

children with VLD on the Test of Visual Motor Integration (VMI; Beery, 1997) and the Memory for Designs subtest of the Detroit Test of Learning Aptitude (Baker & Leland, 1935). The author found that both groups performed more poorly than the control group; however, children with NVLD had relatively more difficulty overall. For both tasks, children with VLD produced the overall gestalt but missed many of the item details. In contrast, children with NVLD produced drawings that were piecemeal and disconnected. Weintraub and Mesulam (1983) noted a similar piecemeal approach from children with NVLD on a task involving a higher degree of visual complexity, the Rey-Osterrieth Complex Figure (Meyers & Meyers, 1995). These authors concluded that children with NVLD might not initially perceive the overall gestalt and instead interpret visual stimuli as simply a number of isolated details.

More recently, researchers have interpreted the organizational piecemeal versus gestalt organization style of children with NVLD from a sequential versus a simultaneous framework. In 1999, Chow and Skuy compared children with NVLD to children with VLD on measures of simultaneous and successive/sequential processing on the Kaufman Assessment Battery for Children (KABC). Results of the study showed that children with NVLD showed significantly lower Simultaneous Processing mean scores than children with VLD. Taken together, these results support the notion that children with NVLD have problems with integrating visual perceptual information. It is important to note, however, that the subjects characterized as NVLD referred to in the above studies consistently showed current signs and a past history of symptoms

associated with ADHD/PI. Therefore, it is unclear whether the problem with part/whole or simultaneous processing is characteristic of NVLD or a function of inattention.

SOCIAL PERCEPTION

As previously discussed, children with NVLD demonstrate visual perceptual deficits that become more pronounced as the demands of a given percept or situation intensify. Processing visual perceptual information involving social meaning is considered the most complex (Flavell et al. 1985). The unraveling and interpreting the intricacies of a social context is multifaceted as the interpretation of a given social situation calls for a number of competencies. These competencies include emotional recognition and interpretation, the evaluation and application of nonverbal cues, and the ability to draw out the common and more general features of interpersonal events and use them to inform the interpretation of future social situations. Rourke (1988) hypothesizes that deficits in visual-perceptual-organizational skills of NVLD give rise to problems in requisite skills that subserve these social competencies. These skills include deciphering the meaning of various facial expressions, gestures, and other forms of nonverbal information. Thus, another visual perceptual processing error that will be investigated in this study relates to social processing – do children with NVLD make specific processing errors that interfere with their ability to comprehend social information? There is evidence to suggest these children do not process social information as others do. Issues of social processing in NVLD will be considered from a developmental and neuropsychological perspective.

Developmental perspective

Developmental researchers have found that infants are reportedly predisposed to attend to the information that is most important for them to learn about. Bias for faces has been seen in infants as early as 2 months of age (de Haan & Nelson, 1998). Attending to faces and facial expressions is crucial to social development as these features teach the child about the emotions, intentions and motivations serving as a roadmap for understanding other people (Buitlaar & van Wees, 1997). Visual perception is also important in the process of social referencing. Ainsworth's (1979) "strange situation" studies first highlighted how children use their caregiver as a social barometer, an indicator that provided clues to the child about the safety of his or her surroundings.

Developmental histories of children with NVLD indicate these children do not actively seek out or respond to visual nonverbal cues and show an apparent lack of attention to and interest in faces. As these children develop, they continue to show poor eye contact, problems with facial recognition and difficulties interpreting facial expressions (Gross-Tsur, et al. 1995; Johnson, 1987). It is reasonable to assume that if faces are not emotionally salient or relevant, less attention would be paid to them, and over time, there would be many missed opportunities for learning about faces and the social messages they convey.

Neuropsychological perspective

Social perception deficits resulting from RH damage are well documented in the adult literature and include deficits in identification of faces (Borod, Koff, & Caron, 1983; Ross, Thompson, Yendosky, 1997), emotional recognition,

emotional discrimination (DeKosky, Heilman, Bowers & Valenstein, 1980) and identification of emotional prosody (Bowers, Coslett, Bauer, Speedie, & Heilman, 1987). Bowers and Heilman (1984) hypothesize that the RH may actually contain a "store of emotional representation" that appears to be damaged in adult patients with RHD (page 464). These patients were asked to identify and interpret emotions but were unable to do so even when the nonverbal signals were described verbally (e.g., "his face whitened," "he shook his fist," "she raised her voice"). Because the verbal cues involved gestural, facial and vocal signals, the authors concluded that RH specialization is not just specific to processing faces but extends to other nonverbal modalities. Children with NVLD are thought to suffer maldevelopment rather than damage of the RH. Thus, if a RH store of emotional representation does exist, it may not be developed in these children.

Schultz and colleagues (2000*)* studied social processing by completing a fMRI on the neurofunctional components of the process by which individuals make social inferences. These authors administered a novel animation task, called the Social Attribution Task (SAT; Klin et al., 1999) to children and adults with autism and Asperger's syndrome (AS). Subjects were shown a film that simply depicted moving shapes (a circle, a small triangle, and a larger triangle). The movements of the shapes were contingent on each other. In a pilot study Klin (1999) reported that typically developing children and adults appeared to use a social framework when describing the movement of the shapes (e.g., "he tagged him" or "she made him hit that one"). However, in the current study subjects with autism and AS did not always make social attributions but simply explained the

movements in concrete terms ("the block moved to the right and then the triangle moved up"). The authors hypothesized that children normally use a social frame even when faced with ambiguous stimuli. However, for children with autism spectrum disorders, of which many believe NVLD is a part, the authors surmised, "…the propensity to interpret ambiguous scenes through a social lens may be missing" (page 193).

SOCIAL MISPERCEPTION

A final question was addressed in this study is whether the underlying visual perceptual deficits lead children with NVLD to misinterpret the actions, intentions and motivations of other people (i.e., it violates or distorts experiences which involve social meaning). Dimitrowsky, Spector, Levy-Shiff and Vakil (1998) compared children with NVLD to children with VLD and a control group on the interpretation of basic emotions from facial expressions. They found children with LD were less accurate overall than the control group, with children with NVLD having the most difficulty.

Loveland, Fletcher and Bailey (1990) demonstrated that the inability to interpret facial expressions led to a distortion of social context. These authors compared a group of nondisabled children (ND) with children with primarily verbal deficits (VLD) and children with primarily nonverbal deficits (NVLD). These children viewed videotaped scenarios in verbal (narrative) and nonverbal (puppet actors) formats and were asked to describe or enact with puppets the events depicted in the stories. Children with learning disabilities were found to have more problems than the control group depending on the type of learning

problem. Children with VLD tended to be imprecise and use nonspecific words when describing the events; however, their errors did not appear to affect their understanding of the events. However, errors in describing affect noted in children with NVLD led to misinterpretations of the motives of the characters that led to a misinterpretation of the event as a whole.

SUMMARY

Developmental histories suggest that children with NVLD and related disorders do not attend to or glean information from visual perceptual stimuli early in their development. Consequently, these children may fail to acquire crucial social information through facial expressions, gestures and other forms of nonverbal communication. Consider the following excerpt from a mother with a 6-year-old child with NVLD:

> Janet and I were at the park when a mother and her two children came by. I could tell….the older child was blind. He sat down in the sand and started playing. Janet went up to him, picked up his sand pails and asked him if she could play. While playing Janet never recognized that he was blind. She would talk with him and never noticed that he did not "look" at her. She would say, "look at…" and did not notice that he was feeling instead of looking. After about 10 minutes Janet moved to another spot in the sand and asked him to come over. He made his way over to where she was, thanks to her nonstop talking, and she did not notice his arms being out and that he did not walk directly over to her.

After the children finished playing, the mother told Janet that the boy was blind. Janet's reply, "How do you know?"

This example illustrates how the inability to interpret nonverbal cues interferes with the child's ability to interpret a given social situation. However, an alternative explanation for the social perceptual deficits noted in children with NVLD may be related to inattention. Many of the studies reviewed have noted symptoms associated with ADHD/PI as part of the NVLD profile. These symptoms have included slow performance on cognitive and motor tasks (Gross-Tsur, et al., 1995; Rourke, 1989), underarousal (Johnson, 1983; Myklebust, 1975, Weintraub & Mesulam, 1983), organizational deficits (Badian, 1992), inattention and cognitive sluggishness (Voeller, 1986; 1994). However, to date researchers investigating children with NVLD have failed to systematically consider the confounding effects of inattention on visual perceptual processes. Given the high comorbidity of attentional problems associated with this disorder, this study compared children with ADHD/PI to children with NVLD and comorbid ADHD/PI. The following section will provide a brief review of ADHD/PI as it relates to NVLD.

Attention Deficit/Hyperactivity Disorder/Predominately Inattentive Type (ADHD/PI)

DIAGNOSTIC CRITERIA AND HISTORY

The behavioral symptoms of developmentally inappropriate hyperactivity, impulsivity and inattention have long been recognized and have become the object of intense research over the last few decades. The nomenclature used to describe these symptoms has changed over the years from *Minimal Brain*

Damage and *Minimal Brain Dysfunction* (MBD) to *Hyperkinetic Reaction of Childhood or Adolescence* in the Diagnostic and Statistical Manual of Mental Disorders, 2nd Edition (DSM-II) (American Psychiatric Association, 1968). The primary focus was on overactive motor behavior until the 1970's when Douglas (Douglas, 1972; Douglas & Peters, 1979), through her research into the cognitive aspects of hyperactivity, identified attentional deficits and impulse control problems as primary symptoms in these children. The disorder was renamed *Attention Deficit Disorder with (or without) Hyperactivity* in the DSM-III (APA, 1980). In 1987 the disorder was renamed Attention-Deficit Hyperactivity Disorder (ADHD) in DSM-III-R (American Psychological Association, 1987) and did not distinguish whether or not hyperactivity was present in conjunction with attention deficits. In DSM-IV (1994) the term has undergone another change and has refocused on the differentiation between inattention and a combined hyperactivity/impulsive factor. The specific diagnostic criteria of each group, ADHD with hyperactivity (ADHD/H), ADHD, predominately inattentive type (ADHD/PI), and ADHD combined type are outlined in Appendix A.

RESEARCH FINDINGS

The focus of this review is on the ADHD/PI subtype. Research findings relating to this subtype are drawn from comparisons with children who show primary symptoms of hyperactivity and impulsivity. Although the terminology for the subgroups has changed over time, this review will adopt the current nomenclature when discussing past studies.

Prevalence and comorbidity

Although there are no clear numbers as to the prevalence of specific subtypes, children diagnosed with ADHD represent the most common disorder of childhood and adolescence (Goodyear & Hynd, 1992) with conservative estimates of occurrence with the school age population ranging from 3-5% (APA, 1994). The co-occurrence of learning disorders (no subgroup classifications) with the ADHD population has been documented by numerous researchers (Cantwell and Baker, 1991; Cantwell & Satterfield, 1978; Epstein, Shaywitz, Shaywitz & Woolston, 1991; Shaywitz & Shaywitz, 1991) and is one of the most consistent findings in ADHD research. In referred samples of children with ADHD, estimates of the prevalence of LD ranged from 15% to 50% for reading (August & Garfinkel, 1989; Lambert & Sandoval 1980) to 24% to 60% for spelling (Barkley DuPaul & McMurray, 1990). Overall, according to Barkley (1997), 25% to 50% of children with ADHD have LD while Mayes, Calhoun & Crownwell (2000) extended that number to close to 70% when written expression was included in the assessment.

Etiology

There is increasing evidence that ADHD may be associated with features of right hemisphere dysfunction (Cantwell & Baker, 1988; Gross-Tsur, et al., 1995; Heilman, Voeller & Nadeau, 1991; Malone, Couitis, Kersher, & Logan, 1994; Voeller, 1986; Voeller & Heilman, 1988), particularly specific subtypes of ADHD (Semrud-Clikeman & Hynd, 1990; Voeller, 1994). Frank and Ben-Nun (1988) found that children with ADHD/PI showed significantly more indications

of prenatal, perinatal and neonatal abnormalities and neurological soft motor signs than children with ADHD/H. Voeller (1994) found that a substantial portion of children with learning deficits of the right hemisphere have co-occurring ADHD/PI. Taken together, these findings suggest NVLD and ADHD/PI may share an etiology of RH dysfunction or maldevelopment. It is unclear whether ADHD/PI is a subset of NVLD or whether NVLD is a subset of ADHD. The overlap between these disorders represent an area of future research which may eventually shed light on the similarities between them and the possible brain abnormalities that might underlie their expression.

Nature and time of referral

The first reason for referral for children with NVLD is often due to a question of attention. After reviewing numerous developmental histories of children with NVLD, Rourke (1988) noted that during preschool and early school years, children with NVLD appear as hyperactive presumably because their motor clumsiness, distractibility and seemingly odd or oblivious social behavior are perceived as signs of impulsivity and distractibility. However, as these children advance in age, there is a marked tendency toward *hypo*activity. It is unclear whether this behavioral change reflects the child's attempt to modify or inhibit his behavior in response to social rejection or criticism or, as Rourke (1979) would suggest, simply a different expression of the same underlying perceptual deficits. However, as they develop, children with NVLD appear to have attentional symptoms more characteristic of ADHD/PI. These symptoms include selective

attention and internal distractions versus the more generalized problems of inhibition and sustained attention found in ADHD/H (Barkley et al., 1990).

Children with ADHD/PI are often referred 6 months to 1 year later than are children with ADHD/H (Rourke & Fisk, 1988). This difference in referral age is also noted between children with NVLD and children with VLD. Perhaps the difference is due to the fact that children with ADHD/PI and NVLD share symptoms that are often subtle and not as well understood. ADHD has an impressive literature base and the bulk of the research findings are focused on ADHD/H rather than ADHD/PI. Similarly, the volume of research on nonverbal or performance deficits pales in comparison to studies examining problems affecting reading, writing and verbal expression. Consequently, a myriad of behavioral modifications and remediation techniques are available to children with ADHD/H and language based learning problems while few intervention options exist for children with more subtle signs of inattention and deficits in nonverbal processing.

Neurocognitive findings

Children with ADHD/PI have been found to have a sluggish cognitive tempo (Lahey, Schaughency, Hynd, Carlson, & Nieves, 1987). Denckla (1996) noted that children with ADHD (no subtype noted) showed response patterns similar to those noted in NVLD – they obtained normal scores on visual recall and recognition tasks but failed to apply a strategy to organizing named items into meaningful groups that facilitate learning. While children with ADHD/H and ADHD/PI showed more cognitive deficits than controls, Douglas (1983) noted

that children with ADHD/PI demonstrated significantly impaired abilities on tests measuring visual perception and visual sequential memory. He reasoned that for children with ADHD/PI their problem was not due to perceptual distortions or encoding problems; rather they had problems with organization and retrieval.

In a recent study, Weiler and colleagues (2000) compared children with reading LD to children with ADHD/PI without LD on measures of processing speed. The results of the study indicate speed of processing was characteristic of LD in general, with children diagnosed with ADHD/PI having relatively more difficulty. An important finding was that children with ADHD/PI without LD had specific difficulty and responded more slowly on measures that involved *visual* information processing (e.g., Coding, Symbol Search). This finding may suggest that children with ADHD/PI, like children with NVLD, have particular weaknesses for information presented through a visual channel.

Socioemotional functioning

Lahey and Carlson (1991) noted that children with attentional problems, regardless of subtype, were not considered popular among their peers. Their unpopularity; however, stemmed from different social behavioral problems. Children with ADHD/H were described as aggressive and disruptive while children with ADHD/PI were shy and withdrawn. This finding supports Edelbrock, Constello & Kessler's (1983) study that reported that children with ADHD/PI could be classified on the internalizing dimension and those with ADHD/H on the externalizing dimension. Anxiety is more prevalent in ADHD/PI,

with the coexistence of conduct disorder present in children with ADHD/H (Barkley et al., 1990)

Egan and colleagues (1998) looked specifically at ADHD with externalizing problems on an important aspect of social functioning – the decoding of emotions – and found that children with ADHD were as successful in this area as controls. However, these children failed to use their knowledge to inform their decisions in social situations. The authors concluded that these children had deficits in the execution of social skills, not in their cognizance of appropriate social nuances. Although this study did not look at ADHD/PI, this finding presents a potential basis for distinguishing between NVLD and ADHD in that children with NVLD are believed to have social deficits at the acquisition level, not at the performance level; that is, they are not reluctant to perform socially, but rather do not have the social skills within their behavioral repertoire.

Summary

Children with NVLD share many behavioral, neurocognitive, and socioemotional features with children with ADHD/PI. Voeller (1986) suggests that children with NVLD and children with ADHD/PI may share a right frontal problem that is also associated with internalizing problems noted by both groups. However, current studies investigating NVLD have failed to isolate confounding attentional problems. In the current study, children with NVLD with coexisting ADHD/PI were compared to children with ADHD/PI and a control group on measures of visual perceptual processes using the Rorschach Inkblot Test. The Rorschach will now be reviewed.

Rorschach Inkblot Test

OVERVIEW

While inkblots have been utilized to examine human behavior for centuries, Herman Rorschach first introduced the concept to the scientific community in the early 1900's (Klopfner & Kelley, 1942). According to published accounts of his life, Dr. Rorschach's work with inkblots was highly influenced by the writings of pioneers in the field of perception including Ach, Mach, and Helmholtz (Exner, 1993). Rorschach was especially intrigued with Lissauer's notion of apperception and association. By apperception, Lissauer referred to what he called the "…conscious perception of a sensory impression", or the piecing together of separate visual attributes into a whole (Bauer, 1993, 215). Association refers to the imparting of meaning to the content of the perception by matching and linking it to a previous experience or object. Through his experiences as a physician and his knowledge about perceptual processes, Rorschach came to believe that people reveal something about their psychological functioning when they are forced to impose structure on ambiguous stimuli. Horn (1994) writes that by linking perceptual concepts to psychological functioning, Rorschach "…anticipated future information processing models of psychology that were not elaborated on until the 1970's and 1980's" (page 24).

Standardization

Although Rorschach began an empirical investigation of his inkblot method, his efforts were virtually abandoned by his colleagues after his death in 1921. His method was, instead, adopted by the prevailing zeitgeist of psychodynamic theory and was subject to numerous forms of misinterpretation for decades. In the 1970's, John Exner was commissioned by the Rorschach Foundation to establish a single, reliable system for administration, scoring and interpretation procedures for the Rorschach. He published the first empirically validated Rorschach system in 1974. Now in its third revision, the *Rorschach Comprehensive System* continues to be updated as new empirical findings and modified norms data warrant revisions. Exner's system reestablished the test not as an "X-ray of the mind" or test of free association, but "…exactly as it had been designed and intended by Rorschach, as a diagnostic test based on perception…" (Exner, 1993, page 87).

Nature of the test

An important feature of the Rorschach is that it provides a means to systematically investigate how an individual responds to and processes ambiguous visual stimuli. Procedurally, a subject is handed an inkblot and asked, "What might this be?" Exner (2001) writes:

> "the world is complex and when we identify things in it we are usually influenced by multiple stimulus elements such as color, shape and apparent movement. So too, Rorschach supporters suggest, is it with the inkblot, which, in a microcosmic way, contains many of the visual stimuli that we find in the environment" (page 87).

The basic premise of Rorschach "scoring" involves coding what elements (color, shape, etc.) were used to form a percept.

Although classified as a "projective" test by some, Kleiger (1999) states the Rorschach responses, "… reflect consistent properties of an individual's style of perceiving, thinking and communicating and can provide a basis for making inferences about how an individual perceives, thinks and communicates in a setting that is unstructured, open-ended and not clearly defined" (page 147). Thus, the paramount purpose of Rorschach data is not to grade responses as right or wrong or to predict behavior. Rorschach data provide a *description* of the cognitive processes underlying the response (Klofner & Kelley, 1942; Leitchman, 1996).

PSYCHOMETRIC PROPERTIES

Reliability

In the early history of the Rorschach, split-half techniques were used in attempts to establish reliability; however, the correlation coefficients produced seldom fell into the .80 or higher range that would be required for a test to be truly consistent (Exner, 1986). Exner (1986) reasoned that spilt-half procedures were inappropriate for the Rorschach because the blots are not equivalent stimuli. Thus, the type of response will be different dependent upon which cards were shown to the subjects. More recent studies conducted by the Rorschach Research Foundation (Exner, 1986) focused on studying the temporal consistency of types of responses. These researchers reasoned that people have preferred response

styles that manifest in their responses and these styles should be consistent with repeated testing at different intervals of time. Results of these studies indicated that this was the case for many of the variables related to perceptual processing. Correlations for two of the scoring variables exceeded .90 and 13 other variables fell between .81 and .89. Only five fell below .72 and these variables have been found to be related to state rather than trait features. Retest correlations after a three-year interval were similar, again showing that the variables related to state responses have the lowest correlations.

Although the Rorschach appears reliable for adults, many variables do not become stable for children until late adolescence (Exner and Weiner, 1995). According to Exner, Thomas and Mason (1985), this should not be surprising because it would be inconsistent with the changes that are observed in children due to their development. To assess these changes in terms of Rorschach variables, the authors conducted an 8-year longitudinal study of 57 children. These children were tested with the Rorschach every two years for a total of 5 Rorschach tests. It was found that some variables stabilize as early as the beginning of the school years (age 6) such as frequency of popular responses, the *X+%* denoting use of good form, and the frequency of movement responses (*M*). Exner et al. (1985) sought to determine at what points in time other features of the Rorschach stabilize and continue to remain stable. They found that it is only between ages 14 and 16 that a majority of the variables appeared to take on a consistency using a criterion of .75. Only one variable, *X+%,* was relatively stable from age 8 to age 16. According to Exner (1986), correlations for retest data show

that *DQ+* are quite reliable ranging from .89 to .92 for brief intervals and .83 to .85 for longer retest periods. Human movement (*M*) began to stabilize at age 8 or 9 and was completely stabilized by age 12 (Ames, Metraux, Rodell & Walker, 1995).

Validity

The results of a metanalysis reported in the Psychological Bulletin indicate that by usual psychometric standards, the reliability, stability and validity of the Rorschach is comparable to the Minnesota Multiphasic Personality Inventory (MMPI) and the Wechsler Adult Intelligence Scale (WAIS) (Parker, Hanson & Hunsley, 1988). Similarly, in their review of empirical support for psychological assessments in clinical health care settings, Kubiszyn et al. (2000) noted that the Rorschach has produced large validity coefficients comparable to the MMPI (i.e., $r = .37$). Weiner (1996) writes: "Those who currently believe the Rorschach is an unscientific or unsound test with limited utility have not read the relevant literature of the last 20 years; or, in having read it, have not grasped it's meaning" (page 208).

While there is a growing body of research supporting the psychometric properties of the Rorschach, Viglione and Exner (1995) suggest assessing the instrument's validity is difficult because of the multidimensional nature and complexity of the test. These authors state that, unlike tests that measure unidimensional constructs, the Rorschach cannot be described with any precision just one validity number. A more appropriate method for assessing validity is to consider the specific variable under investigation according to the individual's age

group. Numerous validation studies investigating individual Rorschach scoring variables was accomplished through numerous studies by comparing large numbers of protocols from different diagnostic groups to each other and through tests of varying lengths. A review of these studies is found in Exner (1993). A few of these studies will be reviewed in the section covering scoring indices.

Important issues affecting Rorschach internal validity are the administration conditions and protocol interpretations. Exner (1986) states that if the test is administered when an individual is in an emotional crisis or is experiencing extreme stress, the interpretation is valid for the individual only for those specific circumstances (i.e., responses represent how the person responds in crisis or under stress) but the interpretation is not valid for the functioning of the individual when he or she is not in this condition. Finally, through extensive studies comparing brief records with longer records, Exner (1991) determined there are significant changes in structural variables if a record contains 13 responses or less. Therefore, a protocol is considered valid only if it contains at least 14 responses per record.

Scoring indices

While NVLD has primarily been conceived as a neuropsychological disorder, researchers have demonstrated that the Rorschach should not be considered a neuropsychological measure (Frank, 1991; Frank, 1994; Kleiger, 1999). Kleiger argues that only a limited number of studies have actually attempted to correlate patterns of Rorschach responses with deficits in neurological syndromes and different functional systems of the brain. However,

Kleiger notes there is abundant information about the kinds of cognitive impairments associated with these functional systems and syndromes. This information has allowed for the extrapolation of a set of Rorschach variables that would be expected in patients manifesting different types of neurological impairment relating to visuoperceptual processing. Four of these variables that are considered to be the most suitable for children have been selected for this study: *X-%* (visual distortion), *DQ+* (visual synthesis), *M* (social attribution), *M-* (social distortion). These variables will now be discussed.

PERCEPTUAL DISTORTION (*X-%*)

Definition

Do children with NVLD perceive as others do? Are their visual perceptions accurate or as others would perceive? Using an information-processing model of investigation, Exner (1995) has determined that the process by which one identifies an object is similar in many ways to the process by which one identifies an inkblot. Most subjects, with the exception of those with severe intellectual or neurological deficits, classify some of the elements in the blot as objects that are familiar and commonly seen. For example, the contours of the D1 area of Card VIII are similar in shape to a familiar animal. It has features that are similar to the legs, body, and head of a four-legged animal. Even though the "animal" is colored pink, because the shape of the blot is so similar to an animal, the "animal" response is more than 90% predictable in nonpatient adults and children (Exner, 1995). Thus, one condition of an accurate Rorschach percept is

that it achieves a suitable match between the blot and the external object it purports to represent (Wagner, 1998).

While an accurate percept is characterized by congruency (i.e., correspondence between the blot and reality), a distorted or inaccurate percept is one that does not follow the contours or shape of the blot (Wagner, 1998). Such a percept is said to have poor form quality. The measure of perceptual inaccuracy or perceptual distortion for the Rorschach is the percentage of responses that show poor form quality *(X-%)* (Exner, 2001). *X-%* is also considered a measure of reality testing. Klieger (1999) notes that introducing the aspect of reality testing shifted the emphasis of a response process from "beyond a simple recognition task into the realm of interpretation and assignment of *meaning* to a stimulus" (page 129).

It is hypothesized that children with NVLD have RH dysfunction, that their underlying ability to process visual stimuli is disrupted which among other things, results in perceptual inaccuracies.

LD studies

Champion, Doughtie, Johnson & McCreary (1984) were the first to use the Rorschach Inkblot Test to investigate the performances of children with learning problems. The authors found that children with LD may show problems in perceptual accuracy and reality testing as defined by a higher *X-%*. In a related study, Harper and Scott (1990) compared children with LD and found a similar pattern. The results of these studies suggest variables sensitive to perceptual accuracy may differentiate children with learning disabilities from those without.

However, neither study specified the nature of the learning problem as primarily verbal or nonverbal. Therefore, it is unclear whether the perceptual problems noted were specific to one subset of LD.

In 1990, Acklin elaborated on Champion et al.'s (1984) and Harper and Scott's (1990) studies by creating a within group comparison of LD separating groups with visuospatial problems (NVLD) and linguistic problems (VLD). Acklin concluded that there were no significant differences between the VLD and NVLD groups, with both showing equal signs of perceptual inaccuracy and distortion (a higher *X-%).* However, Acklin's study suffered a number of methodological problems that skew the interpretability of the findings. For example, Acklin used scores from archival data records and did not have access to the original protocols or copies of the actual responses. More importantly, the archival records used existed prior to the Exner system. Given the lack of standardization and tremendous variability in scoring and administration procedures prior to the Exner system, the validity and reliability of the scores is questionable. Ritzler and Exner (1995) argue that archival data is only valid and reliable if the data are collected using the comprehensive system, the records are available for review, and inter-rater reliability can be established. A second methodological weakness in Acklin's study is his use of Exner norms data as the control group. Weiner (1996) states that control groups are deliberately heterogeneous and almost any group that is homogeneous for some features should differ from published referenced groups.

ADHD studies

While no studies were found that looked specifically at Rorschach responses of children with ADHD/PI, three were found involving children with ADHD. Horn (1994) compared children with ADHD+LD and ADHD without LD (ADHD-LD) to a control group on measures of perceptual accuracy (*X-%).* Children with ADHD, regardless of LD classification, gave significantly more distorted responses than the control group. Cotungo (1995) compared children with ADHD (no subtypes identified) to a clinical group and a control group on Rorschach measures of perceptual accuracy. It was hypothesized that children with ADHD would have problems delaying their responses, miss important attributes of the stimuli and make hurried, uninformed responses. In the study, both children with ADHD and the clinical control group had significantly more inaccurate perceptions (as defined by an extremely high *X-%*) than the control group. However, because children within the ADHD group were not screened for coexisting learning problems (and comorbidity estimates between ADHD/H and LD range from 25-70%), it is unclear whether learning differences or attentional factors may have played a role.

Bartell and Solanto (1995) compared children ages 5-12 with ADHD and ADHD plus Oppositional Defiant Disorder (ODD) and noted both groups showed significantly high *X-%*. It is important to note that while some Rorschach variables become stable around age 8, scoring indices are not considered reliable for children as young as 5. Because ADHD is often concurrent with LD, the

authors speculated that the high *X-%* could be a function of visual perceptual or verbal processing deficits rather than impulsivity.

VISUAL SYNTHESIS AND INTEGRATION (*DQ+*)

Definition

The second research question in this study is related to visual synthesis and integration. In Rorschach terms, integration or synthesis occurs when the subject forms relationships between the elements of the blot rather than simply reporting singular objects. The notation for a response that includes integration between two or more objects is *DQ+*. Acklin and Fechner-Bates (1989) examined the association of *DQ* (developmental quality) and found a statistically significant association between *DQ+* score and the Perceptual Organization of the Wechsler Intelligence Scale-Revised (WAIS-R) ($p < .001$). An example of a response receiving *DQ+* is found on Card VIII. Many subjects often report the pink parts on either side represent an animal. The response is so common it is considered a Popular response (i.e., it occurs in an unusually high frequency among protocols in most groups of people) (Exner, 2001). Other subjects report that the animal(s) are involved in some type of activity such as climbing a tree or mountain, or walking across rocks. Responses where one aspect of the blot (animal) is involved in a meaningful relationship with another aspect of the blot (tree or mountain) require a higher level of cognitive activity because it requires the individual to organize the stimulus field in a more sophisticated manner. The response would be scored *DQ+*.

Adult studies

Studies have shown that the ability to integrate and organize visual stimuli influences the Rorschach response and is differentiated between the left and right hemispheres (e.g., Brugger & Regard, 1995; Hall & Lovie, 1968; Kestanbaum-Daniel et al., 1988). As discussed previously, the left hemisphere has been found to specialize in identifying and interpreting parts or fine details, while the right is specialized for processing the gestalt and integrating parts of the whole. Hall and Lavoie (1968) examined the impact of lesions in the right versus the left hemisphere on a number of Rorschach variables including *DQ+*. These authors found that adult patients with right hemisphere damage tended to elaborate on nonessential details and integrated their responses in bizarre ways. Kestanbaum-Daniels, et al. (1988) found that damage to the posterior area of the left temporal lobe interfered with an individual's ability to detect and process small details on the Rorschach. Patients with right-sided cortical damage had difficulties forming an integrated whole response. The authors found that patients with RH damage were able to perceive individual details of the blot but they could not integrate the details in such a way to form a gestalt. In his review of neuropsychological signs in Rorschach responses, Kleiger (1999) notes a subject with RH damage who looked at Card V and said, "I see wings…antennae…and legs" but failed to synthesize the responses into an integrated whole of "a bat" (page 325).

ADHD studies

Cotugno (1995) did not find differences on *DQ+* between children with ADHD, the clinical group and the control group. Horn (1994), however, noted a

slightly higher (non significant) difference between the ADHD group and the control group on *DQ*+. No differences were found between ADHD+LD and ADHD-LD. However, it is important to note that the control group in Horn's study was comprised of children who were nominated by their teacher as having average to above average intelligence and no known learning disability. Because these children did not complete the assessment battery required of the children in the ADHD groups, it is unclear whether the control subjects were truly free of attentional and/or learning problems. The potential for group overlap presents a serious confound that limits the interpretability of these findings.

SOCIAL ATTRIBUTION (*M*)

Definition

The third question of this study deals with social attribution. For purposes of this study, social attribution is defined as the ability to impose a social template when interpreting ambiguous stimuli. The *M* variable is used to investigate perceptual processes when human meaning is involved. Specifically, the *M* score is used to indicate projection of human movement such as "I see two people dancing" to Card III. Exner (1993) states that *M* answers reflect, in part, an interest in human interaction. Blatt (1990) explains that unlike the *H* responses, which also deal with human content, *M* responses require more effortful processing and an understanding of human behavior. Among the several ways in which the *M* responses in a record may be problematic, the most obvious is the low frequency of occurrence. Exner (1993) suggests that subjects who give very few *M* responses are likely to be pathologically withdrawn from engaging in

or even thinking about interactions with people.

Adult studies

The *M* variable has been the subject of more empirical studies than any other Rorschach variables. A recent study conducted by Burns & Vigilone (1996) showed that the *M* variable, which is related to social functioning, has been shown to predict social functioning over and above variables such as education, intelligence, age and income. *M* responses have been found to be correlated with intelligence measures and higher levels of intellectual operations that require deep and meaningful processing such as abstract thinking (Exner, 1995). Brugger and Regard (1995) demonstrated the extent to which one can produce meaningful responses on the Rorschach might be related to access to right hemisphere processing. In 1993, Brugger and colleagues demonstrated that the RH is more inclined to see meaningful configurations in random patterns of dots than the left. Using a similar procedure, Brugger and Regard (1995) presented the inkblots to subjects who were blind-folded covering the left visual field (related to right hemisphere processing) and later covering the right visual field (related to left hemisphere processing). The authors tape-recorded the subjects' responses and noted that subjects with access to their left visual field (RH) were able to produce responses representing more psychological complexity including human interaction (*M*) and visual integration (*DQ+).* The authors reasoned that RH bias should not be simply confined to nonverbal processing but may also include semantic processing when depth and meaningful processing is required.

ADHD studies

Only a few child studies were found that directly addressed the *M* scoring variable. While *M* responses did not differentiate between children with ADHD or those with LD in a study by Horn (1994), Gordon and Oshman (1981) found hyperactive children gave significantly fewer *M* responses compared to children from a control group. While the limitations of Horn's (1994) study have been addressed, Gordon and Oshman's (1981) study suffered methodological problems that limit the interpretability of the results. These authors utilized the Klopfner scoring system and many of the protocols included too few responses to be valid. Bartell and Solanto (1995) noted a significantly lower *M* score for children with ADHD/H and ADHD/ODD and suggested these children may have failed to mediate the percept correctly due to impulsivity.

SOCIAL DISTORTION (*M*-)

Definition

When children with NVLD attribute social meaning to a stimuli, are they more likely to distort the percept? This is the final question of this study. The Rorschach variable purported to measure social distortion is *M*-. While the *M* variable deals with attributing social meaning to ambiguous stimuli, a large number of *M* responses do not indicate social competence. *M* responses, like those involving just form, are evaluated according to the perceptual accuracy of the form of the percept. A poor or minus (-) form quality score is given when the subject disregards the appropriate use of the contours of the blots in a response which involved human movement (Exner, 1993). Exner (1986) contends subjects

who give *M* responses with – (minus) form level have an interest in people, but they may have a propensity for inaccurate or unrealistic interpretations of interpersonal situations (i.e., they distort social stimuli). Smith et al. (2001) have shown *M*- is a particularly robust indicator among children and adolescents.

Child studies

Adolescents and even young children are a bit more likely to give an *M*- response than adults. Nevertheless, the percentage of patients giving *M*- is small enough to warrant viewing even a single distortion of this kind as evidence of an inclination to misperceive the implications of social situations and, ultimately, exhibit poor judgment in interpersonal relationships (Exner, 1993). In her study of children with ADHD, Horn (1994) did not find *M*- to differentiate between children with ADHD with or without LD from each other or from the control group.

Statement of the Problem

Children with NVLD are thought to suffer nonverbal perceptual deficits purported to be sequelae from right hemisphere (RH) insult or maldevelopment (Rourke, 1989). In examining case studies and performances on neuropsychological measures, it appears these children have difficulty perceiving and translating visual perceptual stimuli into meaningful concepts (Harnadek & Rourke, 1994; Loveland et al., 1990; Little, 1993; Myklebust, 1975; Rourke & Fisk, 1988). While there is strong empirical and anecdotal evidence to suggest

these children misinterpret visual stimuli, the nature of their cognitive perceptual errors is not clearly understood. Therefore, the current study was designed to explore the processes by which children with NVLD translate visual stimuli into meaning to determine the nature of the misinterpretations (i.e., what visual perceptual errors are occurring?). In this study it was hypothesized that, when faced with ambiguous visual stimuli, children with NVLD would demonstrate four specific cognitive perceptual errors. These errors and the associated Rorschach variables to investigate them include: (1) visual distortion (*X-%*), lack of visual synthesis and integration (*DQ+*), limited social attribution (*M*), and social distortion (*M-*).

A confound in many of the studies discussed has been the failure to consider the potential role of attention in performance deficits in children with NVLD. Because ADHD/PI and NVLD share many behavioral, neurocognitive, etiological and emotional characteristics, it is unclear whether ADHD/PI is a subset of NVLD or whether NVLD is a subset of ADHD or if they both are simply different expressions of RH deficits. The overlap between these disorders represents an important area of study. Therefore, the second purpose of this study was to examine whether or how children with NVLD with coexisting ADHD/PI (NVLD+ADHD/PI) differ in their responses from children with ADHD/PI and children from a control group on the selected Rorschach variables. Examination of these responses may be informative in determining whether a pattern of cognitive perceptual errors is unique to NVLD or a factor of inattention. While this study represents a first step at understanding the manner in which children

with NVLD respond to visual stimuli, awareness of their pattern of responses may offer insight into future assessment options and facilitate new, more appropriate intervention strategies.

RESEARCH QUESTION 1: Do children with NVLD + ADHD/PI show more signs of perceptual distortion as measured by *X-%* than children with ADHD/PI and the control group?

Hypothesis 1a: Children with NVLD + ADHD/PI will show more signs of perceptual distortion than will children with ADHD/PI.

Hypothesis 1b: Children with NVLD + ADHD/PI will show more signs of perceptual distortion than will children from the control group.

Research has shown that children with NVLD perform poorly on recognition tasks despite the fact that they posses knowledge of the objects represented and can name them correctly (Johnson, 1987; Myklebust, 1975). However, determining the nature of the problem is complex as recognition errors can occur for a number of reasons. Exner (1991) has shown that the process by which one "recognizes" a Rorschach inkblot is similar to those required in naming a known object and, with the exception of those who have serious neurological impairment, most people identify the blots in a common way (i.e., provide responses that conform with the contours of the blot). *X-%* provides a way to determine if a child's responses do not conform with or violate the contours of the blot (i.e., distort the percept). Only a few studies have looked at

the *X-%* variable in relation to NVLD; however, the interpretability of the findings have been questionable as each study suffered significant methodological weaknesses. For the proposed study it is hypothesized that children with NVLD+ADHD/PI would show more signs of visual perceptual distortion than children with attentional problems alone or the control group.

RESEARCH QUESTION 2: Do children with NVLD + ADHD/PI show fewer signs of visual synthesis measured by developmental quality (*DQ+*) than children with ADHD/PI and the control group?

Hypothesis 2a: Children with NVLD + ADHD/PI will show fewer signs of visual synthesis than will children with ADHD/PI without NVLD.

Hypothesis 2b: Children with NVLD + ADHD/PI will show fewer signs of visual synthesis than will children from the control group.

Myklebust (1975) contends that because children with NVLD are able to name individual objects correctly, their misperceptions are not perceptual in nature but are due to the child's inability to organize and integrate separate visual percepts into a meaningful gestalt. Failures of integration or part-whole deficits have been noted on performances in visual recognition and visuoconstructive tasks in the NVLD (Johnson, 1987; Myklebust, 1975; Rourke, 1988). Some researchers contend failures of integration are a factor of LD and are not specific to NVLD (Brumback, 1990), while others have suggested these failures may be a function of inattention (Denckla, 1978). Examining the developmental quality

(*DQ*+) of the child's responses will be used to measure the extent to which children with visual perceptual deficits are able to integrate and synthesize visual perceptual stimuli as compared to children with ADHD/PI and a control group. It was hypothesized that children with NVLD+ADHD/PI would likely fail to integrate aspects of a blot and may, instead, choose to report objects singularly or as a pair using the symmetry.

RESEARCH QUESTION 3. Do children with NVLD + ADHD/PI show fewer signs of social attribution as measured by *M* than children with ADHD/PI and a control group?

Hypothesis 3a: Children with NVLD + ADHD/PI will show fewer signs of social attribution than will children with ADHD/PI.

Hypothesis 3b: Children with NVLD + ADHD/PI will show fewer signs of social attribution than will children from the control group.

Rourke (1989) hypothesizes that deficits in visual-perceptual-organizational skills in children with NVLD give rise to problems in requisite skills that subserve these social competencies including deciphering the meaning of various facial expressions, gestures, and other forms of nonverbal information important for effective social perception. These deficits hinder the child's ability to glean information from nonverbal stimuli. As a result, they may not have developed the requisite perceptual abilities or social schemata necessary to view the world through a social framework. Neuroimaging studies of adults with RH

damage and studies of children with autism spectrum disorder (AD) suggest the ability to see the world through a social lens may be related to the prefrontal cortex of the RH (Schultz et al., 2000). Other studies have suggested children with autism spectrum disorders may improperly process social information (namely faces) in a piecemeal manner as though they were objects. The third question of this study considered whether children with NVLD would impose a social frame or infer social meaning when presented with ambiguous visual stimuli by using the *M* variable. Rorschach studies have shown that most individuals will attribute movement and social meaning in one or more of the inkblots. It was hypothesized that children with NVLD+ADHD/PI would be less inclined to infer social meaning in contrast to children with ADHD/PI and a control group into the blots.

RESEARCH QUESTION 4. Do children with NVLD + ADHD/PI show more signs of social distortion as measured by *M*- than children with ADHD/PI and a control group?

Hypothesis 4a: Children with NVLD + ADHD/PI will show more signs of social distortion than children with ADHD/PI.

Hypothesis 4b: Children with NVLD + ADHD/PI will show more signs of social distortion than children from the control group.

Myklebust (1975) contends that NVLD is more debilitating than VLD because deficits in verbal process "… do not seriously violate the experience…[however]; deficits in nonverbal processes lead to distortion of the

experience itself." (page 87). Rourke and Fisk (1988) and Loveland and colleagues (1990) provided empirical support for this idea by demonstrating that while children with verbal deficits missed nonessential verbal details of social situations, the errors committed by children with nonverbal deficits (failing to interpret or misinterpretation of gestures, eye contact, facial expressions) resulted in the distortion of the overall meaning of the given social exchange. While the previous research question, #3, addresses the extent to which children with NVLD attribute social meaning to ambiguous stimuli, question #4 investigates whether children with NVLD will distort when faced with ambiguous stimuli for which they have attributed social meaning.

CHAPTER III: METHODOLOGY

Chapter III is divided into four major sections: *Participants, Instrumentation, Statistical Analysis* and *Hypotheses.* The *Participants* section includes demographic information, inclusionary and exclusionary criteria used to establish group membership, and the data collection procedures. The second section, *Instrumentation*, includes the descriptions and associated psychometric properties of the independent and dependent measurement instruments. Issues of inter-rater reliability are also discussed. In the third section, *Statistical Analysis*, the nonparametric techniques that were used to test the hypotheses will be presented. In the final section, *Hypotheses*, the research questions and hypotheses for this study are reviewed.

Participants

DEMOGRAPHICS

Fifty-four students participated in the study comprising three groups (n = 18 per group): (a) NVLD plus ADHD/PI (NVLD+ADHD/PI), (b) ADHD/PI without NVLD (ADHD/PI), and (c) a Control Group. The participants included 36 males and 18 females between the ages of 8 and 14. The sample of 54 participants included 44 Caucasian (81.5%), 5 Hispanic (9.3%) and 5 African-American (9.3%) students. Table 1 outlines the breakdown for ethnicity and gender per group.

Table 1: Ethnicity and Gender Breakdown Per Group

Group	Ethnicity	Male	Female	Total
NVLD+ADHD/PI				
	Caucasian	14	2	16
	African American	1	1	2
	Hispanic	0	0	0
	Total	15	3	18
ADHD/PI				
	Caucasian	11	1	12
	African American	1	1	2
	Hispanic	3	1	4
	Total	15	3	18
Control				
	Caucasian	4	11	15
	African American	1	0	1
	Hispanic	1	1	2
	Total	6	12	18

RECRUITMENT

The majority of the 54 participants for this study (n = 44; 81.4%) were part of an ongoing research project at the University of Texas at Austin (UT). The project is designed to provide teachers, administrators, and parents with assessment and intervention information that will assist them in managing the educational and social needs of students suspected of having learning disabilities and/or learning delays. The author of this study serves as a primary researcher on this project under the direction of Margaret Semrud-Clikeman, Ph.D. The Institutional Review Board (IRB) form for this project is provided in Appendix B.

As outlined in the IRB, the referral sources for the project include:

- School personnel from the Austin Independent School District (AISD), Eanes Independent School District (EISD) and Rawson Saunders School
- Austin Neurological Clinic (ANC)
- Children's Hospital of Austin (CHOA)
- Community referrals

The remaining 10 participants for the study (18.6%) were students who had originally participated in a research study under the direction Dr. Melanie Horn, a graduate of the University of Texas at Austin's School Psychology Program. In her dissertation study entitled *An Exploratory Study of the Rorschach Responses of Children with Attention-Deficit Hyperactivity Disorder*, Dr. Horn administered the independent and dependent measures used in the current study. The IRB approved the use of Dr. Horn's archival records for the current study in May 2000. Because the records were originally recruited from ANC, the IRB stipulated that current ANC employees were permitted to review clinic records for research purposes. Thus, the lead investigator, an employee of ANC, was granted approval to review the archival records by an ANC director, Dr. Nancy Nussbaum.

PROCEDURES

Data Collection

Letters inviting students to participate in the study were circulated to parents from the participating school systems (AISD, EISD, Rawson Saunders) and ANC. A member of the school or clinic staff signed the letters. A consent form was sent along with the letter. Parents of students who were referred from the community or from CHOA were mailed a letter and registration form directly from UT and contacted by the lead investigator. An example of the AISD letter and the UT registration form are included in Appendix C.

Parents who wished their children to participate in the study returned the registration form to UT. Once the form was received, a member of the research team contacted the parent(s) to determine if the student met age and symptom eligibility criteria. If criteria were met, a Parent Packet, which consisted of behavioral questionnaires and a parent consent form, was sent to the family. Once the investigator received the completed questionnaires and a signed consent form, students were enrolled in the project. The child completed a Student Assent Form at the first interview/assessment visit. Copies of the consent and assent forms are located in Appendix D.

All data entry, analysis, and reporting utilized coded identification numbers rather than student names in an effort to protect confidentiality. All protocols and questionnaires were secured in a locked file in the office of the lead investigator, Dr. Semrud-Clikeman. The archival protocols and questionnaires, minus the identifying information, were secured in a locked file cabinet in the

office of the lead investigator. Based on parent request, all interviews and assessments were conducted at either the student's school, home or in the School Psychology Program assessment rooms. Once testing was completed, a brief written report was mailed to the parents.

Administration and Scoring

Administrators had graduate level training and experience using all of the instruments. The administration and scoring procedures outlined by the test manuals were followed and the lead investigator reviewed all test records for group membership. Placement into groups was consistent with the criteria that were established. Participants who did not have valid and current testing scores (i.e., less than a year old) completed the measures in a one-on-one testing environment. Participants who had one or more valid test (i.e., less than one year old) were not asked to complete those measures and the previous test scores were accepted. All Rorschach testing, including that of Dr. Horn was conducted following the standardized administration and scoring procedures outlined in Exner's Comprehensive System (1986). All responses and inquiries were taped to enable cross checking and inter-reliability. The Rorschach sequence of scores in the structural summary was collected manually, and these scores were used to complete the computerized structural summary. A computerized version was used in order to reduce the likelihood of transposing and/or mathematical errors.

To insure inter-rater reliability, two administrators independently scored 12 of the Rorschach protocols. The number of protocols selected represented 22% of the total (N = 54), slightly exceeding the proportion suggested by Acklin and

McDowell (1995). These authors suggest that an 80% agreement among administrators on at least 20% of the records is required to establish inter-rater reliability. Of the 12, 9 of the protocols were from recently recruited participants and 3 were protocols from the archival data set. Inter-rater reliability was calculated on the four variables investigated. The averages were 86.9% for *X*-%; 95.3% for *DQ+;* 95.2% for *M* and 88.7% for *M*-. Based on these results, it was determined the values of the variables under investigation were properly scored.

GROUP CRITERIA

Participants selected for the study were required to receive a Full Scale IQ score of 85 or higher. Research has shown that individuals with intellectual limitations may be limited in their ability to participate in the Rorschach (Exner, 1986). Subjects who obtained IQ scores below 85 were excluded from the study. The average IQ overall was 108.96 (*SD* = 17.70). All participants were identified as being right handed, primarily English speaking and free of gross neurological, sensory, language and psychotic disorders as well as co-existing diagnoses of Conduct Disorder, Major Depressive Disorder, and severe anxiety disorders. Six additional children completed the testing measures for the study but their protocols were not included in the data set for the following reasons: Two students received an IQ score below 85, one had a diagnosis of Major Depressive Disorder, one had ADHD with hyperactivity, and one child did not provide enough responses on the Rorschach Inkblot test to be considered valid.

NVLD + ADHD/PI Group

Although many studies have concurred on the deficits that define a nonverbal learning disability, clearly defined diagnostic criteria for the disorder have yet to be established. Studies have differed in the way they determine NVLD status with some basing their diagnosis on a VIQ/PIQ split (Rourke & Fuerst, 1991; Weintraub & Mesulam, 1983), care taker ratings (Casey et al., 1991) or simply motor delays with VMI and motor weakness in neurological measures (Lyytinen & Ahonen, 1989). In 1994, Harnadek and Rourke examined the identifying features of NVLD to determine which features were the most discriminative. These authors determined that intact verbal skills in the presence of deficits in visual-perceptual organizational psychomotor coordination and complex tactile perceptual skills appeared to be the most representative of the NVLD syndrome in children examined. Based on Harnadek and Rourke's findings, participants selected for the NVLD Group were required to demonstrate:

1. FSIQ $\geq$ 85
2. Age appropriate verbal skills as measured by a standard score of $\geq$ 85 on the Vocabulary subtest of the WISC-III.
3. Impaired performance in at least two of three areas of functioning:
    a. visual spatial skills as measured by a standard score of < 85 on the Block Design subtest of the WISC-III.
    b. visual organizational skills as measured by a standard score of < 85 on the Rey Osterreith Complex Figure Drawing (Rey-O).

c. graphomotor skills as measured by a standard score of < 85 on the Beery Developmental Test of Visual Motor Integration (VMI).

Children with NVLD often show symptoms consistent with a diagnosis of ADHD/PI. Thus, in addition to the inclusionary criteria, subjects selected for the NVLD Group also met DSM-IV criteria for ADHD/PI. To establish criteria, parent(s) were asked questions from the Structured Interview for Diagnostic Assessment of Children for DSM-IV (SIDAC).

ADHD/PI Group

Participants for the ADHD/PI Group were required to meet the severity and age of onset criteria set forth in DSM-IV by using the SIDAC. Participants from Dr. Horn's study who were diagnosed with inattention using previous criteria established in DSM-III (referred to as ADD-H) were used. In addition to meeting criteria for ADHD/PI or ADD-H, participants for the ADHD/PI group were required to demonstrate:

1. FSIQ $\geq$ 85
2. Age appropriate verbal skills as measured by a standard score of $\geq$ 85 on the Vocabulary subtest of the WISC-III.
3. Performance within the normal range in at least two of three areas of functioning:

a. visual spatial skills as measured by a standard score of ≥ 85 on the Block Design subtest of the WISC-III.
b. visual organizational skills as measured by a standard score of ≥ 85 on the Rey-O.
c. graphomotor skills as measured by a standard score of ≥ 85 on the VMI.

Control Group

Control participants were those children who did not meet criteria for ADHD/PI, but satisfied inclusionary criteria and had at least average school performance. Participants for the Control Group were required to demonstrate:

1. FSIQ ≥ 85
2. Age appropriate verbal skills as measured by a standard score of ≥ 85 on the Vocabulary subtest of the WISC-III.
3. Performance within the normal range in at least two of three areas of functioning:
    a. graphomotor skills visual spatial skills as measured by a standard score of ≥ 85 on the Block Design subtest of the WISC-III.
    b. visual organizational skills as measured by a standard score of ≥ 85 on the Rey-O.

c. graphomotor skills as measured by a standard score of $\geq$ 85 on the VMI.

Instrumentation

INDEPENDENT MEASURES

Wechsler Intelligence Scale for Children – Revised (WISC-R; Wechsler, 1974) and the Wechsler Intelligence Scale for Children – Third Edition (WISC-III; Wechsler, 1991).

The WISC-III (previous version known as WISC-R) is an individually administered intelligence test consisting of 13 subtests that yield Full Scale, Verbal and Performance IQ scores. Although the WISC-R and WISC-III provide a comprehensive assessment of cognitive functioning, its long administration time often precludes its use when testing time is limited. Therefore, two specific subtests, block design and vocabulary, were used and their scores prorated to determine an overall IQ score. In his latest edition of Assessment of Children – 4th Edition, Sattler (2001) states these two subtests provide an efficient and accurate measure of intelligence because they correlate most highly with the Full Scale IQ: Vocabulary correlates .91 and Block Design correlates .86. Using this short form to establish FSIQ has been used in studies of ADHD (Kaplan et al., 2000).

Of the 54 participants, 44 completed the subtests of the WISC-III and 10 completed the subtests of the WISC-R. The correlation of items between the two WISC short form versions is approximately 73%, with over thirty validation studies which showed the median changes between the two test versions average around five to six points lower on FSIQ for the WISC-III as compared to the WISC-R (Sattler, 2001). In addition to establishing a prorated FSIQ, the block

design and vocabulary subtests were used to establish whether age appropriate verbal skills existed in the presence of relatively lower visual spatial skills.

Rey Osterreith Complex Figure Drawing (Meyers & Meyers, 1995)

The Rey Osterrieth Complex Figure Drawing, also known as the Complex Figure (CF) and Rey Figure (RF), is a measure of visuoconstructional ability. The full administration of the test (copy, immediate recall and delayed recall) permits assessment of a variety of cognitive processes including planning, organization, and problem solving strategies as well as perceptual motor and memory functioning. However, for purposes of this study, the copy portion of the test was used to test perceptual, visuospatial and organizational skills. The Johnson scoring system was used to score the 44 subjects from the current study. The Rey-O protocols of the 10 archival subjects were originally evaluated using an alternative scoring system. The archival protocols were re-scored using the Johnson system.

Developmental Test of Visual-Motor Integration (VMI; Beery, 1997)

The VMI was selected as a test of graphomotor skills. The VMI has been shown to be useful for the exploration of visual-perceptual and motor skills in children, especially for those with learning disabilities and other neuropsychological deficits. To complete the VMI, a subject is presented with 24 geometric designs to be copied in clearly delineated squares of space. The designs are intended to follow a developmental gradient of difficulty starting with a vertical line for 2 year old progressing to a three-dimensional cube for 14-15 year olds. The validity studies of VMI focus on correlations with the Bender Gestalt

test ranging from .74 to .79. The VMI will be used in this study as a measure of graphomotor skills. The inter-rater reliability averages .79 (Spreen & Strauss, 1988).

The original VMI scoring system used a dichotomous scoring system with a maximum raw score of 27. In 1989, the revised manual included a 1-4 scoring system for older children with a maximum score of 50. However, the scoring system returned to a 27-point system in 1997 (Spreen & Strauss, 1998). The 50-point scoring system was originally used to score the VMI protocols of Dr. Horn's subjects. The 10 participants selected from Dr. Horn's archival records were re-scored using the 27-point system, making the VMI data set comparable.

Structured Interview for Diagnostic Assessment of Children for DSM-IV (SIDAC)

The SIDAC is a semi structured, diagnostic interview that can be administered to the child, the caregiver and/or the teacher. The SIDAC includes questions about symptoms found in the DSM-IV (American Psychological Association, 1994) for the diagnosis of ADHD, conduct disorder, depression, dysthymia, overanxious disorder, separation anxiety disorder, and oppositional defiant disorder. Inter-rater reliability has been found to be .77 to .80 (Morgan, Hynd, Riccio, & Hall, 1996). To complete the SIDAC, the caregiver is asked "Has *child's name* had any of the following problems for at least the last six months?" The caregiver is then asked questions regarding each symptom outlined in the DSM-IV criteria for ADHD (see Appendix A). If at least 6 of the inattention items and less than 6 of the hyperactivity/impulsivity items are

endorsed, the student meets criteria for ADHD/PI. If at least 6 of the hyperactivity/impulsivity items and less than 6 of the inattention items are endorsed, the student meets criteria for ADHD/Predominately Hyperactivity-Impulsive Style. If at least 6 of the inattention items and at least 6 of the hyperactivity/impulsivity items are endorsed, the student meets criteria for ADHD Combined Type.

DEPENDENT MEASURE

The Rorschach Inkblot Test was used as the dependent measure. Exner's most recent manual, *A Rorschach Workbook for the Comprehensive System, 5th Edition* (Exner, 2001) was used for administration and scoring purposes. Specifics regarding reliability and validity were discussed in Chapter II.

Statistical Analysis

DESIGN

Before determining the proper analysis technique for testing the hypotheses, tests of normality were performed using the Kolmogorov Smirnov technique with the Lillifors correction. The results of the analysis indicated normality assumptions could not be made for three of the four dependent variables; therefore, a nonparametric design was used. The Kruskal Wallis technique was selected because it allows for the comparison of more than two groups. The assumptions for the technique include:

1. Each case is represented only once (no repeated or matched sample).
2. The groups represent different levels of a single independent variable, and consist of at least six cases in each group.
3. The populations represented by the groups have symmetrical distributions or, at least, the distributions have similar shapes. Although the data is not normally distributed, each of the distribution groups is assumed to have similar distribution shapes on the dependent variable.

The design of this study satisfies each of these assumptions: Three groups were used; each representing different levels of the independent measures of LD: NVLD+ADHD/PI, ADHD/PI and No LD (control) and each group consisted of more than 6 subjects. Although the populations of the groups were not normally distributed, a histogram was constructed and inspected visually visual scan and, based on the shape of the distribution, it was determined that the groups had roughly similar shapes with respect to the dependent measure.

Another assumption of the Kruskal Wallis is that the variables are continuous. As depicted in Figure 2., the *M*- dependent variable could be considered a dichotomous variable. Therefore, this variable was analyzed using the Kruskal Wallis and a separate chi-square analysis.

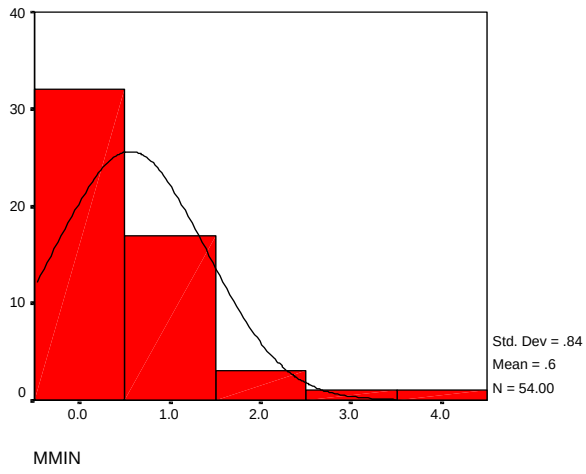

Figure 2: Distribution of Social Distortion (*M*-).

PROCEDURE

The Kruskal-Wallis procedure compares the average ranks of the samples against the average ranks that would be expected if the groups were drawn from a population of identically treated cases. The test statistic for Kruskal - Wallis is *H*, and varies in value as a function of the size of the disparity between observed average ranks and average ranks that would be expected if there were no group effect (Diekoff, 1996; Siegel, 1988). If the groups are identical, *H* will be 0; and the more disparate the groups, the higher the *H* value. The probability of obtaining a value of *H* if all the samples are treated the same (come from the same group) is obtained by comparing the *H* against the sampling distribution of chi-square (*X2*) for *k-1* degrees of freedom, where *k* = the number of groups. The sampling distribution for *H* is nonexistent; it simply looks like that for the chi-square distribution. If the computed value of *H* meets or exceeds the critical

value of *x* for *df* = *k*-1 at the selected significance level, the obtained *H* has a small probability of occurring in the absence of a treatment (group) effect (Diekoff, 1996; Siegel, 1988).

The results of the Kruskal-Wallis test will only indicate *whether* a significant difference exists between the groups. It does not indicate *where* the difference is found (i.e., which groups in particular differ on a given dependent variable). A specified post hoc technique is not part of the Kruskal Wallis procedure; however, the Mann-Whitney U is considered a conservative and appropriate follow up technique for nonparametric tests when the samples are independent. The technique is similar to the parametric *t*-test in that it tests the differences between groups individually. The Mann-Whitney U was used as the post hoc procedure for this study. Because this is a planned comparison rather than an exploratory analysis, directional hypotheses were made regarding differences between (a) NVLD+ADHD/PI and ADHD/PI (b) NVLD+ADHD/PI and the Control group. No specific hypotheses were made concerning comparisons between the ADHD/PI group and the control group.

Hypotheses

RESEARCH QUESTION 1: Do children with NVLD + ADHD/PI show more signs of perceptual distortion as measured by *X-%* than children with ADHD/PI and the control group?

Hypothesis 1a: Children with NVLD + ADHD/PI will show more signs of perceptual distortion than will children with ADHD/PI.

Hypothesis 1b: Children with NVLD + ADHD/PI will show more signs of perceptual distortion than will children from the control group.

RESEARCH QUESTION 2: Do children with NVLD + ADHD/PI show fewer signs of visual synthesis measured by developmental quality (*DQ*+) than children with ADHD/PI and the control group?

Hypothesis 2a: Children with NVLD + ADHD/PI will show fewer signs of visual synthesis than will children with ADHD/PI without NVLD.

Hypothesis 2b: Children with NVLD + ADHD/PI will show fewer signs of visual synthesis than will children from the control group.

RESEARCH QUESTION 3. Do children with NVLD + ADHD/PI show fewer signs of social attribution as measured by *M* than children with ADHD/PI and a control group?

Hypothesis 3a: Children with NVLD + ADHD/PI will show fewer signs of social attribution than will children with ADHD/PI.

Hypothesis 3b: Children with NVLD + ADHD/PI will show fewer signs of social attribution than will children from the control group.

RESEARCH QUESTION 4. Do children with NVLD + ADHD/PI show more signs of social distortion as measured by *M*- than children with ADHD/PI and a control group?

Hypothesis 4a: Children with NVLD + ADHD/PI will show more signs of social distortion than children with ADHD/PI.

Hypothesis 4b: Children with NVLD + ADHD/PI will show more signs of social distortion than children from the control group.

CHAPTER IV: RESULTS

Chapter IV is divided into two major sections. In the first section, the results of preliminary analyses[3] are reviewed. These analyses involved the individual level characteristics of the participants such as age, IQ, ethnicity, and socioeconomic status (SES). In the second section, the results of tests of the hypotheses are presented.

Preliminary Analyses

Comparisons between the three groups for ethnicity, mother's educational status, father's educational status, and gender were performed using chi-square tests. There was no statistically significant association between Ethnicity and Group, $X2(2, N = 54) = 6.3$, $p = .17$. Mother and father educational status was recoded into three groups: 1) High School or less, 2) Undergrad or some college, and 3) Graduate School and beyond. For mother's educational status, there was no statistically significant association between Group and the recoded variable using three groups, $X2(4, N = 54) = 3.9$, $p = .41$. For father's educational status, there was no statistically significant association between Group and the recoded variable using three groups; $X2(4, N = 54) = 8.0$, $p = .09$.

A statistically significant association was found between Group and Gender; $X2(2, N = 54) = 13.5$, $p < .001$. To determine whether a statistically significant relationship existed between males and females on the dependent variables, the Mann-Whitney U non-parametric test was employed. No

[3] The alpha level for all of the analyses conducted in this study was set at .05.

statistically significant differences were found for *X-%* (p = .48), *DQ+* (p = .47), or *M* (p = .84). A separate chi-square test was conducted to test the association between *M-* and Gender. No statistically significant relationship was found, $X2(1, N = 54) = 1.93$, $p < 0.30$.

The participants for the study ranged in age from 8 years, 0 months (96 months) to 14 years, 6 months (174 months) with the average age of 123.06 months (*SD* = 17.70). The average IQ was 108.96 (*SD* = 11.95). A One-way Analysis of Variance (ANOVA) was used to test for mean differences between groups on age and IQ. As shown in Table 2, no significant differences were found between groups based on IQ (p = .25). However, a statistically significant difference was found for age. The Tukey Honestly-Significantly-Different (*HSD*) test was used to determine which groups accounted for the difference. Table 2 shows a statistically significant difference was found between the NVLD+ADHD/PI group and the ADHD/PI group.

Table 2: Group Differences on Age and IQ

	Group	Mean	*SD*	*F*
Age				
	NVLD+ADHD/PI	171.2 $_A$	14.7	3.2*
	ADHD/PI	131.4 $_N$	21.5	
	Control	121.1	13.7	
IQ				
	NVLD+ADHD/PI	105.1	13.1	1.4
	ADHD/PI	110.8	10.4	
	Control	110.9	11.9	

n = 18 per group

Note. The subscripts indicate the means from other groups for which it differs using post-hoc multiple comparisons tests. N= NVLD+ADHD/PI; A = ADHD/PI; C = Control.

* $p < .05$.

To control for the effect of age, scores on the four dependent variables were transformed to z-scores based on the age-based norms and standard deviation scores provided in the Exner Comprehensive System. A follow up test was run to determine if a statistically significant association could be found between age (transferred to z-scores) and the dependent variables using the Mann-Whitney U non-parametric test. No significant differences were found. Due to the small sample size, the exact tests were computed in addition to the asymptotic tests and all were also statistically non-significant. An additional analysis was conducted on *M*- using a chi-square test. No significant relationship was found between *M*- and age.

As a final preliminary test, comparisons were made between participants from Dr. Horn's study (n = 10) and participants recently recruited (n = 44) on the dependent variables using *t*-test. No significant differences were found. There were no archival subjects used as control subjects; therefore, the control group was not included in this analysis.

Results of the preliminary analysis indicate a statistically significant relationship was not found for Group X (a) ethnicity, (b) SES and (c) IQ. A statistically significant relationship was found for Group X Gender and Group X Age; however, a follow-up analysis investigating these characteristics with the dependent variables indicated no statistically significance was found. Given these findings, these variables were not incorporated into the analysis.

Test of Hypotheses

OVERALL GROUP DIFFERENCES

The Kruskal Wallis procedure was used to determine if any differences existed between the groups on the dependent variables. The Kruskal Wallis procedure compares the average mean ranks between groups. Therefore, the z-scores for each variable were ranked from 1-54 to reflect the fact that there are 54 total scores for each dependent variable. For example, the highest z-score for *X-%* is ranked 54, the second highest is ranked 53 and so on. As depicted in Table 3, the average rank for *X-%* for the NVLD+ADHD/PI group was 45.06 compared to an average rank of 20.36 for the ADHD/PI group. Table 3 shows a statistically significant difference was found on three of the four dependent variables: Perceptual Distortion (*X-%*), Visual Synthesis (*DQ+*), and Social Attribution (*M*). Table 3 is graphically represented in Figure 3.

Table 3: Mean Rank by Groups on Dependent Variables

Dependent Variable	Group	Mean Rank	Kruskal-Wallis Test Chi-Square (*df* = 2)
Perceptual Distortion (*X-%*)			
	NVLD+ADHD/PI	45.06	34.03***
	ADHD/PI	20.36	
	Control	17.08	
Visual Synthesis (*DQ+*)			
	NVLD+ADHD/PI	15.53	8.93**
	ADHD/PI	34.33	
	Control	32.64	
Social Attribution (*M*)			
	NVLD+ADHD/PI	19.50	5.45*
	ADHD/PI	31.72	
	Control	31.28	
Social Distortion (*M-*)			
	NVLD+ADHD/PI	26.22	0.91
	ADHD/PI	28.25	
	Control	28.03	

* $p < .05$, ** $p < .01$, *** $p < .001$

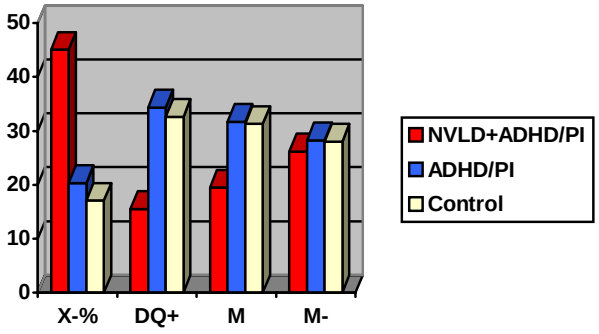

Figure 3: Mean Rank by Groups on Dependent Variables

PAIRWISE COMPARISONS

To determine which groups accounted for the differences on *X-%, DQ+,* and *M,* pairwise comparisons were performed using the Mann-Whitney U between the NVLD+ADHD/PI Group and ADHD/PI Group, and between the NVLD+ADHD/PI Group and a Control Group. A statistically significant difference was not found between groups on *M-*; therefore, this variable was not included in the post hoc analysis. Results of the mean rank comparisons between NVLD+ADHD/PI and ADHD/PI[4] are shown in Table 4. The following hypotheses were supported:

Hypothesis 1a: Children with NVLD+ADHD/PI will show more perceptual distortion than children with ADHD/PI; ($p < .001$).

Hypothesis 2a: Children with NVLD+ADHD/PI will show fewer signs of visual synthesis than children with ADHD/PI; ($p < .01$).

Hypothesis 3a: Children with NVLD+ADHD/PI will show fewer signs of social attribution than children with ADHD/PI; ($p < .05$).

The results of Kruskal-Wallis test indicated there were no significant differences between groups on *M-* ($p = .94$); therefore, the following hypothesis was not supported:

Hypothesis 4a: Children with NVLD+ADHD/PI will show more signs of social distortion than children from a control group.

[4] Although not part of the design of this study, post hoc comparisons between ADHD/PI and the control group revealed there were no statistically significant differences between these groups on any of the dependent variables.

Table 4: Overall Ranks Between NVLD+ADHD/PI and ADHD/PI

Dependent Variable	Group	Mean Rank	Sum of Ranks	Mann-Whitney U
Perceptual Distortion (*X-%*)				
	NVLD+ADHD/PI	27.06	487.00	8.00***
	ADHD/PI	9.94	179.00	
Visual Synthesis (*DQ+*)	NVLD+ADHD/PI	12.33	222.00	51.00**
	ADHD/PI	22.86	444.00	
Social Attribution (*M*)				
	NVLD+ADHD/PI	14.58	262.50	91.50*
	ADHD/PI	22.42	403.50	

Note. *n*= 18 per group.
* $p < .05$. ** $p < .01$ *** $p < .001$

Table 4 is graphically represented in Figure 4.

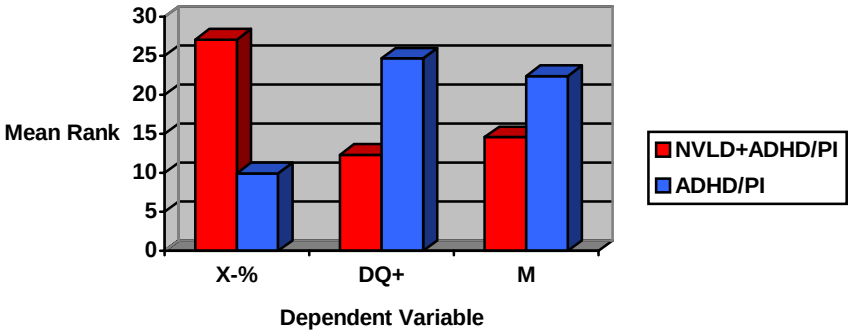

Figure 4. Overall Ranks Between NVLD+ADHD/PI and ADHD/PI

Results of the mean rank comparisons between NVLD+ADHD/PI and the control group are shown in Table 5. The following hypotheses were supported:

Hypothesis 1b: Children with NVLD+ADHD/PI will show more signs of perceptual distortion than children from a control group; ($p < .001$).

Hypothesis 2b: Children with NVLD+ADHD/PI will show fewer signs of visual synthesis than children from a control group; ($p < .01$).

Hypothesis 3b: Children with NVLD+ADHD/PI will show fewer signs of social attribution than children from a control group; ($p < .05$).

The results of the Kruskal Wallis indicated there were no significant differences between groups on *M*- ($p = .94$); therefore, the following hypothesis was not supported:

Hypothesis 4b: Children with NVLD+ADHD/PI will show more signs of social distortion than children from a Control Group.

Table 5**:** Overall Ranks Between NVLD+ADHD/PI and Control Group

Dependent Variable	Group	Mean Rank	Sum of Ranks	Mann-Whitney U
Perceptual Distortion (*X-%*)				
	NVLD+ADHD/PI	25.50	495.00	<0.01***
	ADHD/PI	9.50	171.00	
Visual Synthesis (*DQ+*)	NVLD+ADHD/PI	12.69	228.50	57.50**
	ADHD/PI	24.31	437.50	
Social Attribution (*M*)				
	NVLD+ADHD/PI	14.42	259.50	88.50*
	ADHD/PI	22.58	406.50	

Note. $n = 18$ per group.
* $p < .05$, ** $p < .01$, *** $p < .001$

Table 5 is graphically illustrated in Figure 5.

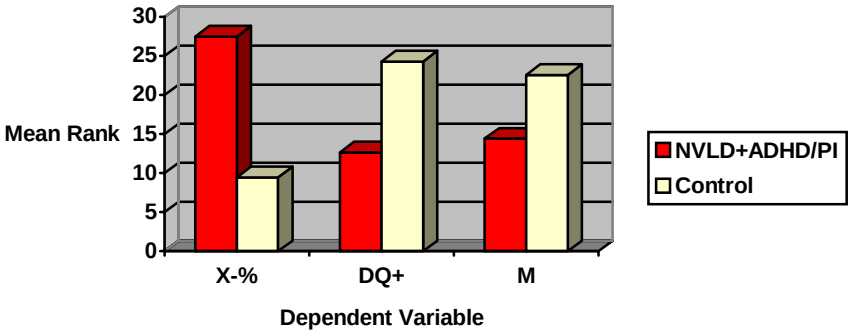

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Figure 5: Overall Ranks Between NVLD+ADHD/PI and Control Group

As previously discussed, it was determined that *M*- could be considered a dichotomous variable. Therefore, a separate chi square analysis was used to test the research questions regarding *M*-. Responses for *M*- were recoded into two groups: Responses of 0 or 1 were coded "0" and responses of 2 or more were coded as "1". Consistent with the results from the nonparametric test, there were no significant differences between groups on *M*- ($p = .92$).

CHAPTER V: DISCUSSION

Summary and Discussion of Findings

Chapter V will be divided into three major sections. The first section will be organized around the four major findings relating to Perceptual Distortion (*X-%*), Visual Synthesis (*DQ+*), Social Attribution (*M*) and Social Distortion (*M-*). Within this section, explanations of each specific finding will be considered in the context of existing research. In Section Two, the implications of the study will be presented. In the Third Section, *Strengths and Limitations,* a review of the specific issues that may enhance or limit the interpretability of the study will be covered. This section will deal with limitations not previously addressed under specific findings. The final section, *Future Directions,* will focus on how the findings relate to future research efforts, particularly those relating to social skills interventions.

PERCEPTUAL DISTORTION (*X-%*)

One of the first questions put forth in this document was, Do children with NVLD perceive accurately? The current study was designed to address a more specific question: When faced with ambiguous nonverbal stimuli, do children with NVLD show more signs of perceptual distortion? The results of this study showed that, when compared to typically developing children and children who have inattention, children with NVLD+ADHD/PI showed significantly higher levels of perceptual distortion as measured by *X-%*. The degree to which children

with NVLD distorted the visual percept or violated the contours of the blot was not only discrepant from the comparison groups ($p < .001$); children with NVLD received a score of *X-%* that was significantly impaired based on Exner's norms. Exner (1993) has determined that in nonpatient adults and children, the value of *X-%* is expected to be less than 15 percent. Values at this level indicate that the frequency of perceptual inaccuracy or distortion is no greater than for most people. If the value is 20%, some concern may be warranted. However, Exner states, if the value of *X-%* exceeds 30%, it is likely that the level of perceptual distortion is such that it will interfere with an individual's daily functioning. In this study, the average value of *X-%* for children with NVLD was 39% (*SD* = .11). In contrast, *X-%* for children with ADHD/PI and children from the control were in the normal range (.17, *SD* = .01 and .18, *SD* = .01 respectively). Overall, the results of this study show that, when compared to typically developing children and children who have inattention, children with NVLD do not perceive accurately.

The findings relating to *X-%* were considered in light of the existing research. A search of the literature found that only one empirical study has been published that investigated Rorschach performances of children with NVLD. In 1990, Acklin compared children with NVLD to children with verbal learning disabilities (VLD) on *X-%*. In the study, he found there were no significant differences between the groups in perceptual distortion, with both groups showing significant impairment. However, methodological weaknesses in Acklin's study limit the interpretability of his findings. The current study sought to improve on

Acklin's study by (1) using more stringent design and data collection criteria, (2) only including archival records collected using Exner's standardization methods and (3) only including archival records that were available for review in order to establish inter-rater reliability.

The current study continues Acklin's line of research by using the Rorschach with children with LD; however, rather than comparing children with NVLD to children with VLD, the focus of this study was to compare children with NVLD+ADHD/PI and ADHD/PI. By contrasting these two groups, it was possible to show that perceptual deficits shown by children with NVLD cannot simply be attributed to inattention, but seem to reflect a more severe disability. Moreover, the exploratory analysis comparing children from the ADHD/PI group and children from the control group showed there was no statistically significant difference between the two groups on *X-%*; suggesting there is no relationship between inattention and perceptual distortion as measured by the Rorschach.

Findings regarding perceptual distortion and ADHD/PI do not support existing studies which show children with ADHD have elevated *X-%* (Bartell and Slanto, 1995; Cotungo, 1995; Horn, 1994). However, because these studies did not include ADHD/PI as a separate group, the high levels of perceptual distortion noted may have been to symptoms of hyperactivity, impulsivity, not inattention.

VISUAL SYNTHESIS (*DQ+*)

In 1975, Myklebust suspected children with NVLD did not suffer from problems of visual perception, but rather they failed to integrate aspects of

individual objects into meaningful whole concepts. The results of this study support his contention regarding integration problems: Children with NVLD+ADHD/PI were significantly less inclined to engage in visual synthesis as manifested by decreased performance on *DQ+* relative to children with ADHD/PI and children from a control group.

Integration problems noted on the Rorschach are consistent with what would be expected given the performances of children with NVLD on measures of organization and integration (e.g. Rey-Osterrieth, VMI). In studies comparing NVLD and VLD, researchers found that children from both groups made errors on integration and organizational measures, but each made errors for different reasons. Children with NVLD focused on details and missed the overall gestalt; children with VLD appreciated the gestalt but overlooked details. The visual synthesis required to receive a *DQ+* on the Rorschach is not directly comparable to the integration and part whole thinking required to complete a psychomotor tasks such as the VMI and Rey-O figure. However, the processes may be similar in that they call on the child's ability to combine singular details to form meaningful whole concepts or images.

A final point regarding the research of Foss (1991) and Weintraub and Mesulam (1983) is related to inattention. These authors did not isolate the effects of attention in their studies of NVLD; therefore, it is unclear whether attention played a role in their findings. The current findings suggest the inattention was not a factor in the integration problems noted in children with NVLD+ADHD/PI. Children from the ADHD/PI group did not show a statistically significant

difference on *DQ+* as compared to the control group. This finding suggests inattention does not interfere with a child's ability to synthesize and integrate visually presented stimuli.

A review of literature revealed no studies that evaluated the performance of children with NVLD on *DQ+*. However, a meaningful comparison can be made between responses on the Rorschach of the children in the current study and those given by individuals with right hemisphere (RH) damage or disease. Kleiger (1999) found that patients with RH damage have difficulties forming an integrated response, fail to combine aspects of the blot, and focus on individual details. The study noted that even when compared to patients with schizophrenia and bipolar disorder, patients with RH damage demonstrated significantly more fragmented responses (i.e., decreased *DQ+*). The comparison groups showed more cognitive slippage and illogical thinking, but integration problems were most severe with patients with RHD. This finding adds further support to the notion that adults with RH damage and disease provide a meaningful framework to consider the perceptual deficits of children with NVLD. However, unlike adults in this study, children with NVLD have not lost previously intact abilities. Rather, the impoverished visual synthesis and integration noted may be characteristic of the NVLD profile.

Given the results on *X-%* coupled with the results on *DQ+*, it would appear that the misinterpretations made by children with NVLD are due to perceptual distortion *and* a failure to integrate. The cumulative effect of perceptual distortion and failures of integration on all areas of functioning,

namely social perception, are potentially devastating. Social perception requires the spontaneous integration of numerous nonverbal visual cues. Functionally, children with NVLD may misperceive a visual cue (a frown) and fail to relate the cue to a given context (a funeral), while ignoring supporting visual information (a room full of people looking down). Consequently, the child with NVLD may enter a darkened room full of individuals with frowning, sad faces and loudly inquire, "Hey everybody…what's going on?" The social implications of the visual perceptual and integration deficits noted in children with NVLD point to the third question presented in this study: Do children inaccurately perceive social situations, or, as the third hypothesis states, do they fail to see the world through a social lens?

SOCIAL ATTRIBUTION (*M*)

The results of this study suggest children with NVLD+ADHD/PI were significantly less inclined to engage a social template as manifested by decreased performance on *M* relative to children with ADHD/PI and children from a control group. Although a statistically significant difference was found, a comparison between mean scores suggests the number of *M* responses given by children with NVLD was below average as compared to Exner norms. Adults and children generally give between 2 and 5 *M* responses. Children with NVLD gave an average of 1.44 *M* responses (*SD* = 1.42). Thus, this finding must be interpreted with caution. Rather than pointing to a lack of social attribution, the low (but

adequate) *M* responses may be indicative of the unnatural or prescribed social style noted in these children. Children with NVLD are *interested* in social aspects of their world; however they are often inflexible in the way they think about interactions with other people. Thus, they often engage in scripted social behavior that was appropriate for one situation, but inappropriate for another. In this way, the child is seeing the world through a social framework (adequate *M*) but the framework is rigid and constricted, or simply inaccurate.

Exner (1993) has noted that *M* responses are related to social proficiency, but a high number of *M* responses do not signify interpersonal competence. To determine the quality of the responses relating to human movement, the form quality of the response must be considered (i.e., *M-).*

SOCIAL DISTORTION (*M*-)

It was hypothesized that children with NVLD+ADHD/PI would show significantly more signs of social distortion as measured by *M*- than (a) children with ADHD/PI and (b) children from a control group. The results of this study did not support this hypothesis. However, in light of the findings regarding *M,* this finding would be expected. Because *M*- is a subset of *M,* a limited number of *M* responses would preclude a high number of *M*- responses. Thus, the research question regarding *M*- may not have been appropriately addressed in this study. A

more useful examination would be to consider the ratio of *M*- to *M* (i.e., if a *M* response is given, is it more likely to have poor form quality?).

Smith et al. (2001) found that *X*-% and *M*- are highly correlated due to the influence of poor form quality in both. Given the high *X*-% and relative low *M*-, it would appear that children with NVLD had a significant proportion of distorted responses, but these distortions did not usually inform human movement.

Implications

In addition to those discussed earlier in this chapter, the findings in this study are important for a number of reasons. First of all, because the Rorschach does not rely on a dichotomous scoring system, an investigation of the responses provided a means to *describe* the visual perceptual errors noted in children with NVLD. The study also provided a method by which the role of inattention in visual perceptual processing could be examined. In the current study, it was shown that children with NVLD show significant visual perceptual deficits that are complicated by a failure to integrate, leading to significant misinterpretations of visual stimuli. It is reasonable to assume that if a percept is distorted, any manipulations or interpretation attributed to the percept will be equally distorted. Thus, these findings would serve to support Rourke's hierarchical

conceptualization of NVLD with visual perceptual deficits serving as the primary neuropsychological weakness leading to subsequent perceptual, memory, cognitive and social deficits.

This study is also important in that it serves as empirical validation for a number of behavioral observations frequently cited in the NVLD literature. Children with NVLD have purportedly made interpretations of situations and events which have led many to question the quality of the child's reality testing. Results of the study demonstrate that these children have significant visual perceptual processing deficits that serve to undermine the ability of the child to make sense out of his or her world. The severity of the deficits found highlight the importance of conceptualizing this disorder not in LD terms of strengths and weaknesses, but as one involving profound perceptual impairments that warrant more research and services.

Strengths and Limitations

STRENGTHS

One of the strengths of the study was the choice of statistical technique and the careful selection of only four Rorschach variables. Because Rorschach variables are not normally distributed, nonparametric techniques are preferable to parametric designs that potentially inflate the chance of committing a Type I

error. In the majority of Rorschach studies reviewed, researchers performed exploratory parametric studies comparing responses on most or all of the variables in the Structural Summary. The strength in this study was the compelling rationale established for the variables selected. Each variable was believed to represent a specific are of functioning pertinent to the study of NVLD.

Another strength of the study was the reliability of the Rorschach scoring data. All administrators, including Dr. Horn, had graduate level training and experience in scoring and interpreting Rorschach data. The consistency in scoring decisions was reflected in the high inter-rater reliability achieved. Agreement among the three administrators exceeded the recommended level of concurrence of .80 for the four variables tested.

LIMITATIONS

One of the primary weaknesses in the study was the inability to control for medication usage. Because NVLD is relatively low in prevalence, restricting participation based on medication regime would have made the collection of participants quite difficult in terms of time and resources. Kavale's (1982) meta-analysis of medication effects showed modest improvement in all areas of functioning including visual-spatial. Given the high correlation of *X-%* and *DQ+* to poor visual-spatial abilities, it is possible that an improvement in visual spatial functioning may impact the Rorschach performance of children with NVLD. However, in Exner, 1993 he states the medication effects have not been found to

influence the Rorschach response. Clearly, the role of medication in Rorschach responses needs further investigation.

It is also important to note that based on the criteria for qualifying for LD, many of the participants from the NVLD and ADHD/PI group may have had a co-existing LD in math, written expression, and/or reading. No effort was made in the current study to control for these other diagnoses; therefore, the findings do not account for the potential confound of other learning disabilities.

Another potential weakness may be the inclusion of archival records. Although no specific cohort effect was anticipated, potential confounds may exist that may limit the interpretability of the findings. However, a number of steps were taken to equalize the comparisons between archival and newly recruited subjects. An analysis was conducted to determine if a systemic difference existed between the two data sets and none were found. Steps were also taken to equalize the scores on the Rey-O and VMI by using an identical scoring system for all participants. Given the strong results found, a follow-up study that does not include archival records would help bolster the confidence in the current findings.

Future Directions

Given the severity of the visual perceptual deficits noted during the Rorschach administration, a follow-up study designed to test the limits would be highly useful. Testing the limits in a Rorschach inquiry involves telling the child a few of the responses that are often seen by other children. These responses should

include human movement, integration and popular responses. It will be important to determine whether children with NVLD are *capable* of perceiving more conventional percepts; i.e., the perceptual ability is within their cognitive repertoire.

Although this study has highlighted the visual perceptual processing deficits inherent in NVLD, the most devastating aspect of the disorder for the child and his or her family is social incompetence. However, existing social skills interventions are ineffective for these children because, as this study has revealed, children with NVLD suffer from visual perceptual processing deficits, whereas most current social interventions intercede at the skills level. Rather than focus on *how* to intervene, this study has hopefully been useful in illuminating *where* the intervention will need to be targeted for children with NVLD.

Appendices

APPENDIX A

Criteria for Attention-Deficit/Hyperactivity Disorder

* The patient has either inattention or hyperactivity-impulsivity (or both), persisting for at least six months to a degree that is maladaptive and immature, as shown by the following:

Inattention: At least six of the following often apply:

1. Fails to pay close attention to details or makes careless errors in school work, work, or other activities
2. Has trouble keeping attention on tasks or play
3. Doesn't appear to listen when being told something
4. Neither follows through on instructions nor completes chores, schoolwork, or jobs (not because of oppositional behavior or failure to understand).
5. Has trouble organizing activities and tasks
6. Dislikes or avoids tasks that involve sustained mental effort (homework, schoolwork)
7. Loses material needed for activities (assignments, books, pencils, tools, toys)
8. Is easily distracted by external stimuli
9. Is forgetful

Hyperactivity-Impulsivity. At least six of the following often apply:

1. Hyperactivity
2. Squirms in seat or fidgets
3. Inappropriately leaves seat
4. Inappropriately runs or climbs (in adolescence or adults, this may be only a subjective feeling or restlessness)
5. Has trouble quietly playing or engaging in leisure activity
6. Appears driven or "on the go"
7. Talks excessively
8. Impulsivity
9. Answers questions before they have been completely asked
10. Has trouble waiting turn
11. Interrupts or intrudes on others

* Some of the symptoms above began before age seven.
* Symptoms are present in at least two types of situations, such as school, work, home.
* The disorder impairs school, social, or occupational functioning.
* The symptoms do not occur solely during a pervasive developmental disorder or any psychotic disorder, including Schizophrenia.
* The symptoms are not better explained by a mood, anxiety, dissociative or personality disorder.

APPENDIX B

TITLE: ASSESSMENT AND INTERVENTION OF CHILDREN WITH NONVERBAL LEARNING DISABILITIES IN SCHOOL-AGED CHILDREN

1. Participants for this project come from two sources: school personnel from the Austin Independent School District (AISD) and from parent referrals. This project was proposed to AISD in the spring of 1997. Its purpose is to provide teachers, administrators, and parents with assessment and intervention information that will assist them in managing the educational and social needs of students suspected of having nonverbal learning disabilities (NVLD). Educators and psychologists are just beginning to understand NVLD. The characteristics typically associated with the disorder include difficulty with math calculation, visual-spatial deficits, poor social skills, inattention, and poor conceptualization and abstraction abilities. Frequently, children with NVLD are misdiagnosed or they go undiagnosed, resulting in years of frustration for them, for their parents, and for their teachers. This project focuses on children between ages 8 through 14. The diagnosis is difficult to make in children younger than seven or eight, and we are trying to begin intervention prior to age 14. AISD has estimated that there may be as many as 1000 students who meet criteria for NVLD in the District. Although some researchers suggest that girls and boys are equally affected, our own research suggests a ratio of three boys to one girl. Students who meet generally accepted criteria (determined mainly by test scores as explained below) are included in the project. Students with sensory or motor impairments will be excluded if these disorders are thought to be related to NVLD. Students with chronic illnesses can be included as many chronic illnesses are associated with NVLD. Because this is a service project as well as a research project, we want to make these services available to as many students as possible. In all cases, parental consent and student assent forms are completed before any student is considered for participation.

2. As noted above, participants come from two sources, AISD referrals and independent parent referrals. During the 1997-1998 school year, teachers in the AISD will be made aware of the project and they will be asked to refer students between ages 9 and 14 who are thought to meet criteria for NVLD.

Once a student is identified, school personnel will contact parents to request their permission to include the student in the project. Once parents agree, they will be mailed the **PARENT PACKET** that includes the following materials: CONSENT LETTER, DEVELOPMENTAL HISTORY QUESTIONNAIRE, BEHAVIORAL ASSESSMENT SYSTEM FOR CHILDREN (BASC) PARENT REPORT FORM. Referrals will also be accepted from parents. Parents will be instructed to telephone the School Psychology Program office at UT (471-4407) and to ask to speak with faculty or students involved in the nonverbal learning disabilities project. If the student meets age and symptom eligibility criteria, a **PARENT PACKET** will be mailed or given to the parents. Upon receipt of the completed Parent Packet, students will be enrolled in the project. The STUDENT ASSENT FORM is completed at the student's first interview/assessment visit.

3. There are no known risks to any of the procedures used in this project. All assessment instruments are standardized, published materials that are used routinely in schools and other agencies charged with evaluating and developing intervention plans. No new, unpublished, nor experimental procedures will be used in any part of this project. In addition to the PARENT PACKET, the following instruments are used to generate data for the project.
   The following materials will be used during the assessment phase of the project:
   - Parent Packet
     - BASC Parent Rating form
     - Developmental History Questionnaire
     - Parent Consent Form
   - Parent Interview
     - Structured Interview for the Assessment of Children (SIDAC)
   - Teacher Packet
     - BASC Teacher Rating Form
   - Student Assessment
     - Wechsler Intelligence Scale for Children–Third Edition (WISC-III)
     - Woodcock-Johnson Tests of Achievement--Revised
       - Letter-Word Identification
       - Passage Comprehension
       - Calculation
       - Applied Problems
     - Woodcock-Johnson Tests of Cognitive Ability–Revised
       - Analysis/Synthesis

Concept Formation
Judgment of Line Orientation
Rey Osterrieth Complex Figure Test
California Verbal Learning Test-Children's Version
Finger Tapping
Purdue Pegboard
Developmental Test of Visual Motor Integration–Fourth Edition
Stroop Color Word Test
D2
Test of Memory and Learning
Wisconsin Card Sort Test
Children's Category Test
Rorschach
Child and Adolescent Social perception test (CASP)
DANVA I

4. As in all cases involving research, it will be necessary to assure participant confidentiality. Once a student is evaluated, all data entry, analysis, and reporting will be done by coded identification numbers rather than by student name. Student identity will be in a locked cabinet in the UT office of the project's two faculty sponsors.

5. Benefits are expected for individual participants and for other students with NVLD. First, each student receives a comprehensive cognitive, academic, and affective assessment that is specifically designed to identify the characteristics of NVLD. Although several researchers have attempted this delineation, parents and teachers continue to feel ill-prepared to deal with children with NVLD. Second, the assessment includes a detailed evaluation of each participant's social skills. To date, poor social skills are usually included in the symptoms associated with NVLD, but these deficits have not been adequately specified and efforts to ameliorate them have met with little success. Third, in addition to a comprehensive evaluation, this project contains an intervention component. Furthermore, the efficacy of each intervention will be documented and interventions deemed to be effective will be passed along to parents and to teachers for implementation at home and in school. Because of the project's research and dissemination components, the information gained from this project will be distributed to others through publications and presentations at professional meetings.

6. Except for the usual and unlikely risk of lack of confidentiality, there are no known threats to participants. As explained above, procedural safeguards will be in place to protect participant confidentiality.

7. As indicated earlier, students will be referred through AISD and directly through parents. In the former case, initial identification and parent contact will be made by school personnel. Based on parent request, all interviews and assessment can be conducted either at the student's school or in the School Psychology Program assessment rooms at UT. A letter documenting AISD's agreement to participate is included in this packet.

   Inquiries initiated independently by parents carry an implicit assumption of parental consent. All interviews and assessments will occur in the School Psychology Program assessment rooms at UT unless other arrangements are requested by parents and approved prior to the assessment. In all cases, signed letters of parent consent and students assent must be completed before any student is evaluated.

8. Not Applicable

9. Not Applicable

10. Not Applicable

APPENDIX C

University of Texas at Austin
Austin, Texas 78712

College of Education
Educational Psychology

Form to Return to Investigators

Parent Form: Please read each of these statements carefully and check and sign only those for which you grant permission. Please note that participation or non-participation will not affect your child.

_____ Yes, I am interested in knowing more about the investigation and you or the investigators may contact me.

_____ _____
Signature of Parent of Legal Guardian Date Phone Number

_____
Address

_____ No, I am not interested
_____ I am interested, but I have more questions. Please call me at _____.

Please fill in the information below and return this form to the school office.

My child's name is _____ Sex _____Handedness _____
Girl or Boy Right or Left

My child's birthday _____
Month Day Year

My child's grade _____Teacher _____School _____

Fill in the blank. (Choose from less than high school; high school; high school + ; college or college +).

Mother's highest level of education completed _____

Father's highest level of education completed _____

APPENDIX D

CONSENT FORM

Title: Assessment of social competence in children with developmental disorders.
You and your child are invited to participate in a project about social competence. My name is Margaret Semrud-Clikeman. I am a faculty member in the Department of Educational Psychology at the University of Texas at Austin. In cooperation with the Austin Independent School District, we are trying to learn the best ways to evaluate your children suspected of having difficulties in social skill development. More important, however, we are looking for better and more effective ways for parents and teachers to help students with social skills problems. We are asking parents of children who do not have these problems to participate in this study to determine how these children differ from children who do have social competence difficulties. You child's teachers have indicated that he or she may qualify for this project and we as seeking your permission to have your child participate. Your child will be one of several hundred asked to participate in the project over several years.

The purpose of the study is twofold. First, we will conduct a comprehensive assessment to determine whether your child has social skills difficulties or not. This assessment is a longer version of the one school districts use to determine eligibility for special education services. This assessment will take place in the School Psychology assessment rooms at the University of Texas. We will also ask you to have your child's teacher complete two rating scales. We will deliver these to the teacher. Second, we will provide students with interventions designed to improve their academic performance and their social skills. As with assessment, all interventions are extensions of techniques offered in schools. If you decide to participate, each step of the assessment and intervention phases and project will be described to you in detail. We encourage you to ask any questions you may have regarding why certain tests are administered, how long each phase will take, and how often we will see you and your child. In addition, we will explain possible risks and discomforts as well as the benefits of the project.

Your decision to participate or to refuse to participate in this project will in no way adversely affect your child's present school program or placement. By signing the Consent Form, you are indicating that you have read this form and you understand this project and that you agree to participate. You may withdraw your permission at any time after signing this form should you choose to discontinue participation in the study. If you have any question about this project, or should you have questions after the project begins, please call us at (512) 471-4407. If you would like to keep a copy of this form, please let us know.

Signature of Participant	Date
Signature of Parent or Legal Guardian	Date
Signature of Witness	Date
Signature of Investigator	Date

ASSENT FORM

Title: Assessment of social competence in children with developmental disorders.

I agree to participate in a project that is interested in improving how students' learn in school and get along with others. I understand this project has been explained to my parents or guardian and that he/she has given permission for me to participate. I understand that I may decide at any time that I do not wish to continue this study and that it will be stopped if I say so. Information about what I say/do will not be given to anyone else.

I understand that I will be given a number of tests and that I will be asked questions about how I feel about myself and my family and friends. I also understand that nothing bad or wrong will happen to me if I decide to stop participation in this study at any time.

When I sign my name to this page I am indicating that this page was read to (or by) me and that I am agreeing to participate in this project. I am indicating that I understand that I what will be required of me and that I may stop the study at any time.

_____ _____

Child's Signature Date

_____ _____

Signature of Investigator Date

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