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Social emotional differences of students who have a nonverbal learning disability or Dysphasia

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SOCIAL EMOTIONAL DIFFERENCES OF STUDENTS WHO HAVE NONVERBAL DISABILITY OR DYSPHASIA

by

Carrie Ann Kimpton Heald

An Abstract

Of a thesis submitted in partial fulfillment of the requirements
for the Doctor of Philosophy degree in
Psychological and Quantitative Foundations (School Psychology)
in the Graduate College of The University of Iowa

July 2011

Thesis Supervisors: Associate Professor John Northup
Adjunct Assistant Professor Tammy Wilgenbusch

ABSTRACT

Children who have Nonverbal Learning Disabilities (NLD) exhibit strengths in verbal domains and deficits in perceptual reasoning domains. These children are often seen as bright and may even be identified as gifted due to their superior decoding proficiency, expansive vocabulary, and remarkable rote memory skills. Conversely, psychosocial difficulties such as acquiring self-help skills and interacting with others appropriately often present serious challenges. Children with NLD may also vacillate between internalized (e.g., anxiety) and externalized (e.g., acting out) behaviors and are commonly seen as unmotivated, defiant, and oppositional.

Given the potential psychosocial difficulties that children who have NLD experience, it is imperative that early and effective interventions are accessed. In order to provide appropriate treatments, the identification of factors that occasion psychosocial difficulties is warranted. Thus, the primary purpose of the study was to identify specific NLD characteristics based on specific demographic variables of age, gender, parent education, and number and types of other diagnoses. Further identification efforts compared the Pediatric Behavior Scales (PBS) of Conduct, Attention, Depression, Anxiety, and Deviation to both General Ability Index (GAI) scores and Verbal Comprehension and Perceptual Reasoning (VCI/PRI) discrepancy scores on the Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV). Identical analyses were performed for a Dysphasia contrast group. A secondary purpose of this study was to add to the growing body of evidence suggesting the existence of NLD subtypes.

Analyses conducted indicated that children in the NLD group had significantly more diagnoses, higher mother and father education, and higher VCI and GAI scores than those in the Dysphasia group. In addition, children in the NLD group held substantially more ADHD diagnoses whereas the Dysphasia group supported more Dyslexia and Dysnomia diagnoses. Further analyses showed relationships between GAI and the PBS Depression scale, GAI and both mother and father education, and VCI/PRI discrepancy

and number of diagnoses for the NLD group. PBS Conduct, Attention, and Deviation scales and VCI/PRI discrepancy were correlated for the Dysphasia group. Overall, results revealed that NLD and Dysphasia groups presented different social and emotional symptomology. In addition, there is tentative support for the presence of NLD subtypes. Future areas of research and treatment recommendations are provided.

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CERTIFICATE OF APPROVAL

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PH.D. THESIS

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To my husband, Chris Heald,
and my parents,
Bev and Craig Kimpton
Thank you for your love and support throughout the years
I love you

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CHAPTER I

INTRODUCTION

Nonverbal learning disability is a set of specific symptoms that presents serious challenges for children, for it is not a learning disability in the traditional sense; rather, NLD is a severe chronic disability that effects the development of multiple basic functions (Semrud-Clikeman, Walkowiak, Wilkinson, & Christopher, 2010; Tanguay, 2002). Rourke (1995) identified three broad areas impacted by NLD including academic, neuropsychological, and psychosocial functions. Neuropsychological deficits include tactile and visual perception/attention, motor coordination, executive functions, and nonverbal memory whereas academic difficulties include reading comprehension, mathematical reasoning, calculation, and handwriting (Semrud-Clikeman & Glass, 2008; Rourke, & Tsatsanis, 1996; Rourke, 1989). Of particular concern are deficits associated with psychosocial functions. Children with NLD are noted to have social perception and social interaction difficulties and an increased risk for developing depression and social withdrawal (Semrud-Clikeman, et al., 2010; Petti, Voelker, Shore, & Hayman-Abello, 2003). There has also been evidence to suggest a greater risk for suicide (Bigler, 1989; Poremba, 1975; Rourke, Young, & Leenaars, 1989).

Traditional definitions of learning disabilities tend to have a narrow focus on academics and are generally associated with verbal deficits. NLD, on the other hand, is more debilitating than those verbal in nature due to the connection between nonverbal experience and acquisition of meaning (Myklebust, 1975). NLD affects the ability to learn academics and also the acquisition of social/emotional (Semrud-Clikeman, et al., 2010), self-help (Petti et al., 2003) and psychomotor skills (Rourke, 1995). And with the exception of verbally-based achievement tasks, the child with NLD is severely limited as to the activities he/she can successfully accomplish within the school environment. Myklebust (1975) proposed that, “Although oversimplified, this can be illustrated by noting that the word orange has no meaning except as one has experienced this fruit (or

color). Likewise the word chair represents only the object we sit on. When a child is deficient in nonverbal learning, the meaning of the experience itself, he indeed has a serious learning disability" (p. 85). (For purposes of this paper, it will be assumed that the author recognizes that the term "children with NLD" is considered the most appropriate way in which to characterize a child and his/her disability, however given the nature of this document, "NLD child" will be used intermittently to enhance efficiency).

History of Nonverbal Learning Disability

NLD has only recently been considered as a diagnostic entity although there is no doubt that the existence of such is far from new. NLD research began in the late 1960s when the first written descriptions of the syndrome were given by Johnson and Myklebust (1967). The researchers noted that there appeared to be predictable ways in which certain clusters of assets and deficits were presented in the children they evaluated. Also, these clusters of assets and deficits were consistent among children with the same indicated difficulties. Included in their description were deficits associated with right brain functions (visual-spatial, motor, interpersonal operations, etc.) suggesting the presence of a disability subtype which was nonverbal in nature. From this early "clinical" research approach, Myklebust (1975) proposed a cognitive theoretical framework from which to consider learning disabilities. His framework distinguished auditory, visual, and tactile modalities as intermediaries for information storage and retrieval. A framework of this type permitted verbal and nonverbal difficulties to exist independently, hence the birth of subtyping. Accordingly, the cluster of visual-spatial and social deficits was named "Nonverbal Learning Disability."

In the mid-1970s, another set of researchers were also gathering evidence to support the existence of disability subtypes. Prompted by the idea that learning disability subtypes required different modes of intervention, Mattis, French, and Papin (1975) mirrored Johnson and Myklebust's clinical approach to the identification of LD. Then, through the use of Q-type factor analysis and cluster analysis, the investigators sought to

support reliable subtypes of children with learning disabilities (Doehring & Hoshko, 1977; Fisk & Rourke, 1979). Prior to this, however, Rourke, Young, and Flewelling (1971) had begun submitting research findings of specific subtyping efforts that—similar to Johnson and Myklebust—suggested NLD as a specific learning disability subtype. Rourke continued to build on this early research leading to ongoing refinement of NLD symptomology and the development of the "Right-Left" model and subsequent establishment of the "NLD Syndrome" (1989, 1995).

Syndrome of Nonverbal Learning Disabilities

In 1989, Rourke proposed a neurological conceptualization of Nonverbal Learning Syndrome describing the etiology, neurological basis, and developmental course of the disability. Rourke's model indicates that NLDs present a cognitive profile, or subtype, consisting of relatively higher verbal comprehension abilities and lower nonverbal (or perceptual reasoning) abilities and particular patterns of social emotional functioning. Specific characteristics are grouped into primary, secondary, and tertiary assets and deficits (see Appendix A). The model is dynamic in that primary neuropsychological deficits of tactile and visual perception, bilateral psychomotor coordination, and adaptation to novel stimuli lead to secondary deficits in tactile and visual attention and limit exploratory behavior. Secondary deficits, in turn, lead to tertiary deficits in tactile and visual memory, speech and language, and executive functioning.

Rourke's (1995) model also accounted for a number of primary, secondary, and tertiary assets of NLD children. Again, characteristics of the model are dynamic thus primary neuropsychological assets—including auditory perception and simple motoric and rote skills—occasion auditory attention and verbal attention secondary assets which in turn lead to tertiary assets. Tertiary assets are chiefly verbal in nature and include auditory and verbal memory. Based on these assets and deficits, an overall verbal, academic, and social/emotional NLD profile is created**.**

Academic performance, social functioning, and emotional well-being, are direct by-products of this constellation of primary, secondary, and tertiary, neuropsychological deficits (Rourke, 1995; p. 16). For example, deficits in reasoning and concept formation thought to facilitate scientific reasoning and mechanical arithmetic difficulties also lead to inadequate social judgment. Therefore, reasoning and concept formation serve not only academic and cognitive purposes but impact social skills as well. Additionally, Rourke suggested that difficulty recognizing subtle nonverbal cues were rooted in visual-spatial and organizational skill deficits. Consequently, it seems likely that children who have NLD are less equipped to identify the nuances of nonverbal communication which can create social difficulties and contribute to emotional problems. Based on verbal assets and nonverbal deficits, children and adolescents who have NLD are more likely than the general population to experience depression, anxiety, substance abuse, and even suicide (Fuerst & Rourke, 1995; Rourke et al., 1989).

Education

Understanding NLD and the implications of the disability is critical to the identification and implementation of successful inventions (Stewart, 2002; Tanguay, 2002). Long-term prognosis significantly increases as a result of early identification and implementation of appropriate school classroom accommodations and instructional modifications (Tanguay, 2002; Thompson, 1985). Such interventions are instituted when a student is deemed eligible for special education. Decisions regarding special education eligibility are based on state standards and the Individuals with Disabilities Education Act (Cortella, 2006; IDEA, 2004), which are national standards. Before a student may be declared eligible, he/she must demonstrate a disability or giftedness and have special learning needs in at least one of several areas. It is important to keep in mind that a child may have a disability and not require special education services or a child may have specific needs but not meet state eligibility standards.

According to Federal standards, eligibility for special education requires that a child have a disability and a need for special education and/or related services to function adequately within the school environment (Cortella, 2006; IDEA, 2008). If a child has a disability but does not require special education services in order to perform satisfactorily, the child is not eligible for special education under IDEA. Although, when a child is not found to be eligible for Special Education Service, he or she may be eligible for accommodations under section 504 of the Special Education Rehabilitation Act. A 504 Plan may be available to students diagnosed with a medical illness or those who may not require instructional modifications but may benefit from classroom accommodations. In addition to Federal requirements, individual states have a set of standards. These standards typically vary among states but are similar to, and fulfill, Federal requirements. Therefore, when these criterions are used to determine eligibility for services, the NLD child often falls short of meeting requirements (Tanguay, 2002). Because NLD may not be recognized as a medical condition and NLD symptomology can be difficult to detect due to an internalized psychosocial presentation and high verbal ability (Stewart, 2002; Tanguay, 2002), these children are rarely provided with needed treatments, interventions, or accommodations.

Bartlett, Etcheidt, and Weinstein (2007), outline the various ways that children qualify for special education including low academic achievement. Behavior problems are another way in which a child may be declared entitled to services although this placement is typically extended to those who exhibit more severe forms of externalizing behavior. A child may also be entitled to services due to a physical disability such as vision, sight, or mobility impairment (IDEA, 2004). However, a child who experiences difficulties that do not fit neatly within one of these categories is often overlooked, thus a child with NLD will likely have difficulty qualifying for special education. Both verbal strengths and the appearance of academic competence—or even giftedness—make it difficult for school personnel to identify and understand the ramifications of a nonverbal

learning disability (Stewart, 2002; Tanguay, 2002). The full impact of NLD may not be realized until late elementary or early middle school and then—at best—may be misidentified as lack of motivation or acting-out behavior (Tanguay, 2002). Academic difficulties may surface as work becomes more challenging; however the extent of such difficulties may not be enough to draw the attention of education providers (Stewart, 2002; Tanguay, 2002).

Purpose of the Study

Individuals that have Nonverbal Learning Disability are at an increased risk for significant social and emotional problems. Therefore, this study aims at providing further evidence supporting such increased risk and at identifying the social and emotional problems and patterns most likely to occur. Based on the identification of predictable social/emotional patterns, further possible subtyping of NLD may be supported. The potential for sub-typing has direct implications for matching school placement and other treatments for those with NLD (Hendrickson, Keulers, Feron, Wassenberg, Jolles, & Vles, 2007; Semrud-Clikeman, Walkowiak, Wilkinson, & Portman Minne, 2010; Voeller, 1995) therefore, data supporting the relationship between NLD and significant social and emotional problems is crucial.

Given the social and psychological needs of children with NLD, this study will begin to specifically identify those behaviors most likely to occur based on cognitive ability scores. Additionally, the magnitude of discrepancy between verbal and nonverbal cognitive functioning will be analyzed for possible sub-typing purposes. Demographic variables (i.e., gender, age, parent education, grade, and number and type of learning and psychological diagnoses) will also be considered. Any differences and/or similarities detected will move the research closer to a clearer conceptualization of NLD subtypes. Additionally, evidence gathered will underscore the importance of identifying social and emotional deficits; the benefit of which will be an increase in the effort directed toward mediating deficits. A cookie-cutter approach is a disservice to the student who has NLD

as well as all parties who are involved in his/her general care. Moreover, if symptoms are left untreated, psychopathology worsens with advancing years and the probability increases that these children will experience significant impairments as adults (Biegler, 1989; Fuerst & Rourke, 1995).

CHAPTER II

REVIEW OF LITERATURE

Organization of the Literature Review

Relevant literature is presented in this chapter. The review begins with a discussion on the subtyping of learning disabilities and the primary methods utilized for subtyping. Next, research detailing the psychosocial inefficiencies linked to NLD is presented and is followed by a brief review of literature on the relationship between psychosocial problems and Dysphasia. Assessment guidelines for both NLD and Dysphasia are also provided. The chapter concludes with an outline of questions and hypotheses included in this investigation.

Subtyping of Learning Disabilities

The emergence of scientific investigations into learning disability subtypes resulted from clinical observations of children evaluated for learning disabilities. Various researchers (Cruickshank, 1977; Delacato, 1963; Doehring & Hoshko, 1977) initially tried to identify a single cognitive factor that would explain the disability. However, Johnson and Myklebust (1967) recognized that children demonstrated varying strengths and weaknesses even when equal levels of cognitive impairment were identified. Clinical research provided evidence that children demonstrated specific cognitive patterns of verbal and perceptual assets and deficits and that specific variations in cognitive strengths and weaknesses appeared to coincide with specific developmental problems (e.g., reading). Thus, they concluded that there were different etiologies for the same type of learning disabilities which were based on the identified patterns of perceptual and verbal strengths and deficits.

More recently, describing LD according to a specific cognitive pattern or subtype is common practice among neuropsychologists. The identification of three general subtypes, Dysphasia (language disabilities) or “Basic Phonological Processing Disorder,” visual-perceptual/visual-motor disabilities or “Nonverbal Learning Disability,” and a

combination of language and visual disabilities have been repeatedly established by various studies (Hendrickson et al., 2007; Mattis et al., 1975; Rourke et al., 1971; Rourke & Finlayson, 1978; Rourke & Strang, 1978). Moreover, Dysphasia has been further divided into expressive, receptive, and expressive/receptive subtypes where as NLD has remained a singular, expansive diagnostic category (Forrest, 2004). Likewise, attempts to clearly match psychological or psychosocial characteristics to specific LD subtypes have been fraught with controversy and methodological conundrums. But because the ability to learn is fundamental in the acquisition of social skills and emotional regulation, researchers have become increasingly concerned that LD children are at risk for developing significant problems relating to such (Rourke & Fuerst, 1991). Since psychosocial functioning has been tied to overall school performance, identifying specific patterns of behavior is warranted (Forrest, 2004). Richman (1992) indicated that child neuropsychology has moved toward a more sophisticated approach to LD which focuses on the interplay of cognitive and psychological variables rather than separating the two.

Subtyping by Cognitive Performance

The origins of the neurocognitive LD subtypes were characterized through a series of studies completed by Rourke (1991) and his colleagues. One of their first investigations grouped children's abilities using the Wechsler Intelligence Test for Children (WISC: Wechsler, 1949) and subsequently confirmed various subtype assets and deficits through various testing measures. Three subtypes were included in the study. The first group, or subtype, achieved significantly higher scores on the WISC Performance scale than the WISC Verbal scale. The second group showed equal performances on both Performance and Verbal scales. And group 3, which became identified as NLD, was characterized by higher Verbal IQ as compared to WISC Performance scale IQ. Although all three groups were equated for WISC Full-Scale IQ, performances within specific scales varied considerably.

Two subtypes showing Verbal and Performance discrepancies were of particular interest given the dichotomous nature of strengths and weaknesses presented. The group achieving higher Performance scores—the language-learning disorder group (Dysphasia)—showed adequate visual-perceptual performance as demonstrated on Picture Completion and Block Design subtests and poorer performance on subtests including Information and Similarities. The opposite was true for the children comprising the NLD group who demonstrated at least adequate verbal ability and deficient visual-perceptual ability. Both groups demonstrated at least a 10-point difference between Perceptual Reasoning Index (PRI) and Verbal Comprehension Index (VCI).

These findings are a direct result of the expected discrepancy between verbal, language-based cognitive abilities and nonverbal, visual-spatial cognitive abilities. Typically, a VCI-PRI discrepancy of 15 points or more is expected however, a discrepancy of as few as 10-points may be supportive of an NLD or Dysphasia diagnosis if there is other confirmatory evidence to support such. And, in general, a greater discrepancy typically results in a more accurate diagnosis. It is not unusual to find differences of 40 points or more between Verbal and Performance IQ scores for those more severely impaired individuals (Johnson, 1987). One of the most identifying features of NLD is a significantly higher Verbal Comprehension index score than Perceptual Reasoning index score on measures of intelligence (Johnson, 1987; Rourke, 1989; Weintraub & Mesulam, 1983).

Nonverbal Disability

In general, most investigators agree that children who have NLD can be identified by a core set of nonverbal characteristics (Rourke, 1995). The characteristics identified include visual-spatial/motor skills deficits relative to verbal skills, lower mechanical mathematical achievement as compared to word recognition skills, and nonverbal abstract reasoning and problem solving deficits (Bender & Golden, 1990; Korhonen, 1991; Little, 1993; Lyytinen & Anhonen, 1989; Ozols & Rourke, 1985; Semrud-

Clikeman et al., 2010; Share Moffitt & Silva, 1988; Strang & Rourke, 1985a; Van der Vlugt, 1989). Other, less agreed upon characteristics include, well developed memory ability, reliance on speech for social relations and information gathering, difficulty adapting to novel and complex situations, and significant social skill deficits (Forrest, 2007; Harnadek & Rourke, 1994; Little, 1993; Ozols & Rourke, 1985; Rourke & Strang, 1978; Rourke, Bakker, Fisk, & Strang, 1983; Rourke, Fisk, & Strang, 1986; Rourke et al., 1989; Semrud-Clikeman et al., 2010; Strang & Rourke, 1985; Thompson, 1985). Researchers have proposed several factors that possibly contribute to the disagreement including the use of different evaluation measures, small numbers of participants, age of subtyping, and inclusion and exclusion variables (Little, 1993; Rourke, 1999). Additionally, differences in verbiage used (social emotional v. psychosocial), specificity in terms (social problems vs. peer difficulties), and lack of subtyping (verbal vs. nonverbal disability) add to the divergence in research findings of social skills and social relations (Little, 1993).

Despite the differences, general research suggests that children who have a Nonverbal Learning Disability (NLD) present a particular risk for developing social and emotional problems (Casey, Rourke, Picard, 1991; Little, 1993; Stewart, 2002; Tanguay, 2002; Thompson, 1985; Tsatsanis, Fuerst, & Rourke, 1997). Difficulties with peer interactions and acquiring appropriate social skills are pervasive and emotional comprehension and expression are challenging. These proclivities may be due, in part, to neurologically-based right hemispheric brain impairment. Right hemispheric deficits are believed to cause specific neuropsychological deficits in psychomotor coordination, tactile and visual-spatial perception, and difficulties in the perception of nonverbal social cues such as facial expressions, personal space, tone of voice, and body language (Forrest, 2007; Myklebust, 1975; Petti et al., 2003). Significant problems can develop when a child lacks the ability to understand his/her social environment and behavior; and

experiences problems interpreting and expressing nonverbal communication (Myklebust, 1975; Rourke et al., 1989).

Establishing and maintaining peer and adult relationships are demanding for students with nonverbal learning disabilities. The NLD child may not accurately interpret nonverbal communication hence, may not receive clear messages from others (Forrest, 2007; Semrud-Clikeman, 2003; Tanguay, 2002). Because a child's self-concept is heavily influenced by the way others respond to him/her, the NLD child may not develop a clear concept of self as they fail to receive or correctly interpret feedback from others (Forrest, 2007). In addition, these children may exhibit aversive behaviors such as extreme immaturity and self-centeredness (Casey et al, 1991; Gross-Tsur, Shalev, Manor, & Amir, 1995; Thompson, 1985). Poor judgment and lack of empathy are also NLD characteristics that impede socialization and often lead to rejection and social isolation (Dimitrovsky, Spector, Levy-Shiff, & Vakil, 1998; Harnadek & Rourke, 1994; Myklebust, 1975; Rourke et al., 1989; Sisterhen & Gerber, 1989).

Emotional difficulties are also common for those who have NLD. Anxiety, depression, and disruptive behaviors can arise as a result of poor adaptation to novel or challenging situations (Rourke et al., 1989). Inadequate emotional comprehension and expression may result in oppositional and hyperactive behaviors and acting out (Myklebust, 1975; Rourke, 1995). Children that exhibit these externalizing behaviors when young are likely to develop internalized forms of emotional problems as they get older (Bigler, 1989; Casey et al, 1991; Rourke, 1989); however, externalizing behavior may remain stable over time (Casey et al., 1991). Delinquent behavior and suicide have also been implicated for those with NLD (Bigler, 1989; Poremba, 1975).

Studies on NLD and Emotions

Evidence suggests a greater likelihood for NLD children to develop emotional difficulties than that of non-disabled peers (Casey et al., 1991; Little, 1993; Tsatsanis et al., 1997). In general, it has been shown that emotional problems are more likely to

include internalized behavior, such as social isolation, depression, anxiety, and increased suicide risk (Rourke et al., 1989). Additionally, researchers found that without appropriate intervention, social emotional difficulties worsen with age (Fuerst & Rourke, 1995; Pelletier, Ahmad, & Rourke, 2001). A longitudinal study conducted by Spreen (1988) provided support to this research. Spreen compared the long-term social emotional functioning of two groups of adults that were diagnosed with learning disabilities as children. The LD groups were categorized as either neurologically impaired or not neurologically impaired. Each group was compared to a nondisabled control group. Results indicated that the individuals who were in either LD group were more likely to have social and emotional problems as adults than those in the control group. Moreover, those individuals who were diagnosed with neurological impairments showed a tendency to exhibit more psychological difficulties than either the control or non-neurologically impaired LD group.

Results from a retrospective study by Casey and Rourke (1991) suggested that social and adaptive functioning did not worsen with age; however a higher number of internalized symptomology was endorsed by older children. The protocols of 15 NLD children were selected for the study. The protocols completed by their caregivers included a combination of the Personality Inventory for Children - Revised (PIC-R; Lachar, 1982), Anxiety Rating Scale, and the Behavior Problem Checklist (BPC; Quay, 1983). The 15 completed protocols were separated into age ranges of 7-8 and 9-14 forming a “young” and an “old” group, respectively. There were no group differences indicated on the ARS and BPC although the PIC indicated that the “old” group of children scored higher on all scales that contributed to the internalized psychopathology index. Also indicated by the PIC were clinically significant elevations on Adjustment, Social Skills, and Psychosis scales for both groups.

In a similar study, Casey, Rourke, and Piccard (1991) found that NLD children from different age groups demonstrated varied psychosocial presentations. Again,

subjects were selected from a pool of previously evaluated clinical population of children diagnosed with NLD. There were six subjects who comprised the "young" group and six who comprised the "old" group. The mean ages for the groups were 8.5 and 11.6, respectively. Caregiver responses on the PIC were analyzed and subsequently yielded Internalized, Externalized, and Combined composite scores based on individual scales; that is, the scales of Anxiety, Depression, Withdrawal, Social Skills, and Psychosis comprised the Internalized scores while the Delinquency and Hyperactivity scales produced the Externalized scores. Accordingly, a combination of Internalized and Externalized scores created the Combined composite. Consistent with Casey and Rourke's (1991) study, results for the "old" group had overall higher Internalized composite scores. The "old" group also demonstrated significantly greater elevations on the Combined composite scores. Groups did not differ for Externalized composite scores, although significant elevations across groups were noted. Other studies have also supported consistency in pathology across age groups (DeLuca, Rourke, & Del Dotto, 1991; Fuerst & Rourke, 1995).

The relationship between nonverbal processing difficulties and children's feelings of competence and depression was investigated by Nowicki and Carton (1997). Evidence from their previous research (Nolwicki & Duke, 1994) suggested that children's mistakes in reading nonverbal social cues appeared to create negative personal and social consequences. Furthermore, unlike verbal processing difficulties, children with nonverbal processing deficits, called dyssemias, were less likely to be aware that they had such difficulties therefore they were less likely to resolve the underlying deficit. As a consequence of the findings, Nolwicki and Carton (1997) designed a study to determine whether depression and competence could be added to the already established set of social and personal correlates related to dyssemias. Included in their study were 93 boys and 49 girls each between 9 and 11 years of age. All participants were administered the Adult Facial Expressions 2, Child Facial Expressions 2, and Child Tone of Voice subtest

from the Diagnostic Analysis of Nonverbal Accuracy (DANVA; Nowicki & Duke, 1994), which were designed to measure nonverbal decoding ability. Feelings of Competence and depression were measured by the Perceived Competence Scale for Children (PCS; Harter, 1985) and the Children's Depression Inventory (CDI; Kovacs, 1985), respectively. Results of the study indicated that nonverbal deficits (i.e., dyssemias) were related with feelings of incompetence for both girls and boys, although the relationship was stronger for girls. In addition, the dyssemias were associated with feelings of depression for boys but not for the female participants. A connection between nonverbal processing difficulties, depression, and high rates of suicide for males were implicated.

Another recent study (Semrud-Clikeman et al., 2010) showed a tendency for NLD children to experience internalizing symptomology, such as feelings of sadness and social withdrawal. Multiple informants provided ratings for behavioral and social functioning for children ($N = 342$) with Asperger's disorder, NLD, or ADHD. The findings showed that children with NLD experienced considerable difficulty understanding emotional and nonverbal cues, were indicated as isolating from peers, and had inclinations to feelings of sadness. It should be noted however, the Asperger's group showed the greatest penchant for externalizing and internalizing pathology, as well as social challenges.

NLD children find it difficult to learn from past experience, deal with novel situations, internalize feedback, and understand cause and effect relationships; all of which requires information processing and generalization skills. Thus it would seem logical for children with NLD to experience more difficulties with analogical problem solving tasks that require processing and transfer of knowledge from one situation or context to another. Schiff, Bauminger, and Toledo (2009) compared three groups of children with verbal (VLD), nonverbal (NLD), or no learning disabilities and found this to be the case. The children without learning disabilities outperformed both LD groups overall and the VLD group surpassed the NLD group for target problem solving tasks. Similar to Nowicki and Carton's study, results indicated that skills critical for social

interactions (e.g., problem-solving skills, generalization ability, and understanding cause and effect relationships) were likely hampered by information processing deficits conceivably nonverbal in nature.

Higher verbal versus lower nonverbal skills such as those exhibited by the NLD group were found to be a detriment for children evaluated by Fuerst, Fisk, and Rourke (1990). The researchers reported that children who demonstrated higher verbal/lower performance on the WISC exhibited elevated psychopathology on several of the Personality Inventory for Children (PIC) scales. Their study compared three groups of 44 children on the basis of discrepancy between WISC Verbal IQ and Performance IQ scores (i.e., VIQ > PIQ, VIQ < PIQ, & VIQ = PIQ). Normal PIC profiles were indicated for both the VIQ = PIQ and VIQ < PIQ groups, however the VIQ > PIQ group showed elevated scores for Adjustment, Delinquency and Psychosis scales.

In addition, group average linkage cluster analysis using Development, Somatic Concern, Depression, Family Relations, Delinquency, Withdrawal, Anxiety, Psychosis, Hyperactivity, and Social Skills, and revealed 6 psychosocial subtypes, which included: normal, mild anxiety, mild hyperactivity, somatic concerns, internalized psychopathology and externalized psychopathology. Based on these subtypes, children with VIQ > PIQ occurred at higher than expected frequencies for both the internalizing and externalizing subtypes, and lower than expected for mild anxiety and mild hyperactivity subtypes. In sum results supported that those with NLD experience significant psychosocial difficulties. Furthermore, evidence linking patterns of cognitive performance and patterns of psychosocial functioning was established.

Studies on NLD and Social Skills

In addition to emotional difficulties, research suggests that children who have NLD are likely to experience social difficulties. Data supports that children who have a nonverbal learning disability are more likely than those children diagnosed with other disabilities and non-disabled peers to experience both social skills deficits and problems

with behavior (Pearl, 1988; Rourke 1987). These children are regarded as excessively verbal and expressive, and rely primarily on verbal input to experience the world around them. NLDs may talk a great deal, interrupting people, perhaps by speaking out of turn or by moving back and forth between people engaged in conversation, standing too close, or touching too much (Little, 1993). Problems like these are common for children with NLD, who often experience social rejection and social isolation.

One of the most serious challenges resulting from nonverbal deficits includes social imperceptions and the way in which it limits development of meaning and the acquisition of an inner experience, and leads to distortion of experiences (Myklebust, 1967). Dimitrovsky and colleagues (Dimitrovsky, Hedva, Levy-Shiff & Vakil, 1998) investigated the facial expression interpretations of children with and without learning disabilities. The participants included 76 students in grades 3 through 6 with either nonverbal deficits (NVD), verbal deficits (VD), or verbal and nonverbal deficits (BD). A control group of 48 children in grades 3 through 6 were also selected. All children were shown pictures of men and women expressing various emotions, and were asked to identify the basic expression each picture represented from the Pictures of Facial Affect (PFA; Ekman & Friesen, 1976). Results indicated that students in the control group outperformed both LD groups, and participants in the NLD group were the least successful among all children tested. An earlier investigation by Holder and Kirkpatrick (1991) indicated similar results.

Holder and Kirkpatrick (1991) also presented pictures to children with learning disabilities and asked them to identify the emotion expressed. Children with a learning disability were less likely to correctly identify the emotion, and also took more time to provide answers. Results of both the Dimitrovsky (1998) and Holder (1991) studies suggest that children who have learning disabilities present particular problems with social perception. Further, children that have NLD are at-risk for developing social and

emotional problems due to imperceptions of facial expressions. This research is consistent with Nowicki and Carton's (1997) research on dyssemias.

Recent research has also provided support linking right-hemispheric deficits to facial imperceptions. Liddell and Rasmussen (2005) compared visual and verbal memory in children with NLD using the Children's Memory Scale (CMS; Cohen, 1997). Their findings indicated overall lower performances on the visual memory subtests but not on the verbal memory subtests. Further analyses revealed a unique pattern of performance on the visual memory subtests whereby average scores were achieved on all but the Faces Immediate subtest. On this subtest performances were well within the below average range thus implicating facial imperceptions.

Researchers (Petti, Voelker, Shore, & Hayman-Abello, 2003) also suggested that deficits in the perception of nonverbal emotional social cues likely attributed to social difficulties for children with NLD. Their investigation included thirty-three, 9-13 year old children from psychiatric treatment facilities who were diagnosed with a verbal learning disability (VLD), a nonverbal disability (NLD), or no learning disability. All children were administered the Diagnostic Analysis of Nonverbal Accuracy (DANVA-2; Baum & Nowicki, 1998) and the Personality Inventory for Children – Revised (PIC-R; Lachar, 1982). Overall, NLD participants were less accurate at identifying facial expressions and gestures than the VLD and control subjects, and the VLD group demonstrated less accuracy than controls on the same measures. In addition, NLD children were twice as likely to be diagnosed with an internalizing disorder (e.g., anxiety or depression) than those with a VLD, while 82% of the VLD children were indicated for externalizing diagnoses compared to 45% of the NLD subjects. All children showed high rates of pathology.

Semrud-Clikeman and Glass (2008) have also produced evidence suggesting that children with Nonverbal Learning Disabilities experience social difficulties. The researchers explored the association between humor comprehension and social

perception. Initial findings did not indicate differences for the NLD group, reading disability group, and the no disability group. However, when the children with NLD were divided into groups "with" and "without" perceived social difficulties, significant differences were revealed. Thus it seems that humor comprehension difficulties are likely related to poor social perception and not visual-spatial difficulties, supporting that NLD is likely comprised of varying subtypes rather than its current homogeneous design.

Summary

The previous studies suggest that individuals who have NLD are more likely than individuals with other types of learning disabilities or no learning disability to present emotional problems, especially of the internalizing type. These investigations also support that children with NLD experience more difficulty interpreting nonverbal cues beneficial for appropriate social interactions, placing them at risk for any number of psychological problems including social isolation and depression. And although fragmented, there is growing evidence to support the existence of NLD subtypes. Overall, children with NLD have particular social and emotional needs and are deserving of efforts aimed at identifying appropriate home, school and community interventions and treatments.

Assessment of Nonverbal Learning Disability

Administering a formal cognitive test most often provides evidence for the presence of nonverbal disabilities. Overall, students with NLD perform better (average and better) on verbally presented items such as the Similarities and Vocabulary subtests that are included in the Wechsler Intelligence Test for Children (Fisher & DeLuca, 1997; Landau, Gross-Tsur, Auerbauch, Van der Meere & Shalev, 1999; Telzrow & Bonar, 2003). Cognitive weaknesses are those that typically require the use of nonverbal modes of input and output such as the WISC-IV Block Design and Matrix Reasoning subtests (Gross-Tsur et al., 1995). Other instruments designed to detect nonverbal learning problems include the Bender Visual Motor Gestalt Test (BVMGT; Bender, 1938),

Judgment of Line (JOL; Benton, Hamsher, Varney & Spreen, 1983), Visual Form Discrimination (VFD; Benton, Sivan, Hamsher, Varney, & Spreen, 1983), and the Grooved Peg Board Test (Klove, 1963). These measures indicate visual-spatial/motor problems and decisions regarding administration are typically based on age of child. Performances of at least one standard deviation below the mean is considered evidence for nonverbal deficits.

Dysphasia

General Review

Dysphasia, sometimes referred to as developmental dysphasia, is often used in the medical field to indicate a delay in the acquisition of language. The full or partial deficit in skills is attributed to disruption in one or more of the brain's language centers located in the language-dominant left hemisphere and can affect one or more basic language functions of comprehension (understanding of spoken language), naming (identifying items with words), repetition (repeating words or phrases), and speech (Richman & Eliason, 2001). And although a number of Dysphasia subtypes exist, most deficits are typically classified as expressive, receptive or global in nature (Kirk, 1963). For example, a child that is diagnosed with Expressive Dysphasia is typically able to understand what is being said to them, but experiences difficulty with speech initiation, proper grammatical sequencing, and proper word forming and articulation. Unlike Expressive Dysphasia however, a child with Receptive Dysphasia will find it difficult to comprehend spoken language. In addition, his or her output, albeit fluent, is typically comprised of a series of nonsensical words and phrases that result in incomprehensibility, unbeknownst to the child. Global Dysphasia, a combination of expressive and receptive language deficits, affects all language skills in varying degrees. Accordingly, both input and output modes of communication are impacted.

Dysphasia does not necessarily impact overall cognitive functioning; however several academic areas may be affected (Reitan, 1960). Children with Dysphasia are

often regarded as dysfluent and lacking in vocabulary and reading comprehension difficulties often arise (Vellutino, 1977). A history of delayed language development is common and language skills are usually less advanced as compared to other aspects of development. Skills such as performing numeric calculations, spelling words, and writing in complete sentences may also be compromised. And problems may become increasingly pronounced as the child advances through grades (Brown, Aylward, & Keogh, 1996).

Children with Dysphasia often fail to see what is going on around them, miss an obvious point, or become confused during conversations. The child may be considered inattentive or distracted or slow. Dysphasic children may also be seen as illogical or immature because language and expression subtleties are often ineffectively processed. And from the difficulties experienced arises any number of maladaptive social and emotional behaviors (Cantwell & Baker, 1985; Chess & Rosenbburg, 1974).

Assessment of Dysphasia

Some of the symptoms associated with Dysphasia are deficits in auditory perception (Tallal, Stark, & Mellitis, 1985) and memory (Lindgren & Richman, 1986), naming and labeling (Denkla & Rudel, 1976), serial order processing (Wood, Richman & Eliason, 1989), and verbal concept formation and association (Lindgren et al., 1986; Richman & Lindgren, 1980, Wood & Richman, 1988). Selected subtests in the areas of verbal fluency, auditory memory, associative language and auditory processing are often used to help identify Dysphasia subtypes (Richman & Eliason, 2001). Various studies indicate that, similar to NLD, discrepancy scores between language and general intelligence are indicative of a language disorder (Reitan, 1960). More specifically, a relatively low Verbal Comprehension Index score as compared to a relatively higher Perceptual Reasoning Index score provides evidence for the presence of Dysphasia (Semrud-Clikeman & Glass, 2008).

The current diagnostic tool often used by psychologists to classify a language disability is the Diagnostic and Statistical Manual of Mental Disorders-IV-TR (DSM- IV-TR: American Psychiatric Association, 2000), which distinguishes between five subtypes of "Communication Disorders," including expressive, phonological, mixed receptive-expressive, stuttering and communication disorder, NOS. However, in order to provide clarity and consistency, this paper will use the medical term "Dysphasia" to identify children with language disorders.

Dysphasia and Psychosocial Functioning

The association between behavioral problems and language disabilities is well established. Luria (1966) provided evidence that deficits in verbal mediation were related to inattention and impulsivity and implicated associative language deficits to poorer development of self-control behavior. Verbal mediation deficits have also been linked to aggression and delinquency (Lindgren, Harper, Richman, & Stehbens, 1986; Richman & Lindgren, 1981). Hogan and Quay (1984) provided an extensive review on the relationship between language disabilities and aggression, including oppositional and conduct disorders and Attention Deficit Hyperactivity Disorder. Children that have Dysphasia often act impulsively, without consideration of consequences of their behavior and may be confused when reprimanded for inappropriate behavior.

There is also research to support that children with Dysphasia experience increased emotional symptoms such as low self-esteem, poor social skills, and anxiety (Beitchman, Wilson, Brownlie, Walters, Inglis, & Lancee, 1996; Caulfield, Fischel, DeBaryshe, & Whiltehurst, 1989). Baker and Cantwell (1990) conducted a study in which half the Dysphasic subjects met criteria for a psychiatric diagnosis. Eliason and Richman (1988) provided that verbal expression difficulties may lead to anxiety, low self-esteem, and frustration. These children may be punished for behaviors or misdiagnosed with a behavior or emotional disorder. In more severe forms of Dysphasia odd responses

may lead to a diagnosis of thought disorder or even autism. Further, peers may be less inclined to befriend an explosive or anxious child, thus social difficulties emerge.

Summary

Dysphasia is characterized by impairment of the expression and comprehension of verbal communication. Problems with language are typically diagnosed as a result of poor academic achievement and through various assessment measures. There are several terms from various scientific fields (e.g., medical, educational, neuropsychological, and psychological) used to identify disorders that involve language deficits (i.e., Dysphasia, Communication Disorder, Developmental Language Disorder, and Language Learning Disability), and labels used to classify subtypes are also numerous. The association between Dysphasia and behavior problems is clearly related and in general, children with Dysphasia often experience significant psychosocial difficulties (Forrest, 2004) including behavioral outbursts, immaturity, aggression, hyperactivity, and inattention (Cantwell & Baker, 1977; Luria, 1966; Piaccentini, 1987). Deficits in language processes have also been linked to delinquent behavior (Richman & Lindgren, 1981).

Reason for Current Study

Information available regarding the specific social and emotional functioning of children who have NLD is somewhat lacking (Scheeringa, 2001). More often research has focused on broad characteristics of nonverbal learning disability or emphasizes LD without subtyping (Forrest, 2004). Several studies also include children and adults rather than children only. For example, Weintraub and Mesulam (1983) conducted a study that included 14 individuals between the ages of 12-42 years. All individuals, regardless of age, exhibited chronic social emotional problems such as poor eye contact, depression, and social isolation. Another study that included general learning disability subjects was completed by Bruck (1986). In this analysis, Bruck reviewed several investigations supporting that a higher number of individuals in the LD population experienced a higher incidence of non-clinical adjustment problems, more social in nature. Additionally,

Sisterhen and Gerber (1989) reported that adolescents without learning disabilities were consistently better at decoding nonverbal auditory and visual cues. Performances for those children with a learning disability were lower when provided with only visual cues.

While general information and investigations involving mixed groups are important starting places for research, gathering more specific information can lead to better treatments and interventions. Therefore, the purpose of this study is to identify differences in the social and emotional symptomology of NLDs from that of children with Dysphasia, and to determine if there are differences in social and emotional symptomology based on average verses above average cognitive ability. The following information outlines the questions that will be addressed and the hypothesis to be tested in this study.

Questions and Hypotheses

I. Demographic Variables

- A. Continuous Demographic Variables
  1. Question: What are the differences between groups of children diagnosed with either Nonverbal Learning Disability or Dysphasia regarding age, parent education, and number of psychological diagnoses?
  2. Hypothesis: Children with NLD will be older, have more parent education, and more diagnoses.
- B. Categorical Demographic Variables
  1. Question: What are the differences between groups of children diagnosed with either Nonverbal Learning Disability or Dysphasia regarding gender and type of psychological diagnoses?
  2. Hypothesis: Children with NLD have a higher number of attention deficit hyperactivity disorder, anxiety, depression and behavior disorder diagnoses. Children with Dysphasia will have more Dyslexia and Dysnomia diagnoses. Gender differences are not expected.

II. General Ability Index (GAI)

- A. Pediatric Behavior Scale

1. Question: What are the specific social and emotional PBS scales associated with GAI scores for groups of students diagnosed with either Nonverbal Learning Disability or Dysphasia?

2. Hypothesis: Higher GAI scores for children in the NLD group will correlate with an increase in scores of inattention, depression and anxiety as measured by the PBS scales. GAI scores will be related to significant differences in Conduct PBS scores for the Dysphasia group.

B. Continuous Demographic Variables

1. Question: What are the associations among demographic variables and GAI scores for children diagnosed with either Nonverbal Learning Disability or Dysphasia?

2. Hypotheses: Age, parent education, and number of diagnoses will be associated with GAI for the NLD group. Correlations among GAI and Demographic variables for the Dysphasia group are also expected.

III. Verbal Comprehension and Perceptual Reasoning Discrepancy

A. Pediatric Behavior Scales (PBS)

1. Question: What are the specific PBS scales associated with discrepancies between Verbal Comprehension and Perceptual Reasoning Index (VCI/PRI) scores for groups of students diagnosed with either Nonverbal Learning Disability or Dysphasia?

2. Hypothesis: Higher VCI/PRI discrepancy scores for the NLD group will correlate with an increase in Depression, Attention, and Anxiety PBS scale scores. Higher VCI/PRI discrepancy scores for the Dysphasia group will result in a greater number of behavior symptomology as indicated by the PBS Conduct scale.

B. Demographic Variables

1. Question: What are the associations between VCI/PRI and demographic variables for children diagnosed with either Nonverbal Learning Disability or Dysphasia?

2. Hypothesis: Correlations between age, parent education, and number of diagnoses and VCI/PRI discrepancy will be significant for the NLD Group. There are also significant correlations expected for the Dysphasia group.

CHAPTER III

METHODOLOGY

This study was designed to determine the association between nonverbal learning disability and social and emotional functioning. To guarantee confidentiality of participants, all procedures were evaluated and approved by the University of Iowa's Institutional Review Board before accesses to patient files were given. The following is a detailed description of the participants, instrumentation and procedures.

Participants

The data used in this study were drawn from a clinical population of children tested between the years of 2004-2010 at a large Midwestern University Hospital's outpatient Learning Disorders Clinic. Participants selected were between the ages of 6-16 and received a diagnosis of either NLD (experimental group) or Dysphasia (contrast group). Approximately 1000 patient records were reviewed and 262 were selected for analysis. Patient data were transferred to an anonymous data sheet (see Appendix C). Of the initial 262 records identified, 93 of those records were excluded due to missing/incomplete data and/or Borderline GAI scores not identified upon initial review. The final selection of NLD and Dysphasia group participants were reviewed using classification systems established in various subtyping studies using clinical inspection of psychological protocols (Mattis et al., 1975) and applications of statistical methods to the protocols (e.g. Rourke, 1975; Fisk and Rourke, 1979; Fletcher & Satz, 1985, Eliason & Richman, 1988).

Procedures

In order to be included in this study, patient records were reviewed and the following criteria needed to be met: (a) Wechsler Intelligence Scale for Children - IV (WISC-IV, 2004) Global Assessment score (GAI) within the Low Average to Superior Range (85 and above); (b) no primary sensory disabilities; (c) evidence of primary

educational or cultural deprivation not present; (d) English as primary language; (e) completed Pediatric Behavior Scale (PBS; Lindgren & Koppel, 1987), Parent Form.

Subjects were assigned to the NLD group if the following neuropsychological patterns were met: (1) at least a 10-point discrepancy between Wechsler Intelligence Scale for Children - IV (WISC-IV, 2004) Verbal Comprehension (VCI) and Perceptual Reasoning (PRI) index scores whereby VCI is higher than PRI; and (2) Bender Visual Motor Gestalt Test, Grooved Pegboard Test, and/or Judgment of Line Orientation Test visual-motor/visual-perceptual test scores were at least 1 or more standard deviations below average. A total of 61 male and 32 female participants diagnosed with NLD comprised this group.

The 26 female and 40 male subjects diagnosed with Dysphasia met the following criteria; (1) any discrepancy between the WISC - IV Verbal Comprehension Index score (VCI) and Perceptual Reasoning Index score (PRI) did not meet NLD criteria; (2) semantic Word (verbal) Fluency, Boston Naming (Kaplan, Goodglass, & Weintraub, 1983), and Rapid Automatized Naming (RAN; Denkla & Rudel, 1974) language test scores were at least 1 or more standard deviations below average.

Measures

After eligibility of participants was reviewed, the participants were grouped according the specific diagnostic categories of Nonverbal Learning Disability and Dysphasia (Language Learning Disability). The following is a list of various instruments that were used in the study. Because each child assessed in the clinic presented with his or her own unique abilities, not all measures were used for each specific case. Although each child in the study did not complete the same assessment battery, they were included in the present study if they had completed assessments as specified above. Table D1 provides group comparisons for assessment results. The following provides a description of assessment used in the evaluations.

Pediatric Behavior Scale

The Pediatric Behavior Scale (PBS; Lindgren & Koeppl, 1987) was used as a measure of social and emotional functioning. It was designed to be used for children and adolescents, and administered to a child's primary caregivers (e.g., biological parents, step-parents, grandparents, legal guardians) and teachers. The PBS consists of 165 items that require a rating of 0-3 to be selected, based on observations of the child's behavior, attitudes, social interaction, and school performance. The items of the PBS are divided into 24 specific scales. A child's raw score on these scales can be converted to T-scores and plotted to reveal an overall profile. Ratings that indicate T-scores of at least 71 are considered clinically significant for particular pathologies, and T-scores between 63 and 70 are considered "at-risk." Further, the specific scales load into six general scales that include Conduct, Attention Deficits, Depression/Anxiety, Deviation, Health, and Cognition. Depression and Anxiety specific scores and Conduct, Attention, Depression/Anxiety, Deviation total scores are included in this study.

The Pediatric Behavior Scale was developed at the University of Iowa in collaboration with 10 pediatric psychologists using the rational decision-making model rather than statistical methods. The psychologists identified major issues within the pediatric population that were pertinent to the scale which led to behavioral descriptions being written and compiled in each of the six designated behavior and emotional areas: Conduct (CD), Attention Deficits (AD), Depression/Anxiety (DA), Deviation (DV), Health (HL), and Cognition (CN). After researching and comparing the PBS scale to other highly valid rating scales (e.g., Revised Behavior Problem Checklist: Quay, 1983), and through pilot testing and expert reviews, a selection of 165 items were included on the PBS. Items were retained on scales if the selection committee found the items to be clear, unambiguous, and pertinent to the behavioral dimension being assessed (Lindgren & Koeppl, 1987).

To help standardize the PBS, the checklists were completed by parents of a heterogeneous sample of 106 pediatric patients evaluated through a wide variety of the University of Iowa hospitals and clinics. Lindgren and Koeppl reported internal consistency coefficients as .83 for specific scales and .91 for general factors. Interrater reliability between mothers and fathers as the raters was based on scores of 33 children. The specific correlations include: conduct (.79), attention/impulsivity (.76), depression/anxiety (.73), deviation (.73), health (.51), and cognition (.69). Current PBS norms are based on parent ratings of 600 children from the general population.

As stated earlier, the PBS has six general factors (see Appendix B). Each of those factors is derived from scales that are formed from individual test items. The first factor is Conduct (CD) which helps identify levels of opposition, antisocial and aggressive behavior. The Attention Deficit (AD) factor assesses levels of inattention, impulsivity and hyperactivity. The Depression/Anxiety (DA) factor was designed to assess self-esteem, fear, anxiety, depression, and social isolation. The Deviation (DV) factor is more diverse and includes atypical social behavior. The Health and Cognition factors were not used in this study. Each item on the PBS was included in only one scale, though it is likely that some items correlate highly with other scales for some populations (Lindgren & Koeppl, 1987).

Wechsler Intelligence Scale for Children – IV

The Wechsler Intelligence Scale for Children - IV (WISC-IV) is an intelligence measure based on a standardization sample of 2,200 children representative of gender, age, parent education, geographic region, and ethnicity. It was designed to provide a measure of Verbal Comprehension, Perceptual Reasoning, Working Memory and Processing Speed. A full scale Intelligent Quotient and General Ability Index can be calculated. For the purposes of this study, actual or prorated VCI, PRI and GAI scores were utilized. Verbal Comprehension assessments included were Similarities, Vocabulary, and Information subtests, which measure verbal comprehension and language-based

skills. Perceptual Reasoning assessments included were Block Design, Matrix Reasoning, Picture Completion, and Picture Concepts designed to measure perceptual, nonverbal reasoning skills. Based on the actual or prorated scores of VCI and PRI scores, GAI scores were calculated.

Similarities

Similarities is a verbal subtest of the WISC - IV, which presents a series of paired words that the child must conceptually link and verbally present to the test administrator in order to earn points. The subtest is designed to measure verbal reasoning and concept formation, and it involves auditory comprehension and verbal expression (Bannatyne, 1974; Cooper, 1995; Glassar & Zimmerman, 1967; Kauffman, 1994; Sattler, 2008). The examiner scores each child's answer on a scale of 0-2 points depending on the comparability to the standardized answers provided in the test manual. The number of questions presented depends upon a pre-determined basal and ceiling level. The minimum number of word-pairs presented is four, while the highest is twenty-three. The child can receive a raw score between 0-44. Split-half reliability coefficients range from .82-.89 (mean = .86), depending on the age of the child. Test-retest reliability is reported to be .86. Similarities also has an intercorrelation of .74 with the Verbal Comprehension Index and .70 with the Full Scale Intelligence Quotient (FSIQ).

Vocabulary

Vocabulary is a Verbal Comprehension subtest of the WISC - IV which visually presents a series of pictures or words that the child must verbally label or define for the test administrator. This subtest is designed to measure verbal reasoning and comprehension, fund of knowledge, learning ability and degree of language development (Bannatyne, 1974; Cooper, 1995; Kauffman, 1994; Sattler, 2008). The examiner scores each child's answer on a scale of 0-2 points depending on the comparability to the standardized answers provided in the test manual. The number of questions presented depends upon a pre-determined basal and ceiling level. Based on age and ability levels,

the minimum number of items presented is 4 pictures and 1 word, or 5 words. The highest number of pictures and words presented is thirty-six. The child can receive a raw score between 0-68. Split-half reliability coefficients range from .82-.94 (mean = .89), depending on the age of the child. Test-retest reliability is reported to be .92. Vocabulary also has an intercorrelation of .79 with the Verbal Comprehension Index and .72 with the Full Scale IQ.

Information

Information is a verbal subtest of the WISC - IV which presents a series of general knowledge questions that the child must answer and verbally present to the test administrator in order to earn points. It is designed to measure the ability to acquire, retain and retrieve factual knowledge, and it may also include auditory perception, comprehension and verbal expression skill use (Cooper, 1995; Kauffman, 1994; Sattler, 2008). The examiner scores each child's answer on a scale of 0-1 points depending on the comparability to the standardized answers provided in the test manual. The number of questions presented depends upon a pre-determined basal and ceiling level. The minimum number of questions presented is five, while the highest is thirty-three. The child can receive a raw score between 0-33. Split-half reliability coefficients range from .78-.91 (mean = .86), depending on the age of the child. Test-retest reliability is reported to be .89. Exploratory factor pattern loadings for supplemental subtests (all age groups) indicate that Information loads .71 with the Full Scale IQ.

Block Design

Block Design is a Perceptual Reasoning subtest from the WISC-IV consisting of a set of modeled or printed two-dimensional geometric patterns which the child replicates using red and white colored blocks (Wechsler, 2003). Skills associated with Block Design include visual perception and organization, visual-motor coordination, ability to separate figure-ground stimuli, and ability to analyze and synthesize abstract visual stimuli (Cooper, 1995; Kauffman, 1994; Sattler, 2008). The number of questions presented

depends on pre-determined basal and ceiling levels. The minimum amount of questions presented to the child is two trials and the maximum is 14 trials. The child can receive a raw score between 0-68. Reliability coefficients based on the split-half method yield reliability ranges of .83-.88 (mean=.86) depending on age of the subject. Test-retest reliability is reported to be .82. Block Design has an intercorrelation of .61 with Full Scale IQ and .56 with Perceptual Reasoning index.

Matrix Reasoning

Matrix is a Perceptual Reasoning subtest from the WISC-IV consisting of an array of pictures and geometric patterns with one missing square. The child is required to select the picture that fits the array from a set of five options. The subtest is designed to measure visual information processing and abstract reasoning (Sattler, 2008). Questions presented depend on pre-determined basal and ceiling levels. The minimum number of matrices presented to the child is four trials and the maximum is 35 trials. The child can receive a raw score between 0-35. Reliability coefficients based on the split-half method yield reliability ranges of .86- .92 (mean=.89) depending on age of the child. Test-retest reliability is reported to be .85. Matrix Reasoning has an intercorrelation of .61 with the Perceptual Reasoning Index and .64 with the Full Scale IQ.

Picture Concepts

Picture Concepts is a Perceptual Reasoning subtest from the WISC-IV consisting of a series of pictures in pre-selected rows. Categorical and abstract reasoning skills are abilities the subtest is designed to measure. The test taker is required to select one picture from each row that goes together by pointing or calling out the picture number or name. The number of pictures presented depends on pre-determined basal and ceiling levels. The minimum amount of questions presented to the child is four trials and the maximum is 28. The child can receive a raw score between 0-28; each correctly answered item is worth 1-point. Reliability coefficients based on the split-half method yield reliability ranges of .76-.85 (mean=.82) depending on age of subject. Test-retest reliability is

reported to be .76. Picture Concepts has an intercorrelation of .50 with the Perceptual Reasoning Index and .55 with the Full Scale IQ.

Picture Completion

Picture Completion is a Perceptual Reasoning subtest from the WISC-IV consisting of artwork of common objects that contains a missing element. Picture Completion is intended to measure visual perception and organization, and visual recognition of essential details of objects (Cooper, 1995; Kauffman, 1994; Sattler, 2008). The test taker is required to point and/or name the missing part. The number of pictures presented depends on pre-determined basal and ceiling levels. The minimum amount of questions presented to the child is six trials and the maximum is thirty-eight. The child can receive a raw score between 0-38; each question answered correctly earns 1-point. Reliability coefficients based on the split-half method yield reliability ranges of .81-.87 (mean=.84) depending on age of subject. Test-retest reliability is reported to be .84. Exploratory factor pattern loadings for supplemental subtests (all age groups) indicate that Picture Completion loads .71 with the Perceptual Reasoning Index.

Word Fluency Test

The Word Fluency Test was developed to assess the spontaneous production of words beginning with a given letter (Spreen & Strauss, 1998). The examiner asks the examinee to verbally produce as many words as she/he can that begin with a particular letter. The child is given one minute per letter and encouraged to name words for the entire time allotted. The most common letters used for this assessment and those used for this study are “F,” “A,” and “S” although other normative data using alternative letters exists (Spreen & Strauss, 1998). The test participant receives one point for every real word named, unless the word is a proper noun. Slang terms and foreign words that are part of Standard English are acceptable (i.e., “si,” & “oui”). Because the child is expected to name as many words as he or she can within a one minute time interval, the maximum raw score is indeterminate. The minimum score is zero. This instrument contains

normative data that were based on results of performances of children and adults from the United States. Although not used in the current study, Spreen and Strauss (1998) developed normative data with children ages 6-13 with learning disabilities, diabetes, brain damage and epilepsy using the letters "F," "A," and "S." Overall, the reliability of this assessment is considered adequate. Test-retest reliability after 19-42 days is .88 and remains at .68 after 8 months (des Rosiers & Kavanaugh, 1978).

In a study of construct validity, Word Fluency contributed mainly to reading-writing and reading-writing-sentence construction. This factor analytic study completed with children's data demonstrated a strong connection between Word Fluency and fluency ability (Crockett, 1974). Spreen and Strauss (1998) explain that this is likely related to the development of spelling skills during childhood. This test also discriminates between ADHD and LD, diagnostically essential in thwarting misdiagnoses (Barkley & Grodzinsky, 1994). Concurrent validity has been established in several studies as well.

Boston Naming

The Boston Naming test is a measure of object naming (Kaplan, Goodglass, & Weintraub, 1983). There are 60 line drawings available for visual presentation, each worth 1-point for correct verbal identification of the item. Test objects have been rank ordered according to their ability to be named, which is thought to be related to frequency of exposure to items. This type of picture-naming vocabulary test is useful in the assessment of children with learning disabilities and subjects with brain injuries.

Various researchers have attempted to establish developmental norms for the Boston Naming Test, however small sample sizes hinder generalization (Kaplan et al., 1983; Yeates, 1994). Although Boston Naming lacks normative standards, it is used frequently within pediatric populations because of documented validity in numerous research studies (Yeates, 1994).

Construct validity was investigated by Halperin, Healy, Zeitschick, Ludman, and Weinstein (1989), who found that Boston Naming loaded significantly with speech and

language tasks of words knowledge/vocabulary. From this study, the researchers judged Boston Naming a useful tool for measuring children's word naming skills. In another investigation, Yeates attempted to improve norms by collapsing norms from previously published work. Through his efforts, a new set of norms were developed and were thought to achieve norms that were both sufficiently reliable and valid. Further research has indicated the successful identification of children with language learning disability through the use of the Boston Naming test (Cooper & Rosen, 1977).

Rapid Automatized Naming Test

The Rapid Automatized Naming Test (RAN: Denckla & Rudel, 1976) was designed to measure rapid continuous retrieval of well-known words. On this task, the student is required to quickly name 50 items in a 5-row/10-column arrangement. There are four trials (letters, numbers, colors and objects) with randomly repeating items within each trial. Each trial is timed and the time it takes for the child to complete the task is compared to age and gender based normative data. The total time it takes to name each of the 50 items for each trial is shown to decrease with age, and also to discriminate among students who have a reading disability and students who do not have a reading disability and/or other learning disabilities (Denckla & Rudel, 1976). Katz, Curtiss, and Tallal (1992) also found the RAN to accurately discriminate between children with language impairment versus children without language impairments.

Bender Visual Motor Gestalt Test

The Bender Visual Motor Gestalt Test (BVMGT) is a measure of visual-motor skills created for children age 5 years, 0 months to 10 years, 11 months (Bender, 1938). This is an individually administered paper-and-pencil test in which the child is required to copy nine geometric designs that are displayed one at a time on a 4" X 6" index card. The Koppitz (1975) scoring system, based on standardized criteria, classifies errors according to distortion of shape, rotation, integration difficulty, and perseveration. Each error is worth 1-point.

Norms are based on 975 children ages 5-12. Koppitz (1975) reported that the median test-retest reliability is .77 for the total score based on same day to eight month intervals and interrater reliability ranged from .79 to .99.

The Bender VGMT appears to have adequate validity to assess perceptual-motor development (Sattler, 2008). Copying errors steadily decreases between the ages of 5 and 9, suggesting that the test is sensitive to maturation. In addition, the Bender correlates highly with the Developmental Test of Visual Perception and the Frostig Developmental Test of Visual Perception, both of which measure visual-motor perception (Koppitz, 1975).

Judgment of Line Orientation Test

The Judgment of Line Orientation test (JOL) assesses visual-spatial perception without a motor component (Benton, Hamsher, Varney, & Spreen, 1983). The student is required to look at a set of incomplete lines in a booklet and determine which two lines in an 11-line array match the position of the two lines in the test display. Children are given 1 point for each of the 30 items answered correctly and zero-points if 1 or both lines are incorrectly identified. Normative data are available for the children age 7 to 14 based on a study of 221 children (Lindgren & Benton, 1980). A split-half reliability coefficient was found to be .83 and test-retest reliability was .90 when 37 subjects were administered two different forms of the test ranging from 6-hours to 21-day intervals. In addition, validity studies have strongly supported this measure as an acceptable way to measure visual-spatial skills, as it successfully discriminates between patients with right- and left-sided brain lesions (Lindgren & Benton, 1980).

Grooved Pegboard Test

The Grooved Pegboard is a test of visual-motor dexterity (Klove, 1963). This assessment requires children to place small, metallic key shaped pegs into identically shaped holes on a 4” X 4” metallic board, working from left to right, top to bottom. One trial is performed for both the dominant and non-dominant hand, and scores are based on

the time it takes to complete the task and the number of pegs dropped for each hand. Norms are available for ages 5-14; however, little information regarding reliability and validity is available (Mahurin, 1995).

Psychometric Issues

Although there are limited psychometric data available for a few of the tests included in this study, the measures are widely accepted and consistently used within the field of neuropsychology (Rourke, Fisk, & Strang, 1986). There are also extensive published studies indicating the usefulness of test data of this type in creating accurate neuropsychological profiles for children with impairments.

Data Analysis

The first goal of the current study was to evaluate the potential differences between the NLD and Dysphasia groups on the demographic variables of gender, socioeconomic status, age, and total number and type of other psychological and learning diagnoses. This analysis was completed in three steps. First, a Chi Square with Yate's Continuity Correction method was used to detect group differences for the categorical demographic dependent variables of gender and type of comorbid diagnosis categories. Next, categorical dependent variables of age, mom/dad education, and number of co-morbid diagnosis were analyzed using a series of ANOVA's. The Bonferroni Correction method was used to control for Type 1 errors. NLD and Dysphasia served as the independent variables for all analyses.

The second goal of the study was to determine whether GAI scores correlate with continuous demographic variables (i.e., parent education, age, and number of diagnoses) and PBS scales for either the NLD or Dysphasia group. A prior analysis was conducted to identify differences between GAI scores for the NLD and Dysphasia groups. Next, separate Pearson correlation analyses for NLD and Dysphasia groups were conducted to investigate the relationship between GAI and demographic variables. The correlation

method was also used to explore possible relationships between GAI and PBS scales of Conduct, Deviation, Attention Deficits, Depression and Anxiety.

The last goal was to ascertain whether VCI/PRI discrepancies correlated with continuous demographic variables (i.e., parent education, age, and number of diagnoses) and PBS scales for either the NLD or Dysphasia group A prior analysis was conducted to identify differences between VCI/PRI scores for the NLD and Dysphasia groups. Next, separate Pearson correlation analyses for NLD and Dysphasia groups were conducted to investigate the relationship between VCI/PRI and demographic variables. The correlation method was also utilized in the exploration of relationships between VCI/PRI discrepancies and PBS scales of Conduct, Deviation, Attention, Depression and Anxiety.

CHAPTER IV

RESULTS

This chapter presents the analyses of data in three sections. First, demographic characteristics and demographic comparisons are presented. Second, questions regarding social and emotional symptoms associated with the General Ability Index were addressed. The third portion of the chapter addresses questions regarding the relationship of psychosocial difficulties to the discrepancy between Verbal Comprehension and Perceptual Reasoning Indices.

Participants of the study were compared on the basis of their diagnosed disabilities (Nonverbal Learning Disability or Dysphasia); therefore random group assignment was not possible. Diagnostic criteria for all participants were met. A priori analyses, Cross-tabs, Chi-Square, Univariate Analysis of Variance, and Pearson Correlation were conducted using the Statistical Package for the Social Sciences-Version 19 (SPSS). The Bonferroni Correction was used to control for Type 1 errors as necessary.

Demographic Data

There were a total of 159 participants who met inclusion criteria for the study. The children were between the ages of 6 and 12 years with a mean of 11-2 years of age. The NLD group consisted of 32 females and 61 males. Twenty-six females and 40 males comprised the Dysphasia group. Grade placements ranged from kindergarten to 11th grade, and the overall mean was early fifth grade. More specifically, the NLD and Dysphasia group mean grade placement was mid-fifth and mid-fourth grade, respectively. The mean age of the participants in the current investigation are similar to those in other LD studies, however the age and grade ranges are more expansive than typically included in LD research. A summary of demographic data is presented in Table D2.

Parental education level of subjects was also assessed (see Table D3). Maternal education ranged from pre-high school diploma to graduate level. A median of 2 years post-high school education was indicated for the NLD group and 1-

year post-high school for the Dysphasia group. In addition, father's education ranged from pre-high school diploma to graduate level. The median education for NLD and Dysphasia fathers was 3-years post-high school and high school diploma, respectively. And although these numbers are somewhat higher than the national average, the overall distributions of parental education level are representative of those families served by the University of Iowa Learning Disorders Clinic.

The number and type of diagnosis associated with NLD and Dysphasia participants were also investigated. Mean number of diagnoses per subject were 2.31 (SD = .92) (See Table D4). Co-morbid diagnoses of Dysnomia, Dyslexia, Attention Deficit Hyperactivity Disorder, Depression, Anxiety, and Behavior Disorder (i.e., Oppositional Defiant Disorder, Disruptive Behavior Disorder) were prevalent and consequently selected for further analysis (see Table D5). The incidence of Dyscalculia, Motor-Coordination Disorder, Dysmnesia, Dysgraphia, Developmental Writing Disability, and Reading Disorder were quite low (i.e., n = 1 or n = 2); thus further analyses were not completed on these diagnoses.

Research Question 1

To examine group differences on demographic variables, a series of analyses were conducted using either Chi-Square or an ANOVA test statistic. Chi-square analyses with Yates Continuity Correction indicated that significantly more subjects in the NLD group had a diagnosis of ADHD ($x^2 = 9.21$, $p < .01$). Alternately, analyses indicated significantly more diagnosis of Dyslexia ($x^2 = 28.39$, $p < .001$) and Dysnomia ($x^2 = 19.95$, $p < .001$) in the Dysphasia group. Results did not reveal significant findings for gender ($x^2 = .23$, $p = .63$) or rates of Behavior Disorder ($x^2 = .46$, $p = .50$), Anxiety ($x^2 = 3.47$, $p = .06$), or Depression ($x^2 = 2.47$, $p = .12$) diagnoses. Table D7 provides a review of Chi Square analyses.

A series of univariate analyses (ANOVAs) were conducted with NLD vs. Dysphasia groups as the independent variable. Because full data were not available for

each subject, separate ANOVAs were run for each dependent variable. The Bonferroni Correction was applied to minimize Type I error ($p = .0125$). Results varied for demographic variables of age, number of diagnoses, mother education, and father education. In regards to level of education, NLD mother's (F (1, 157) = 18.88, $p < .001$, $\eta_p^2 = .11$) and father's (F (1, 157) = 15.43, $p < .001$, $\eta_p^2 = .10$) were found to have significantly more education than parents of children in the Dysphasia group (see Table D6). The Partial Eta Squared indicated medium to large effect sizes. Number of diagnosis (F (1, 157) = 2.619, $p < .108$, $\eta_p^2 = .016$) and age (F (1, 157) = 4.193, $p < .042$, $\eta_p^2 = .026$) were not indicated as significantly different between groups.

Research Question 2

The second goal of the study was to determine whether GAI scores and PBS scales were related. First, a univariate analysis to control for demographic variables was conducted and a significant effect was found indicating that the NLD group had higher GAI scores F (1, 157), 22.16, $p < .001$, $\eta_p^2 = .12$, reflecting a large effect size (see Table D8). Further analysis investigated the possible relationship between GAI scores and PBS scales of Attention, Deviation, Conduct, Depression and Anxiety. A Pearson correlation was run separately for the NLD and Dysphasia groups at the .05 level of significance (see Table D9). For the NLD group there was a positive correlation between the PBS depression scale and GAI score ($r = .208$, $p < .05$, $n = 93$), indicating that higher GAI scores were related to increased depression symptomology. No other scales showed significance for the NLD group. There were no significant relationships between GAI and PBS scales detected for the Dysphasia group.

An additional Pearson correlation analysis at the .05 level of significance was conducted for GAI and demographic variables of age, number of diagnoses, and parent education (see Table D10). A positive correlation for both mother ($r = .40$, $p < .001$) and father education ($r = .52$, $p < .001$) was found for the NLD group. There were no significant GAI and demographic variable correlation detected for the Dysphasia group.

Research Question 3

The third part of the study was to determine whether a discrepancy in VCI/PRI scores was related to PBS scales. A prior analysis was conducted to control for demographic variables, results of which indicated a medium effect size for NLD to have higher VCI scores, F (1, 157) = 557.53, p = < .001, η_p^2 = 0.78 (see Table D8). Next, the relationship between VCI/PRI discrepancy scores and PBS scales was analyzed by group using a two-tailed Pearson's correlation. Each of the PBS scales of Conduct, Attention, Depression, Anxiety, Depression/Anxiety, and Deviation were included and compared to VCI/PRI discrepancy score at the .05 alpha (see Table D10). For the Dysphasia group, Conduct (r = -.31, p < .05), Attention (r = -.39, p < .001) and Deviation (r = -.37, p < .01) reached significance showing that the number of symptoms increased as the size of the discrepancy between PRI and VCI (PRI higher) increased. There were no significant findings for the NLD group.

An additional Pearson correlation analysis (α = .05) for VCI/PRI discrepancy and demographic variables of age, number of diagnoses, parent education was conducted (see Table D11). A correlation between number of diagnoses and VCI/PRI discrepancy reached significance for the NLD group (r = -.31, p < .01), thus a larger VCI/PRI discrepancy appears to be related to a greater number of diagnoses for the NLD group. There were no significant demographic variables findings for the Dysphasia group.

Summary

Overall, there were significant differences found between the Nonverbal Learning Disability and Dysphasia groups regarding mother and father education, and the diagnoses of ADHD, Dysnomia and Dyslexia. In addition, Global Ability Index scores and the PBS Depression scale, and GAI and mother and father education were correlated for the NLD group. Furthermore, various PBS scales and Verbal Comprehension/Perceptual Reasoning Index score discrepancies were found to be correlated. More specifically, as VCI/PRI became increasingly larger, symptoms

associated with PBS Conduct, Attention and Deviation scales increased for the Dysphasia group. Further analyses indicated that the NLD group experiences more diagnoses as the discrepancy between VCI and PRI increases. Overall, NLD had higher GAI scores and larger VCI/PRI discrepancies.

CHAPTER V

DISCUSSION AND CONCLUSIONS

The following is a discussion of the findings of this research study. The results are discussed in relation to the research questions and reported research on the association between Nonverbal Learning Disability, Dysphasia, demographic variables and psychological symptomology. Conclusions from the research are explained and suggestions for future research are discussed.

Discussion

The primary purpose of this study was to help identify psychosocial deficits that are consistent with the occurrence of Nonverbal Learning Disability or Dysphasia. In order to develop and implement appropriate clinic and school treatments, interventions, and accommodations, identifying social emotional symptomology for NLD and Dysphasia is a necessary. Once clearer trends are established, and appropriate interventions, treatments, and accommodations are selected, it would be assumed that these children would then be able to manage symptoms, thus forestalling various detrimental consequences that accompany NLD and Dysphasia.

Research Question 1

The first question in the study focused on demographic variables. The primary aim was to determine if there were any significant differences between the NLD and Dysphasia groups for the demographic variables of age, gender, parent education, and number and type of psychological and learning diagnoses. It was suspected that the NLD group would have significantly more diagnoses, especially for anxiety, depression and behavior disorders. It also seemed likely that the Dysphasia group would have more Dyslexia and Dysnomia diagnoses. Additionally, it was hypothesized that the NLD group would be older, have more co-morbid diagnoses, and that parent education would be higher for both mother and father. Analyses detected significant differences for parent

education and specific diagnoses, although not all outcomes supported the aforementioned hypotheses.

First, parent education was higher for the NLD group than for the Dysphasia group, which was suspected given the overall higher ability scores NLD participants achieved. It has been shown that a family history of learning and psychological problems is quite common among children that have been diagnosed with a learning or psychological disability, thus hinting at the likelihood of a genetic predilection to a specific pathology (Antshel & Khan, 2008; Weintraub & Mesulam, 1983)**.** If this is the case, then it may be assumed that both strengths and weaknesses are inherited, and therefore high achieving NLD students likely represent characteristics of their well-educated, higher achieving parents who have similar proclivities.

Data collected indicate that NLD WISC-IV standard scores were about 8.5 points higher for GAI and 26.5 points higher for VCI, while the Dysphasia group outperformed NLD by 12.84 points on the PRI scale. These data are consistent with research that shows high achievement or even gifted performances in various subject areas for children that have NLD (Tanguay, 2002; Thompson, 1985). Similarly, data support that students with Dysphasia often encounter a number of academic difficulties (Reitan, 1960) and are less likely to consistently achieve high marks in an educational environment that bases achievement primarily on tasks verbal in nature.

There were several variables that were indicated as statistically different between NLD and Dysphasia groups. Surprisingly, age differences did not reach significance, although NLD subjects were an average of 11-months older than Dysphasia subjects. As noted by Tanguay (2002), NLD children often progress through the earlier grades without too much difficulty; however, when learning demands increase and social interactions become more sophisticated, problems arise. Thus, it seemed reasonable that the NLD group would present for an evaluation at a significantly older age than those with Dysphasia, but data did not support this proposition. Like age, gender differences were

not supported though it is worth mentioning that there were a noticeably lower number of NLD females (i.e., 35) than NLD males (i.e., 68) represented in the study. Further analyses disclosed that number of diagnoses were similar for both groups, which again, is not surprising given the extensive psychosocial difficulties reported for both groups. Interestingly, many participants had at least two diagnoses. According to the Surgeon General (1999), it is expected that about 21% of the normal population to have a given diagnosis; therefore this finding is quite significant given that both groups are higher than the expected average. Moreover, many children represented in this study have more than one diagnosis, which supports the complexity of NLD.

Participants in both groups also showed a tendency for specific co-morbid diagnoses to occur. First, the NLD group accounted for a greater number of social/emotional and behavioral diagnoses than the Dysphasia group. As reviewed earlier, children with NLD exhibit a number of internalizing and externalizing psychological symptomology (Forrest, 2004; Fuerst et al., 1990; Petti et al., 2003; Rourke, 1995; Semrud-Clikeman and Glass, 2008; Tanguay, 2002) resulting from various neuropsychological assets and deficits. Further, data also suggested that the Dysphasia group accounted for a greater number of learning disability diagnosis.

The NLD group was confirmed to have more ADHD diagnoses. Of the 159 participants in the study, almost half (i.e., 72 participants) were diagnosed with ADHD, 52 of which were within the NLD group. Researchers have found that children with NLD also meet criteria for ADHD, particularly inattentive-type symptomology (Brown, 2000; Rourke, 1995; Voeller, 1996), although the association between the two disorders has been fraught with controversy. Several researchers have argued that dysfunction in white matter and right parietal and frontal cortex neural regions give rise to both NLD and ADHD (Denckla, 2000; Landau et al., 1998). Denckla (2000) specifically described an overlapping of neural regions that account for the manifestation of both NLD and ADHD executive functions. Other researchers contend that, although the inattention

symptomology for both NLD and ADHD present similar behavior profiles, the two disorders have differing etiology. Rourke conceptualized NLD as developmental in nature, of which assets and deficits are congruent to the damage to or underdevelopment of white matter in the brain (1995). In this vein, cause and effect relationships are emphasized. For example, children with NLD are expected to have auditory perception strengths and visual-perception weakness, thus the developmental sequence Rourke proposes would then implicate NLD children to have relatively well developed auditory attention skills versus impaired visual attention skills.

The Dysphasia group showed significantly more diagnoses for both Dyslexia and Dysnomia. Because language deficits are associated with a number of learning disabilities, especially Dyslexia and Dysnomia (Eliason & Richman, 1988; Myklebust, 1967; Tallal, 1986), the findings of the present study are consistent with prior research. It is worth mentioning that several children in the NLD group also had a co-morbid learning diagnosis of Dysnomia or Dyslexia. Research regarding these seemingly language-based learning disabilities has been the subject of numerous studies for which several interesting findings have resulted (American Optometric Association, 2008; Misra, Katzir, Wolf, & Poldrack, 2004; Albuquerque & Simones, 2010; Stainthorp, Stuart, Powell, Quinlan, & Garwood, 2010). In fact, it has been hypothesized that a Rapid Naming weakness, used to detect phonological and language difficulties, may be the result of visual – spatial difficulties rather than or in addition to phonological difficulties (Stainthorpe, et al., 2010). In addition, sluggish attention shifting due to visual attention deficits or temporoparietal dysfunction has also been implicated (Misra et al., 2004). Further, integration ability, required by such tasks as Rapid Naming, may impair the performance of children who have NLD due right hemispheric deficits (Albuquerque & Simones, 2010).

In contrast to the aforementioned group differences, specific depression and anxiety diagnoses were statistically similar for both groups, although anxiety diagnoses

approached significance for the NLD group. Furthermore, all participants in the study with a diagnosis of depression also had NLD. Given this compelling evidence, it seems likely that a larger pool of participants would indicate for the NLD group to have significantly more Anxiety and Depression diagnoses. Surprisingly, the hypothesis regarding behavior diagnoses was also not supported. Again, this may be explained by the small number of participants or perhaps the presentation of symptoms was not identified as a true behavior disorder, but rather a symptom of NLD or Dysphasia. It seems somewhat unusual that such a small number of participants were diagnosed with Behavior Disorder given that research strongly supports otherwise.

Research Question 2

The second question addressed the relationship between GAI and social and emotional symptomology, as well as possible associations between GAI and age, parent education, age, and number of diagnoses. It was suspected that all demographic variables would be significantly correlated with GAI for the NLD group. Additionally, Attention, Depression and Anxiety PBS scales were hypothesized to correlate with GAI for the NLD group. Group correlations for Conduct and Deviation scales were not formally hypothesized to be associated with Dysphasia; however the literature suggests a strong relationship between language and difficulties with specific disruptive behaviors (Richman & Lindgren, 1981) comparable to those behaviors measured by the Conduct and Deviation PBS scales. Although a number of studies also implicated the same behaviors as part of a diagnosis of NLD, it seemed plausible that verbal deficits may be likely to precipitate those behaviors measured by PBS Deviation and Conduct scales.

Overall, Global Ability Index scores for the NLD group were higher. Again, data collected indicate an 8.5 point GAI difference between the NLD and Dysphasia groups. Analyses conducted also revealed a significant positive relationship between GAI and the PBS Depression scale; therefore it appears as though children with a higher GAI have more depression symptomology (see Appendix D9). Findings thus support previous

research in that NLDs exhibit elevated internalized symptomology (Bigler, 1989; Casey et al., 1991; Rourke, 1989). And, albeit tentatively, data supports that the NLD group had more Depression diagnoses. Furthermore, analyses showed that anxiety diagnoses approached significance for the NLD group as well. It is hypothesized that a small sample size and the nature of using clinic data for research studies resulted in less robust findings.

GAI and PBS scales of Anxiety, Deviation, Conduct and Attention were not shown to be significant for either group. Consequently, analyses show that increased symptomology is not dependent on either higher or lower overall cognition, thus GAI may not be useful in predicting symptomology or identifying NLD subtypes. It should be considered, however, that PBS totals for both groups were more than one standard deviation higher than the original normative data. It is also worth mentioning that both mother and father education was associated with GAI, consistent with study findings for NLD mother and father education to be higher.

Research Question 3

The third portion of the study addressed whether VCI/PRI discrepancies correlate with demographic variables (i.e., parent education, age, and number of diagnoses) and PBS scales for either the NLD or Dysphasia group. The hypothesis suggested that a larger discrepancy between VCI/PRI would be indicative of more psychosocial symptomology, particularly for the NLD group. More specifically, it was expected that a high VCI over PRI would result in more depression and anxiety for the NLD group, where as lower VCI under PRI would result in a greater number of psychosocial difficulties for the Dysphasia group. Evidence provided by the analyses was somewhat disconfirming to the hypotheses in that there were no data indicating that larger VCI/PRI discrepancies were related to higher ratings on any PBS scales. Conversely, there was strong evidence supporting that larger VCI/PRI discrepancies are related to higher ratings for Conduct, Attention and Deviation PBS scales for the Dysphasia group.

Research has shown that children with Dysphasia may have deficits in various areas associated with language. More specifically, problems with verbal mediation have been associated with inattention and impulsivity (Eliason & Richman, 1988). Language deficits have also been associated with poor anticipatory skills, increased suggestibility, and deficits in impulse control, all of which have been linked to juvenile delinquent behavior (Waldie & Spreen, 1993). Thus it seems reasonable that a decrease in verbal skills may lead to more problems involving behaviors associated with Attention, Deviation, and Conduct Pediatric Behavior Scales.

Further analysis of VCI/PRI discrepancy and continuous demographic variables detected that an increase in discrepancy is related to an increase in number of diagnoses for the NLD group (see figure 5). Accordingly, it seems that intelligent children may exhibit more symptomology associated with (in descending order of prevalence) ADHD, Dysnomia, Depression, Dyslexia, Behavior Disorder and Anxiety. There were no other significant findings for the Dysphasia group.

Limitations

There are several limitations to this study that should be considered. First, the sample included in the study consisted of children from Iowa, who are predominately Caucasian children, from rural areas. Consequently, it is rather doubtful that the sample is representative of all children who have NLD or Dysphasia.

Second, it is unclear if the children included in the study are similar to those who receive evaluations in the school and other private clinics. It seems plausible that children who were evaluated at the Learning and Attention Disorders clinic at the University of Iowa include children who have more complex problems, requiring expertise different from that of a local school psychologist and/or private practice clinician. The evaluation may have also been requested due to subtle difficulties not recognized by other professionals, thus represent a unique population of children.

The nature of clinical data is another limitation. Individual psychologists typically select a variety of testing measures when making decisions about a potential learning disability, and rationale for selecting assessment measures (e.g., initial referral question, experience with different assessments, availability of instruments, validity and reliability, recency of norms, and theoretical orientation) may vary considerably among clinicians. Although the tools used to measure abilities and skills may be fundamentally similar, direct comparison for research purposes can be difficult. In addition to varied assessment measures, clinic methods used to identify psychosocial disturbances were somewhat inconsistent. That is, it appeared as though clinicians relied on parent report and a review of written records for some children, and/or various psychosocial instruments and informal observations for others. And while this is an acceptable and commonly used practice, it presents research difficulties.

Another limitation is that this study is that the sample size was somewhat small. Missing or incomplete data and numerous GAI scores 1-3 points below the cut-off limited the number of participants included. It is possible that those excluded from the study, or a larger participant pool would lead to further significant psychological findings.

Lastly, the Pediatric Behavior Scale norms used were from a collection of Cleft Palate and Premature Infant studies at a university hospital. Further, Likert scale measures can be somewhat misleading due to the subject nature of the method. Unfortunately, there are very few methods for measuring a wide range of behaviors like the PBS. In order to obtain the same information, several measures would have to be administered, which may not be the best use of time and resources. Additionally, it is not possible to determine if PBS scales capture behaviors with enough depth to accurately provide a psychosocial profile; however, it is assumed to be at least adequate.

Implications for Future Research

Overall, the lack of research findings for the NLD group was surprising, for which a combination of factors are likely responsible. First, sample size may have

impacted results, thus it may be advantageous for other researchers to procure a larger number of participants for further evaluation of PBS scales (i.e., Deviation and Anxiety) and GAI and VCI/PRI discrepancy. In addition, PBS limitations may have impacted findings, therefore including instruments designed to specifically measure depression and/or anxiety may serve to measure symptomology more thoroughly and lead to the identification of significant relationships. Control group comparisons may provide additional information not accessed in this study. Such information may also help accentuate the magnitude of psychosocial difficulties that children with NLD experience. Also creating groups based on GAI, VCI, PRI, and VCI/PRI discrepancies to determine whether a particular range of cognitive functioning provides more insight and/or significant findings. In addition, cross-cultural studies were significantly under-represented in research on children with NLD, therefore indicating a need for research that includes children from a variety of cultures.

This study did not definitively address whether NLD or Dysphasia occurred before psychosocial symptomology. Therefore the findings did not identify which disability places the child at risk for developing co-morbid diagnosis. It is recommended that future researcher's gather longitudinal data, following a child from primary grades to at least early adulthood. It is assumed that longitudinal efforts would help ascertain beneficial treatment and intervention approaches, and identify the most effective educational placement thus inhibiting symptom severity. A retro-study or case study may be an appropriate design from which to explore this type of research.

Given the high number of participants diagnosed with Attention Deficit Hyperactivity Disorder, investigating NLD and ADHD co-morbidity is warranted. Research has shown a significant overlap in symptomology between the two diagnoses; therefore determining whether or not "ADHD" is a symptom of NLD or truly a separate diagnosis is worth exploring. Results of such a study may be used prevent misdiagnosis, over-diagnosis, and the misuse of medication management for ADHD-like symptoms.

While not the primary focus of this study, results provided useful information regarding psychosocial presentation of children with Dysphasia. First, it may be useful to delineate specific types of language sequelae that promotes and/or suppresses appropriate behavior and prosocial functioning. This research may be extended for either group; however using specific Dysphasia subtype categories to group children may create a feasible way in which to begin the investigation. Information gathered may be used in a variety of ways, not the least of which underscores the critical importance of language in the management of behavior and emotions.

There were several Dysphasia subjects that were not included in the study due to Borderline GAI scores, thus it is suggested that future studies include children who are functioning within this ability range. As suggested earlier, grouping subjects by cognitive ranges (e.g., 80-84, 85-89, 90-95, etc.) may be an excellent way in which to approach this type of study. And though arguments against including lower functioning (or Borderline) children in this type of study may exist, it is important to address the needs of these children who may present psychosocial characteristics different from those functioning within either the mild intellectually disabled or low average ability range. This type of study may be completed for the NLD as well.

There were significantly fewer numbers of Dysphasia participants who achieved a GAI score within the High Average range (n=3) and disproportionate to the NLD group. A study addressing specific factors that lead to lower performances may provide information valuable in designing interventions for those with Dysphasia.

Conclusion

There are several interesting findings that the study supported. First, data indicates that children with Nonverbal Learning Disability or Dysphasia are more at risk for experiencing mild to severe psychosocial difficulties. Moreover, the psychosocial patterns detected are quite distinct for each group and may be related to assets and deficits not yet properly defined. It does not appear as though a unitary psychosocial

pattern across groups exists, except that overall psychosocial difficulties occurred at greater rates for the participants in the study. For the NLD group, the study implicated significant difficulties with depression, such as low mood, unhappiness, apathy, fatigue, low motivation and suicide ideation and/or attempts at suicide. And as intellect increases, the severity of symptoms intensifies as well. The likelihood for a diagnosis of Attention Deficit Hyperactivity Disorder is quite high, as is for NLDs to have multiple diagnoses. Those diagnosed with Dysphasia are likely to exhibit more oppositional, aggressive behaviors, as well as higher rates of impulsive and inattentive behaviors congruent to a decrease in verbal skill deficits. Similarly, Dysphasia children may likely present problems related to immaturity, perseveration and variable mood. Overall, further research is needed to establish clearer patterns of psychosocial functioning for NLD and Dysphasia groups of children so that valid and reliable mediation efforts may be established.

Given the global nature of NLD, it will be important to provide treatments that address individual weaknesses while drawing on strengths. A systems-level treatment approach will likely provide the best outcomes given the comprehensive nature such. Not only must various environments be targeted for intervention, but also individual behavior, social and academic needs. In addition, NLD is quite unlike other learning disabilities and will likely require a life-long learning approach, whereby treatment will be dependent on individual needs, resource availability, and developmental course. Supportive social and emotional therapy and psychopharmacologic treatments for problems with depression, anxiety, anger, and inattention may also be helpful.

Early intervention has been suggested by many researchers. By providing early social skill training academic accommodations, success greatly increases while greatly reducing social and emotional symptomology. Involving family, school personnel and other community partners in the development of accommodations to improve functioning within different environments is also needed. As a student progresses through elementary

school, comprehension and abstract reasoning difficulties may become more noticeable. Problems with novelty and generalization will also become more apparent. Appropriate classroom placement, limited writing, and assistive technology (e.g., voice recognition software, software that converts print to verbal output) are often beneficial for these children and adolescents. A direct, concrete, verbal teaching approach will likely work well for the student with NLD, and elimination of extraneous stimuli is recommended.

Eliciting appropriate behavior may be addressed by addressing antecedent conditions. Because planning, organization and initiation of tasks may be difficult for children with NLD, the likelihood of shaping or changing behavior through the use of positive reinforcement and consequences will probably not promote desired behavior. Rather address those situations that are likely to create more difficulty and reduce problematic behavior by elimination or alteration of antecedent events. This method of addressing inappropriate behaviors is dissimilar to those used for a student with ADHD, for whom positive reinforcement and consequences typically promote desired behavior.

APPENDIX A

ROURKE'S ELEMENTS AND DYNAMICS OF THE NLD SYNDROME

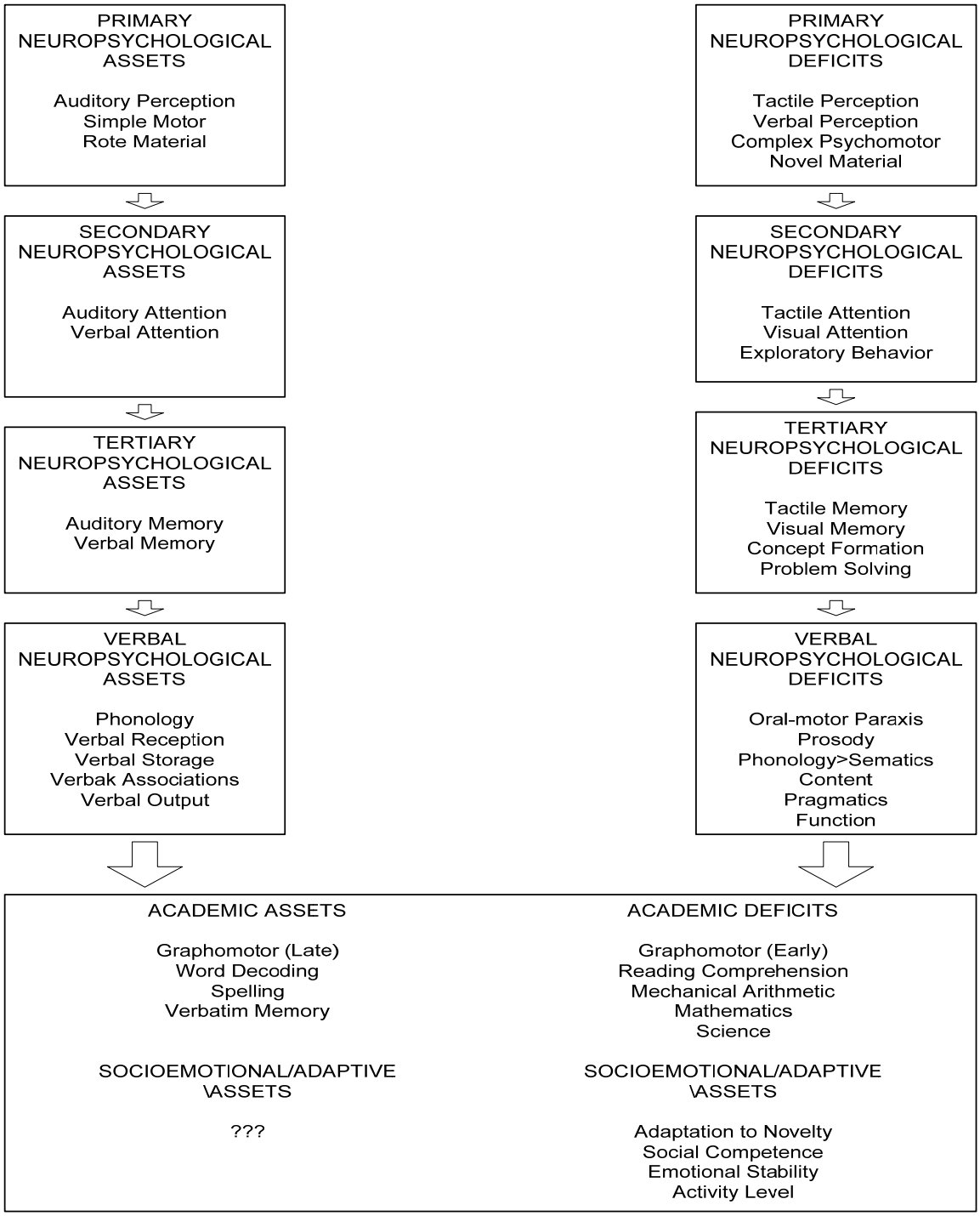

Figure A1. Rourke's Elements and Dynamics of the NLD Syndrome

Source: Rourke, B. P. (1995). *Syndrome of nonverbal learning disabilities* (p.7). New York, NY: Guilford Press.

APPENDIX B

PEDIATRIC BEHAVIOR SCALE (PBS) FACTORS

Table B1. Pediatric Behavior Scale (PBS) Factors

General Factors	Specific Scales
Attention Deficits	Oppositional Behavior Aggression Explosiveness
Depression-Anxiety	Attention Impulsivity Hyperactivity Tension Anxiety
Deviation	Self-Esteem Depression Social Isolation

Specific Scales	Questions
Anxiety	-Fearful, anxious, or worried -Shy or timid -Self-conscious or easily embarrassed -Afraid to try new things for fear of making mistakes -Makes self "sick" with worry -Clings to adults or is too dependent on others -Panic attacks; gets so worried that he/she can't be easily comforted -Feelings are easily hurt; sensitive to criticism
Depression	-Sad, unhappy, or depressed -Cries a lot; cries easily for no reason -Shows little interest or pleasure in activities; apathetic, doesn't seem to care about anything -Thinks too much about death or dying; preoccupied with death -Talks about harming or killing self -Deliberately harms self or attempts suicide

APPENDIX C

DATA SHEET: NONVERBAL LEARNING DISABILITIES

Identification #: _____
Age (in months): _____
Grade: _____
Birthdates: _____

Diagnosis: _____
Gender: _____
Mom Education: _____
Dad Education: _____

Intelligence (WISC-IV only)
GAI:_____

VCI: _____
Similarities: _____
Vocabulary: _____
Information: _____
PRI: _____
Block Design: _____
Picture Concepts: _____
Matrix Reasoning: _____
Picture Completion: _____

Working Memory: ____
Digit Span: ____
Forward: ____
Backward: ____
Arithmetic: ____
Processing Speed: _____
Coding: _____
Symbol Search: _____

Associative Language
Associative Picture Test: ____

Expressive Language
Word Fluency: _____
Rapid Auto Naming: _____

Memory
Color Span: _____ _____ _____ _____
Rey AULT: 1) _____ 4) _____
(Desk/Drum) 2) _____ 5) _____
3) _____ Total: _____

Visual-Spatial/Motor
Bender: _____
JOL: _____
Groovy Peg: _____ (r) D = R/L?
_____ (l)

Achievement
WART-IV – Reading: _____
Spelling: _____
Math: _____
SRI – High: _____ RTI: _____ Comp: ____

Attention
COPT II Variable O C R
Trial 1 _____ _____ _____
Trial 2 _____ _____ _____
Total _____ _____ _____

COPT II Fixed
Trial 1 _____ _____ _____
Trial 2 _____ _____ _____
Total _____ _____ _____

APPENDIX D

TABLES

Table D1. Assessment Scores

Assessment	NLD		Dysphasia	
	M	*SD*	*M*	*SD*
GAI	104.41	12.96	95.94	8.01
VCI	113.40	13.50	86.83	7.94
PRI	92.55	12.81	105.39	11.10
VCI/PRI	21.26	9.39	-18.56	11.851
Boston Naming	*	*	-1.76	2.38
Word Fluency	-0.14	5.25	-1.58	0.89
RAN Colors	-1.94	2.45	-1.71	2.31
Bender	-1.25	1.11	-0.42	.90
JOL	-0.79	1.31	*	*

*data not available

Table D2. Demographic Characteristics of Participants

Variable	NLD		Dysphasia		Total	
	M	*SD*	*M*	*SD*	*M*	*SD*
Age	11.49	2.59	10.58	3.02	11.11	2.80
Grade	5.62	2.60	4.62	3.04	5.21	2.82
Number of Diagnoses	2.31	.921	2.55	0.86	2.41	0.90
Mother Education	3.40	1.58	2.33	1.33	2.95	1.56
Father Education	3.18	1.79	2.03	1.61	2.70	1.80

Note: 0 < High School Graduate (HAG); 1 = HAG; 2 ≥ 1 Year College; 3 = AA Degree; 4 ≥ Bachelor's Degree; 5 ≥ Master's Degree; 6 = PhD/JD/ MD.

Table D3. Distribution of Mother and Father Education

Group	< HAG	HAG	≥1 Yr. College	AA Degree	≥ 4 Yr. Degree	≥ MA Degree	JD/MD PhD
NLD							
Mother	0	15	13	9	26	15	7
Father	2	21	8	10	21	10	10
Dysphasia							
Mother	2	20	13	15	10	2	1
Father	6	27	7	3	11	4	1

Note: 0 < High School Graduate (HAG); 1 = HAG; 2 ≥ 1 Year College; 3 = AA; 4 ≥ Bachelor's Degree; 5 ≥ Master's Degree; 6 = PhD/JD/M

Table D4. Number of Participant Diagnoses

Number	NLD	Dysphasia	Total
1	0	1	1
2	16	6	22
3	42	22	64
4	28	30	58
5	4	7	11
6	3	0	3

Note: Number = total number of diagnoses (e.g., 2 = NLD or Dysphasia diagnosis and one additional diagnosis). Total = NLD + Dysphasia diagnoses.

Table D5. Distribution of Diagnoses

Diagnosis	NLD	Dysphasia	Total
NLD	93	0	93
Dyslexia	9	32	41
Dysnomia	19	36	55
Dysphasia	0	66	66
ADHD	52	20	72
Depression	5	0	5
Anxiety	12	2	14
Behavior Disorder	8	3	11

Note: Total = NLD + Dysphasia diagnoses.

Table D6. Group Comparisons for Continuous Demographic Variables

Variables	*n*	*F*	*P*	np^2
Age	159	4.19	0.04	0.03
Mom Ed	148	18.88	0.00***	0.11
Dad Ed	141	15.43	0.00***	0.10
N of DX	159	2.62	0.12	0.02

Note: Age = age of participant; Mom Ed = level of maternal education; Dad Ed = level of paternal education; N of DX = number of diagnoses.

***$p < 0.0125$.

Table D7. Chi Square Results for Categorical Demographic Variables

Variable	x^2	*p*-value
Gender	0.23	0.63
Dysnomia	19.945	0.00***
Dyslexia	28.37	0.00***
Learning Disability	0.36	0.00***
ADHD	9.21	0.01**
Depression	2.11	0.15
Anxiety	3.54	0.06
Behavior	0.46	0.50
Psychological Diagnosis	0.46	0.00***

**$p < .01$. ***$p < .001$.

Table D8. VCI/PRI and GAI Group Comparisons

Variable	*F*	*P*	np^2
GAI	22.13	0.00***	0.12
VCI/PRI	557.53	0.00***	0.78

***$p < .001$.

Table D9. Correlations for GAI and PBS by Group

	GAI Score NLD (*n*=93)		GAI Score Dysphasia (*n*=66)	
	R	*p*	*r*	*p*
Conduct	-0.09	0.39	-0.05	0.67
Attention	0.08	0.46	0.07	0.60
DEPLANE	0.18	0.09	0.03	0.82
Depression	0.21	0.05*	-0.03	0.81
Anxiety	0.03	0.77	-0.06	0.63
Deviation	0.17	0.11	0.02	0.87

Note: DEPLANE = the PBS scale that combines depression and anxiety scales

*$p < .05$.

Table D10. Correlations for GAI and VCI/PRI Discrepancies and Continuous Demographic Variables

Variable		GAI Score		VCI/PRI Discrepancy	
		NLD	Dysphasia	NLD	Dysphasia
Age	*n*	93	66	93	66
	r	0.05	-0.01	0.01	-0.05
	p	0.63	0.98	0.92	0.67
No. Do	*n*	93	66	93	66
	r	-0.11	-0.04	-0.31	-0.03
	p	0.30	0.78	0.01*	0.78
Mom Ed	*n*	85	63	85	63
	r	0.40	0.18	-0.01	0.01
	p	0.00***	0.16	0.99	0.97
Dad Ed	*n*	82	59	82	59
	r	0.52	0.13	-0.12	0.07
	p	0.00***	0.40	0.27	0.61

**$p > .01$. ***$p > .001$.

Table D11. Correlations for VCI/PRI and PBS Scales by Group

	NLD Discrepancy (*n*=93)		Dysphasia Discrepancy (*n*=66)	
	R	*p*	*r*	*p*
Conduct	-0.03	0.76	-0.31	0.01*
Attention Deficits	0.01	0.98	-0.39	0.00***
Depression/An	-0.09	0.41	-0.10	0.44
Depression	0.03	0.75	-0.11	0.39
Anxiety	-0.09	0.37	0.06	0.66
Deviation	-0.01	0.17	-0.37	0.00***

*$p > .05$. ***$p > .001$.

APPENDIX E

SYMBOLS AND ABBREVIATIONS

α	Alpha: Cronbach's index of internal consistency
F	Fisher's F ratio: A ratio of two variances
M	Mean: the sum of a set of values divided by the number of values in the set
n	Number of cases in a subsample
N	Statistical notation for total number of cases
η_p^2	Partial Eta squared: the proportion of total variability that can be attributed to a factor (effect size)
r	Estimate of the Pearson product-moment correlation coefficient
SD	A statistical measure of variability in a data set; the square root of the variance
x^2	Chi Square: compares the counts of categorical responses between two independent groups
$<$	Less than
$\leq$	Less than or equal to
$\geq$	Greater than or equal to
$=$	Equal to

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