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Comprehension of Humor in Children with Nonverbal Learning Disabilities

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Comprehension of Humor in Children with Nonverbal Learning Disabilities

by

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Dissertation

Presented to the Faculty of the Graduate School of
The University of Texas at Austin
in Partial Fulfillment
of the Requirements
for the Degree of

Doctorate of Philosophy

The University of Texas at Austin
December 2003

Dedication

This Dissertation is dedicated to my family and friends, without whom, I would have faltered and fallen long ago. I am blessed with people in my life who have a wonderful mix of wisdom, empathy, pragmatism and kindness such that I am made aware of my strengths and weaknesses depending on my needs of the moment. It has been said in many different ways that the efforts of many people contribute to the success of any one person; I am grateful for the contribution of the people in my life who have been my touchstones and salute them in this endeavor, as is their due.

Acknowledgements

My parents must come first in my acknowlegements for the countless small graces that can never be fully known and appreciated. My mother has been my role model for most of my personal goals. She has the rare ability to be both parent and best friend and the uncanny knack for knowing which one I need at any given time. My father provided unconditional love and an outlet when diversion was required from the endless grind. In the scientist-practitioner model of my profession, I have both my parents to thank; it is from my father that I have the qualities that make me a researcher and from my mother come the qualities that make me a clinician. My dissertation chair, Margaret Semrud Clikeman has been a mentor in my career as well as consultant for my dissertation. Her tireless efforts to keep this research study afloat and thriving made my small piece of it possible and her contributions to this research and to my career are immeasurable. I would also like to acknowledge the contributions made by Mary Corlett, my best friend and co-researcher, who helped me conceptualize and refine this study. She helped me laugh through the difficult times and provided a shoulder when the laughter just wasn't there. I have the rare fortune of being the best of friends with my brother, who has always been there to lend a hand emotionally or financially. My dissertation coach and stepfather, Byron Buck boosted my executive functioning when I was overloaded with the sheer volume of work and his gentle manner allowed me to gratefully accept his help. My entire family helped with funds, providing the private family scholarship that allowed me to continue

working. Crystal Tani, my friend and fellow intern in Minnesota, gave me a reason to wake up at an ungodly hour each morning to work on my dissertation and a much needed laugh at the end of each day. In addition to the friendship that has developed over the years, Mary Yancy, with her generous offer to share her home, her time and her family, made what might have otherwise have been a lonely, stressful time into a truly enjoyable experience. In her home, I gained a respite from the endless workload of the previous two years and gained back the energy I needed to finish this dissertation. Steve, Claudia, Sarah and Alexander Glass gave me the support and comfort that only having family nearby that you both love and like can provide. Sarah and her friends (particularly Hannah Gilbert) should also be acknowledged for their part in the pilot study in developing the humor measure. Johnny and Kim Smith have provided the same level of love and support on the final phase of the dissertation that Steve and Claudia provided in the beginning phase. Fred and Fran Smith also provided cheerleading and offered perspective and advice. I want to acknowledge Terry Harrison, Elsa Shapiro and Steve Hughes for their help, morale boost and support in gathering participants in Minnesota. I'd like to thank my fellow graduate students and friends who worked with me on the research project and who helped me out in data collection, Laura Guli and Emily Strassner to name a few. Gerry Gioia, my current boss, allowed me to take the summer off from my (not quite post) post doctorate position, and without that time, I am sure this would not have been completed. For the break and the support I received from Gerry and my supervisors at CNMC, I am grateful. Madison Berl, Lisa Gilotty and Laura Kenealy offered me support and friendship during some of the most difficult times of my dissertation struggles. My first mentor, Ned Gaylin, transferred his passion for research in the truest sense to me and Leigh Leslie helped me to discover the next step in my journey following my masters work in marriage and family therapy. Both contributed to my confidence in my ability to go further

academically. There were many other friends who provided me with love, support, discussion and diversion, such as Kathy Conway, Guillermo Aldana, Julie Ries, and others to whom I will always be grateful. Meredith and Morrey attended my graduation ceremony in a wonderful show of support and reminder that I have been surrounded by loving people all of my life. This endeavor has truly been the work of many and I hope they all know what a vital role they have played in my journey.

Comprehension of Humor in Children with Nonverbal Learning Disabilities

Publication No._____

Kimberly Lynne Glass, Ph.D.
The University of Texas at Austin, 2003

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The normal development of humor in children has been well documented and is understood as having a predictable developmental course, which is tied to social, cognitive and linguistic development in children. This dissertation study explored humor comprehension in children with nonverbal learning disabilities (NVLD). Children with NVLD were compared with children with reading disabilities and a control group of children with no learning disabilities to assess their comprehension of humor. The Humor Test was developed for the purposes of this study and was composed of a joke and cartoon section. No group differences in humor comprehension were found when the NVLD group was defined as having visual spatial and visual reasoning deficits. However, when the NVLD group was divided into children with and without social perceptual difficulties as defined by the Child and Adolescent Test of Social Perception (CASP), significant group differences were found in the levels of humor comprehension. These results support the association of humor comprehension with social perception and lend support to the hypothesis that children with NVLD may not be a homogenous group. Future study directions include further exploration into the nature of the association between humor comprehension and social perception as well as closer examination of the heterogeneity of NVLD.

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CHAPTER I: INTRODUCTION

"Laughing, clowning children are ... children vigorously moving out to involve themselves communally in their world." (Bainium, Lounsbury, & Pollio, 1984, p. 1956)

This quote has a special poignancy when one considers children with nonverbal learning disabilities (NVLD) who *desire* to involve themselves in their social worlds but are *incapable* of making those interpersonal connections. Johnson and Myklebust first described children with NVLD as having problems in social perception (Myklebust, 1975). Specifically, Myklebust asserted that a child with NVLD seemed relatively unable to understand "his social environment, especially in terms of his own behavior" (p. 86). Although there is mounting evidence that NVLD is at least as debilitating as verbal learning disabilities (VLD) such as dyslexia, the deficits associated with NVLD are much harder to assess and, therefore, to treat at this point (Badian, 1992; Johnson, 1987; Harnadek, & Rourke, 1994; Myklebust, 1975; Rourke, & Fuerst, 1991; Rourke, 1995; Semrud-Clikeman, & Hynd, 1990). The research to date has primarily focused on identifying the characteristics of NVLD with very little research on assessment of this learning disability.

The term "learning disabled" (LD) refers to "a heterogeneous group of individuals who have problems processing one or more types of information" (Johnson, 1987, p. 133). A *nonverbal learning disability* refers specifically to difficulty processing information that is presented nonverbally, such as visual-spatial stimuli or nonverbal aspects of language. NVLD may be best understood as a right hemisphere disorder[1] reflecting the generally accepted hypothesis that

[1] The term right hemisphere is being used as a convenience to reflect the most common phenomenon of left hemisphere dominance in language among other areas of functioning. It should be understood that there are

these disabilities reflect some sort of dysfunction or maldevelopment of the right hemisphere (Harnadek, & Rourke, 1994; Myklebust, 1975; Pennington, 1991; Rourke, & Fuerst, 1991; Rourke, 1995; Semrud-Clikeman, & Hynd, 1990; Teeter, & Semrud-Clikeman, 1997). The primary characteristics associated with NVLD include: relatively high verbal skills paired with relatively low visual-spatial skills, problems with nonverbal or abstract problem solving, and social skills deficits. Deficits less widely mentioned, or subsumed under the primary deficits include: difficulty with math, poor tactile perception, spatial agnosia, concept formation, confusion with time or directionality, strong word reading with poor reading comprehension, difficulty with novel stimuli, pragmatic/semantic language use and comprehension, difficulty with nonverbal aspects of communication such as prosody or vocal inflection, and a poor understanding of humor (Badian, 1992; Little, 1993; Johnson, 1987; Gross-Tsur, Shalev, Manor, & Amir, 1995; Harnadek, & Rourke, 1994; Myklebust, 1975; Pennington, 1991; Rourke, & Fuerst, 1991; Rourke, 1995; Semrud-Clikeman, & Hynd, 1990; Teeter, & Semrud-Clikeman, 1997).

Although first described in 1964, NVLD has only recently received the interest of researchers (Badian, 1992; Little, 1993; Myklebust, 1975). The bulk of public attention has gone to verbal learning disabilities (VLD) such as reading or other language-based disabilities and to the study of Attention Deficit Hyperactivity Disorder (ADHD). NVLD is though to be less prevalent (1 to 10%), is easier to overlook and often more difficult to quantify (Pennington, 1991). Furthermore, unless their deficits reflect a clear learning disability in math, these children often do not receive classification in the special education system despite difficulties functioning in the regular education classroom. The neglected status of the disorder mirrors the experience of the children who are often ignored and overlooked in class and among peers. Children with NVLD are

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a minority of people who are right hemisphere dominant in language for whom the areas of skill or deficit

described as *different* or even *bizarre,* but in a way that seems to render them all but invisible in group settings (Gross-Tsur, et. al., 1995). This social neglect can lead to withdrawal and social isolation. In turn, the incidence of depression and suicide is elevated among children and adults with NVLD (Brumback, 1990; Gross-Tsur, et al., 1995; Nowicki & Carton, 1997; Rourke 1995; Teeter & Semrud-Clikeman, 1997).

Many researchers have included humor when delineating social deficits connected to NVLD (Harnadek & Rourke, 1994; Johnson 1987; Klin, Volkmar, Sparrow, Cicchetti & Rourke, 1995; Rourke & Fuerst, 1991; Rourke Fisk, & Strang, 1986). Rourke and Fuerst (1991) explain this disorder by asserting that the deficits in humor are due to deficient intermodal judgments required for assessments of incongruity. Beyond this terse explanation and the inclusion of humor as one of the social skills deficits associated with NVLD, no study has tested this assertion or explored the nature of humor in these children and the ramifications of a humor deficit.

Because research on NVLD is in its infancy, it seems understandable that this relatively small aspect has been overlooked. However, the field of humor research offers a unique perspective both in understanding and in assessing this disorder. The cognitive, perceptual, and linguistic abilities fundamental to humor encapsulate the majority of deficits associated with NVLD. Thus, the study of humor may offer a unique perspective in understanding these children.

Outline of Study

This paper identifies and explores the questions through examination of the current literature regarding the relationship between humor comprehension and nonverbal learning disabilities. The first section of the literature review focuses on identifying and organizing the current trends of thought about

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usually attributed to the left hemisphere would be reversed.

nonverbal learning disabilities. The framework of NVLD as a right hemisphere disorder is explored in terms of neurodevelopment and examined within the current understanding of the role of the right hemisphere in various areas of functioning. In this paper, the various functions of the right hemisphere and the characteristics associated with NVLD are organized into the constructs of cognition, visual spatial perception, language and social emotional functioning. Although it is recognized that separation of these constructs over-simplifies the complex interaction between individual development and environmental influences, these constructs facilitate discussion and understanding of the nature of the disorder.

The second section of the literature review focuses on humor as it pertains to NVLD. The function and theories of humor development are outlined. As with the previous sections, the characteristics are organized under the constructs of cognition, perceptions, language and social competence. Findings from studies of RHD are then incorporated into a section exploring humor development and NVLD. These studies provide support for the role of the right hemisphere in humor comprehension and the possible effect of damage in different regions of the brain.

The next chapter reviews the method of analysis used for this study. Included in this section are the criteria used to select participants and sort them into groups. The independent measures are reviewed in terms of standardized administration and indications of reliability. The humor task was adapted from other measures used to assess humor in general LD populations and with adults. The procedures used to conduct a pilot study as well as directions for administration of the task are outlined in detail. This section concludes with a statement of the research problems explored in this study and the corresponding hypotheses.

Chapter IV provides the study findings, preliminary analyses, results of the hypothesis testing conducted as well as post hoc analyses. The chapter concludes with a discussion of the practical significant of these findings. In the final chapter, Chapter V, the research questions and resulting findings are discussed in terms of limitations. The chapter concludes with a discussion of future research directions in the study of humor and children with NVLD.

Introduction to the Research Study

Humor comprehension, appreciation and production draw on the very abilities thought to be most difficult for children with NVLD. Abstract problem solving, pragmatic language skills, and processing of nonverbal and affective cues are all essential to the normal development of humor. Although any learning disability may cause a decrease in humor abilities or a delay in humor development, anecdotal evidence suggests that humor difficulties may be linked specifically to NVLD (Harnadek, & Rourke, 1994; Johnson, 1987; and Short, Basili, & Schatschneider, 1993). As such, a measure of humor may provide an economical means of differentiating this group from children with "garden variety" learning disabilities. The primary focus of this study was to determine whether there is a deficit in humor comprehension in children with NVLD. It was expected that there would be a significant difference in humor comprehension in children with NVLD compared to children with VLD and a group of children with no LD.

Secondly, the author sought to illuminate the specific nature of a humor deficit, if found. Studies of adults with brain injury have made a connection between humor and functioning in the right hemisphere. These studies indicate that humor comprehension is significantly lower in participants with right hemisphere damage (RHD) than with left hemisphere damage (LHD) (Bihrle, Brownell, Powelson, & Gardner, 1986; Gardner, Ling, Flamm, & Silverman,

1975; Brownell, & Gardner, 1988). The connections between the right hemisphere and NVLD allow researchers to extrapolate from the body of research on adults with brain damage and to use that information to inform theories about humor deficits noted in children with NVLD. This study explored the hypothesis that the error patterns found in the responses of children with NVLD would be similar to that found in adults with RHD.

Much of the current understanding of NVLD has been explored through a neurodevelopmental model (Rourke, & Fuerst, 1991; Rourke, 1995; Semrud-Clikeman, & Hynd, 1990; Teeter, & Semrud-Clikeman, 1997). Indeed, the major model of etiology, proposed by Rourke (1995), is premised on assumptions within a neurodevelopmental framework (see Appendix A for the full white matter model). The focus of this study was to explore the nature of the deficit, if found, from a neurodevelopmental perspective. To this end, current understanding of the development and functions of humor in children was integrated with studies of LD, NVLD and adults with RHD. Deficits were examined in terms of modality (verbal jokes vs. verbal plus visual cartoons) and types of verbal humor (phonological, lexical, or cognitive incongruity). It was thought that children with NVLD would demonstrate poor humor comprehension regardless of modality or type of joke within the verbal modality. Past research suggests that children with VLD would have difficulties primarily with phonological jokes related to reading difficulties (Bruno, Johnson, & Simon, 1987).

CHAPTER II: LITERATURE REVIEW

NVLD as a Disorder of the Right Hemisphere

HEMISPHERIC DIFFERENCES

Contrary to the popular notion of 'right brain, left brain', it is thought that the hemispheres function together in most or all behaviors (Semrud-Clikeman, & Hynd, 1990). For example, where once language was thought to be a left hemisphere function, it is now understood that much of the affective and pragmatic aspects of language are processed in the right hemisphere (Gardner, Brownell, Wapner, & Michelow, 1983; Moscovitch, 1983; Ozonoff, & Miller, 1996). Thus, in the production of language, as with other complex behaviors, the hemispheres play an interactive role.

Neuropsychology is based on the supposition that classes of behavior involve different neurological substrata (Hynd & Willis, 1988). Although behaviors are the result of complex interactions of functional systems, the hemispheres are thought to specialize in specific behaviors to different degrees. A function is considered to be lateralized according to the degree to which a hemisphere is specialized for processing that function (Teeter & Semrud-Clikeman, 1997). The functions of the right hemisphere have been less well known and understood than the left. "Disabilities caused by the right hemisphere are more subtle and fit less well into established descriptions of brain function" (Shields, 1991, p. 385). The opaque nature of the right hemisphere is changing as we learn more about brain function.

Table 1: Hemispheric differences (Burgess & Chiarello, 1996; Goldberg & Costa, 1981; Hynd & Semrud-Clikeman, 1990; Rourke, 1995).

Right Hemisphere (RH)	**Left Hemisphere (LH)**
Greater white to gray matter ratio	Greater gray to white matter ratio
Findings:	
• Greater areas of association cortex	• More sensory & motor representations.
• Predominantly an interregional pattern of connections.	• Predominantly an intraregional pattern of connections.
Hypotheses:	
• More neuronal capacity to deal with informational complexity	
• More adapted to integrating input from several sensory modalities (simultaneous, processing)	• More adapted to processing single modalities and then integrated between modalities (sequential processing).
• More able to process novel and complex schematic information (similar to Piaget's concept of accommodation).	• Analyzes and classifies cognitions into existing schema making it more crucial to storage of and access to over learned or automatized behavior (similar to Piaget's conception of assimilation).
• Broader and slower at information retrieval.	• More focused and rapid information retrieval.

Goldberg and Costa (1981) postulated different functions based on a review of neuroanatomical differences in the hemispheres. Findings of the different cytoarchitecture in the two hemispheres led to several hypotheses. First, the right hemisphere is equipped for processing multi-modality input whereas the left hemisphere is best adapted for single mode information input and processing. This difference means that the development of the right hemisphere is more essential to integrating information simultaneously from multiple sources as needed for social interactions or abstract reasoning.

Secondly, the right hemisphere plays a larger role in processing complex schematic information such as reading maps, understanding diagrams, or

performing the type of spatial imagery often needed for mathematics. Due in part to the stronger role in processing novel material and integrating information, the right hemisphere is thought to play a more critical role in the development of a new skill or the acquisition of knowledge. As skills or knowledge becomes more automatized, the left hemisphere plays a more active role.

In addition to different types of processing, organization and storage, the hemispheres retrieve information differently. The LH engages in rapid and focused retrieval whereas the RH uses a broader field of activation and does so more slowly, allowing more time to choose between interpretations (Burgess & Chiarello, 1996). This difference has direct implications for specific strengths and weaknesses such as the RH dominance for comprehending indirect language not well supported by context.

As Rourke and Tsatsanis (2000) point out, NVLD differs from other types of learning disabilities in the extent of deficits that characterize the syndrome. Specific functions thought to be lateralized or dominant in the right hemisphere include cognitive flexibility, organizing and integrating complex or novel information, visual-spatial and emotional perception and processing pragmatic elements of communication (Bowers, Bauer, Coslett, & Heilman, 1985; Cohen, Branch, & Hynd, 1994; Devinsky, 2000; Ross, Thompson, & Yendosky, 1997; Shammi & Stuss, 1999; Schultz, Romanski, Tsatsanis, 2000; Teeter & Semrud-Clikeman, 1997).

Rourke (1995) extended Goldberg and Costa's model of hemispheric functioning to explain what he called "the syndrome of nonverbal learning disabilities" (p. 1). Their model is based on three principles related to the function of white matter (long myelinated fibers that carry information): (a) the more white matter affected, the more likely that NVLD characteristics will manifest; (b) the location of white matter disturbance and the developmental stage of the subject will affect the specific manifestation of NVLD; and (c) white

matter is crucial for the *development* of a behavior in both hemispheres but in the right hemisphere, white matter is critical for *maintenance* of a behavior as well. Thus, functions that have been learned prior to damage of the white matter and lateralized to the left hemisphere will be less affected; whereas those functions associated with the right hemisphere will be permanently affected. This understanding of hemispheric functioning, the role of white matter as well as studies on right hemisphere damage (RHD), has contributed to the conceptualization of NVLD as a right hemisphere disorder.

Using a developmental framework, Rourke explains the spectrum, course and outcome of right hemisphere disorders as dependent on type of white matter destruction, time of onset, and developmental stage of the patient. These premises provide an explanation for NVLD characteristics resulting from injury or disease, stating that the manifestation will differ depending on these three variables. Under this model, any disease or disorder that affects white matter may manifest the NVLD syndrome (Harnadek, & Rourke, 1994). Examples of conditions that lead to white matter deficits include callosal agenesis, hydrocephalus and multiple sclerosis (Roman, 1998). Although this theory is perhaps the best known, it has not been validated by empirical studies.

NEURODEVELOPMENT

Since NVLD occurs in childhood and has been linked to dysfunction or pathoanatomical development of the RH rather than actual damage, neurodevelopmental theory provides a useful framework for the disorder. Luria (1980) describes development of higher mental functions as a hierarchical system of increasing complexity. As the higher mental activities develop, the basal functions are no longer utilized. For example, when learning a complex skill such as reading, the beginner must use visual memory and spatial skills to decode letters and then words. As this skill develops, it becomes automatized, requiring

less cognitive processing for the mechanics of reading and more energy is devoted to the more complex comprehension. Thus early lesions or developmental disruption may lead to systemic dysfunction of a later developing complex behavior. This developmental perspective is important both in extrapolating information from studies of adults with hemispheric damage and in speculating on the effect of early deficits on later, more complex behaviors such as humor comprehension.

Research on early lesions helps direct attention to possible outcomes of early difficulties in right hemisphere development. A lesion in a child's brain will have an effect on the development of higher cortical functions and may lead to systematic dysfunction of the complex behavior, though the deficits may be more diffuse and harder to quantify than in adults (Marlowe, 1992). One study of children who had focal brain injuries as neonates revealed lateralized deficits at five years of age using measures specifically focused on language production and visual discrimination (Glass, et. al., 1998). This finding was in contrast to earlier studies, which found no differences using more global measures of functioning. These deficits were found with fairly mild lesions whereas studies of more severe lesions have shown no effect. Glass, et. al. (1998), postulated that severe damage results in a shift of function to the non-dominant hemisphere whereas this shift does not occur for more mild injuries. This study has implications for right hemisphere disorders that occur due to maldevelopment, which might also result in a failure to shift function to the more strongly developed hemisphere. The findings support the use of more specific instruments rather than more global measures to assess deficits that may arise from early but mild to moderate maldevelopment. For example, a specific language task is more likely than a more global verbal measure, such as Verbal IQ, to show whether verbal deficits exist.

In general, the right hemisphere is more able to engage in a shift of functioning in the case of early damage. The left hemisphere seems to be somewhat less successful in "taking over" right hemisphere functions in the case of early damage (Glass, et. al., 1998; Hynd & Willis). Semrud-Clikeman and Hynd (1990) point out both the faster rate of development and greater involvement of the right hemisphere in infancy. Early learning experiences are, of necessity, pre-verbal and involve the visual, spatial, auditory and emotional processing systems, most of which are strongly lateralized to the right hemisphere. Early dyadic interactions generate learning experiences but also contribute to building critical patterns and skills for later social interaction. Poor early development of the right hemisphere then could have a negative impact on these early experiences that is then compounded with development. In turn, early experiences may have a facilitative or buffering impact on right hemisphere development.

Although Rourke does not contend that NVLD is a degenerative disease or process, according to his model, the fundamental deficits have a "snowball" effect in the face of increasing environmental demands. Rourke and Fuerst (1991) characterize children with NVLD as presenting "deficient right hemisphere capacities within a context of well-developed, modality-specific, intramodal, routinized, and stereotyped left hemisphere skills" (p. 411). Rourke's model suggests that the primary assets associated with NVLD include simple motor skills, auditory perception, and strong memory for, and attention to, rote material. Primary deficits include: tactile and visual perception; complex psychomotor deficits, especially on the left side of the body; and accommodation to novel material (see Appendix A for full model). When the primary abilities are not mastered, the subsequent cognitive and developmental tasks are negatively affected.

Rourke's model is fundamentally developmental, illustrating how early deficits in tactile, visual perception and psychomotor coordination inhibit sensorimotor development. The processing of novel stimuli is not mastered early and spirals down to further deficits in higher order mental processes such as concept formation and hypothesis testing. The model illustrates how deficits in visual-spatial organizational skills result in poor processing of nonverbal cues and result in compromised social interaction. Under Piaget's framework, limited sensorimotor exploration in turn limits the organization, integration and consolidation of one's experiences (Rourke & Tsatsanis, 2000).

Marlowe's (1992) child case study of damage to the right frontal lobe incurred at age three revealed patterns similar to the NVLD profile. The child showed increasing difficulty with novel tasks as he developed. Visual-spatial organization and production were markedly low. The child tended to perseverate on problem solving tasks, was highly literal, showed irritability and hypersensitivity. Voeller's (1995) case studies illustrated the potential developmental course of right hemisphere disorders with subtle impairments in social reciprocity (maintaining social gaze and acquiring joint attention) manifesting as early as 6 months. In contrast to Rourke's emphasis on the visual-spatial processes, Voeller (1995) speculated that early difficulties in dyadic interaction and processing "motherese" might contribute to later social dysfunction. One can extend this hypothesis to the role of early attachment in the development of emotional perception. In the instance of insecure attachment due to rejection or neglect, infants develop a strategy of ignoring cues and reducing demands from the caregiver in order to reduce the often unpredictable response (Belsky & Cassidy, 1994). As such, it is possible that an early insecure attachment could lead to some of the same social deficits associated with NVLD and thus result in a type of acquired NVLD.

An adult who has already developed the complex processes may suffer from more partial or distinct losses of ability. For example, whereas adults show language deficits only when lesions are located in the left perisylvan regions, children show subtle language problems with damage in either hemisphere (Nass, 1997). This difference is important when comparing NVLD as a right hemisphere developmental disorder to focal lesions suffered by adults with previously normally developed abilities. A direct comparison cannot be made between adults with right hemisphere *damage* and children with some sort of developmental right hemisphere *dysfunction*. However, the literature on adults with RHD has the advantage of providing information about functioning before and after the injury, making it possible to draw some inferences about the functioning of the right hemisphere. With this caveat in place, it can be useful to extrapolate information about right hemisphere disorders in children from studies on adults with right hemisphere damage (RHD).

RELATION TO DIFFERENT DISORDERS

Nomenclature for the cluster of symptoms associated with NVLD has included developmental right hemisphere syndrome, semantic pragmatic language disorder (SPD), right hemisphere deficit syndrome, developmental Gerstmann's syndrome, left hemisyndrome, and others (Rourke & Tsatsanis, 2000; Semrud-Clikeman & Hynd, 1990). With the growing understanding of the complex and dynamic transactions between biogenetic and environmental factors, neither etiology nor developmental outcomes are easily determined. Similar etiologies may lead to different profiles of development, while similar clusters of symptoms may be derived from different etiologies (Klin, Volkmar, & Sparrow, 2000).

The argument continues as to whether high functioning autism (HFA) and Asperger Syndrome (AS) are distinct disorders or simply represent different levels and developmental tracts of the same disorder (Freeman, Cronin &

Candela, 2002; see Appendix B for the diagnostic criteria of AS and Autistic Disorder, AD). Wing (2000), in a follow up to her seminal work in bringing AS to the fore, argues strongly against the differentiation of AS into a category separate from the array of similar disorders. She classifies individuals with social impairment according to their quality of social interaction, the level of verbal abilities and the level of nonverbal abilities. These disorders are perhaps more accurately described as overlapping clusters of symptoms rather than as a linear continuum of autistic disorders.

Neither has research clarified distinctions between NVLD and AS, Semantic Pragmatic Language Disorder (SPD), and the different labels of developmental right hemisphere disorders (Rourke & Tsatsanis, 2000; Szatmari, 2000). Szatmari (2000) suggests that diagnoses differ by profession rather than symptomatology with language pathologists diagnosing SPD, psychiatrists diagnosing schizoid or schizotypal personality disorder and neuropsychologists diagnosing NVLD. In a study comparing children with AS and AD along the characteristics associated with NVLD, Klin, et. al. (2000) put forward the hypothesis that the model of NVLD forms a neuropsychological model for AS rather than these being two different diagnoses. With these arguments in mind, this study will not draw distinctions between children with NVLD, AS, and SPD.

NEUROPSYCHOLOGICAL CORRELATES

Complex behaviors cannot be relegated to distinct categories or specific areas of the brain; the deficits of NVLD share many characteristics and may have common substrates. For example, McDonald (2000) found an association between comprehension of language pragmatics and visual-spatial perception suggesting a common neurological substrate. However, for the purposes of this study, the characteristics associated with NVLD, right hemispheric functioning

and humor, will be grouped under the categories of cognition, perception[2] and language.[3] These categories can be understood both through the direct research on children with NVLD and indirectly, through studies of adults with RHD. Although, by definition, learning disabilities are associated with problems in achievement, this paper will focus on each of these categories as they may feed socio-emotional difficulties.

There is growing evidence that NVLD is at least as debilitating as verbal disabilities in adaptive functioning and intelligence assessment, as well as less amenable to intervention (Badian, 1992; Johnson, 1987; Harnadek, & Rourke, 1994; Myklebust, 1975; Rourke, & Fuerst, 1991; Rourke, 1995; Semrud-Clikeman, & Hynd, 1990).[4] This evidence is somewhat counterintuitive. Given the strong emphasis of language in modern society, one might assume that verbal learning disabilities (VLD) would be more problematic. However, the findings make more sense when one examines the characteristics associated with NVLD more closely.

Cognition

Children with NVLD have deficits in cognitive flexibility and complex information processing which lead to problems in concept formation, cause and effect reasoning, and nonverbal problem solving (Harnadek, & Rourke, 1994; Klin, et al. 1995; Rourke, & Fuerst, 1991; Rourke, 1995; Semrud-Clikeman, & Hynd, 1990; Teeter, & Semrud-Clikeman, 1997). All of these basic abilities contribute to social competence as well as academic competence. Social

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2 The construct of memory, where relevant ,will be included under the category of perception.

3 It is noteworthy that many studies also indicate complex psychomotor defects, and soft, left sided neurological signs (Rourke, 1995; Semrud-Clikeman, & Hynd, 1990; Weintraub, & Mesulam, 1983). These characteristics will not be examined in this study as there is no research connecting them with humor.

4 It important to note strengths that are associated with NVLD including phonological decoding, auditory perception, and verbal-auditory memory (Badian, 1992; Johnson, 1987; Harnadek, & Rourke, 1994; Rourke, & Fuerst, 1991; Rourke, 1995; Semrud-Clikeman, & Hynd, 1990; and Teeter, & Semrud-Clikeman, 1997). The purpose of this paper, however, is to determine the factors contributing to humor deficits.

competence can be explained, in part, as a complex problem-solving task. Rourke and Fuerst (1991) indicate that children with NVLD have difficulty with complex informational processing demands, possibly due to a left hemisphere advantage. Brumback (1990) attributes this information overload to "problems conceptualizing the whole as a series of interconnected parts" (p. 51). These children process information much better when presented in a sequential manner. Johnson (1987) refers to the difficulty parents have in disciplining children with NVLD due to deficits in cause and effect reasoning. For example, one mother, seen at a major southwestern university reported that, in social interactions, her son "didn't seem to get it." He was not intentionally willful, but could not make the connection between his own actions and consequences (social reactions or discipline). Even when the relationships were explained to him, and he seemed to understand, he did not apply this knowledge to the next situation. Several factors may contribute to this situation. Determining cause and effect beyond fairly simple relationships requires an understanding of complex inter-relationships. These children may develop social scripts for appropriate responses but they are either unable to correctly process the novel situation (complex information processing) or they are unable to make appropriate adjustments to their social scripts (cognitive flexibility).

Adults with RHD show many of the same cognitive deficits associated with NVLD. These subjects demonstrate less cognitive flexibility when faced with novel tasks (Goldberg & Costa, 1981). They tended to treat all stimuli with a set of previously generated strategies, whereas those adults with LHD treated all problems as novel. This difference was reduced when the correct working hypotheses were provided to the groups. Like the examples of children with NVLD, adults with RHD benefit from cues; both groups need to remember "when to know."

Perception

It is widely accepted that children with NVLD suffer from perceptual difficulties. These difficulties can be further divided into those tasks that rely on pure visual-spatial perception and those tasks, visual-spatial and auditory, that have an emotional component. Although Rourke's model does not include a deficit in this area, studies of adults with RHD and children with NVLD have supported deficits in emotional processing beyond those accounted for by visual-spatial perception (Worling, et. al, 1999; Voeller, 1995). The following sections review these aspects of perception as they pertain to NVLD.

Visual-Spatial Perception

Children with NVLD display strong auditory perception, particularly for verbal stimuli (Harnadek, & Rourke, 1994). They evidence difficulties in tactile and visual-spatial perception and organization, particularly if the stimulus is novel or complex (Johnson, 1987; Harnadek, & Rourke, 1994; Semrud-Clikeman, & Hynd, 1990; Teeter, & Semrud-Clikeman, 1997). Difficulties in accurate perception of visual-spatial stimuli are thought to lead to problems in math, in processing novel and complex stimuli, and in interpreting individual parts as an integrated whole (Harnadek, & Rourke, 1994).

In children with NVLD, there is evidence of less severe problems in basic visual perceptual deficits than in complex spatial visualization tasks (Cornoldi, Rigoni, Tressoldi, & Vio, 1999; Worling, et. al., 1999). Johnson (1987) contends that, in terms of visual-spatial organization, these children "do not know how to look" (p. 137). Johnson illustrates this assertion with an example of a seven-year-old boy who was shown a picture of three firemen with hoses standing around a burning house. The boy initially indicated that this was a picture of a birthday party and indicated "the candles." He was able to self-correct when the examiner pointed to the firemen and house. This difficulty is complicated by, but not solely

due to, poor working memory for spatial concepts (Worling, et. al., 1999). Visual complexity combined with working memory requirements may exceed the child's ability to process the information.

These early perceptual deficits inhibit the sensory and motor exploration that comprises much of early learning (Semrud-Clikeman and Hynd, 1990; Rourke, 1995). For example, as noted by Weintraub and Mesulam (1983), "acquisition of early number concepts is based on active exploration of the physical and spatial attributes of objects" (p. 468). It is unclear whether visual-spatial perception is harmed by early lack of environmental exploration, or whether the lack of exploration contributes to the poor perception. Likely, both phenomena play an interactive role.

Visual spatial perception is often cited as critical in the maldevelopment of emotional and social skills in children with NVLD. For example, early deficits in visual-spatial perception may also inhibit dyadic interaction leading to later social-emotional difficulties (Semrud-Clikeman & Hynd, 1990; Voeller, 1995). Based on the research of both children and adults with RHD, it seems likely that early dysfunction may play a critical role in the early development rather than in the ongoing social interactions of these children.

Socio-emotional Perception

Nonverbal, affective perceptual skills utilized in social interaction are also thought to be deficient among those that have NVLD. These skills include the ability to interpret facial expressions, body language and vocal inflection, or prosody (Badian, 1992; Brumback, 1990; Dimitrovsky, Spector, Levy-Shiff, & Vakil, 1998; Johnson, 1987; Gross-Tsur, et al. 1995; Nowicki, & Carton, 1997). Interviews with parents of children with NVLD often portray a passive infant who engages in little exploration and is less responsive to emotional interaction (Johnson, 1987). Given the primary difficulties in recognizing facial expression

and the expression and reception of prosody, it is reasonable to infer a disruption in the development of attachment and of dyadic reciprocity, which form the beginnings of social interaction (Semrud-Clikeman, & Hynd, 1990). Some researchers have asserted that children with NVLD have particular difficulty in interpreting negative emotions, which limits their ability to profit from feedback (Johnson, 1987). These children may not notice cues that would help them fit their interaction to the situation. This area of social perception and memory overlaps with the communication aspect of linguistics.

One intriguing study showed that children with Asperger Syndrome (AS) and Autistic Disorders (AD) consistently fail to interpret the Social Attribution Test (SAT) as a depiction of social interactions (Schultz, et. al, 2000). The SAT is an animation of geometric shapes that move in relation to the movements of the other shapes. Children and adults without disabilities almost invariably interpret the movements as social. The authors noted the strong propensity to find inherent social meaning seems to be missing in children with AS and AD. These children "lack the propensity to interpret ambiguous scenes through a social lens" (Schultz, et. al., 2000, p.193).

Adult studies reveal that the RH may be dominant for mediating arousal attention to affective processing (of emotional prosody, musical passages, facial expressions, emotional language) and facial identity (Bowers, et. al., 1985). This study suggests that the RH contains schemas or prototype facial expressions that allow the categorization of different facial expression. Additionally, the right hemisphere appears to play a critical role in emotional processing, specifically the recognition of emotions, control of emotional expression and related behaviors, and processing negative emotions (Ostrove, Simpson, & Gardner, 1990). Thus adults with RHD tend to be overly positive when assessing emotional situations. Devinsky (2000) points to evidence from conditions predominantly affecting the

RH suggest that it is dominant for emotional consciousness, or self and relation of self to others.

Language

Language can be analyzed as comprising of four systems: phonological, grammatical, semantic and pragmatics. Respectively, these systems involve: the perception and production of sounds to form words, the rules governing the production of sentences (tense, case, etc), the meaning of words, and the communicative or social use of language (Rescoria, & Mirak, 1997).

Semantics refers to the ability to discern how words and word combinations express meaning (Landa, 2000). This definition refers to an understanding of connotation as well as denotation. For example, in order to understand the phrase 'heavy heart," the listener must be able to interpret the change in the meaning of both words when used in combination.

Pragmatics refers to nonverbal aspects of language and communication, including nonverbal gestures, prosody or vocal tone and speed of word usage. For example, a verbal utterance that rises in tone at the end indicates a direct question, whereas if the utterance is also halting rather than fluid, it conveys uncertainty. Facial expression and tone of voice can transform a statement from literal to sarcastic. These nonverbal aspects of language are often considered more important for deriving meaning from communication than the actual verbal content. Pragmatic competence, the use of linguistic and extra linguistic communication in context, is considered fundamental to linguistic competence (Bara, Bosco, & Bucciarelli, 1999).

Aspects of pragmatic competence include the ability to recognize the appropriate way to communicate in a given social setting (i.e. direct vs. indirect, etc) and the linguistic flexibility to select appropriate forms to express intent (Landa, 2000). Very young children can be alternatively amusing or

embarrassing as they struggle to discern the appropriate settings to communicate directly or indirectly. Effective communication rests on shared expectations based on variables such as relationship, context, and individual characteristics. Additional characteristics of pragmatic communication include intact attentional mechanisms, awareness of social rules, ability to consider the perspective of others, ability to consider alternative forms of expression and language skills to express them (Landa, 2000).

Although language has long been considered the domain of the left hemisphere, studies of adult with RHD have provided support for the right hemisphere's major role in the reception and expression of emotional and linguistic prosody (Cohen, et. al., 1994). The evidence is clearer for emotional than for linguistic prosody. The expressive deficits found in adults with RHD include: socially inappropriate discourse and actions, as well as a tendency to be garrulous and prone to tangential statements (Brownell & Gardner, 1988). Adults with RHD also have difficulty understanding the discourse and actions of others. Among these receptive deficits are comprehension difficulties in understanding jokes; inferences or nuances of communication, as in sarcasm or indirect requests; and understanding or producing prosody in speech. RHD patients seem to be competent at basic discourse forms in structured tasks but display problems when required to make complex or open-ended judgments about discourse (McDonald, 2000).

Early language development is a multi-modal problem-solving task that requires the integration of multiple sources of information. As language develops, many aspects become automatized and lateralized to the left hemisphere (Teeter & Semrud-Clikeman, 1997). As a result of this difference, studies have found delays in word comprehension associated with RHD in children but not adults (Bara, et. al. 1999). Although LHD is grossly associated with language

deficits, in children, RHD results in semantic deficits whereas LHD results in grammatical defects.

Recently, semantic pragmatic language disorder (SPD) has been linked with right hemisphere dysfunction, specifically with AS and AD, though not yet substantively with NVLD (Bishop, 1989; Shields, 1991). Children with SPD and NVLD are described using almost identical terms: fluent and grammatically complex language with poor communicative language including inadequate comprehension, expression, and reception of prosody; difficulty in the use of contextual cues; and difficulty with metaphor, humor, and other inferential information (Bishop, 1989; Hall, 1997; Shields, 1991). In bridging the two bodies of research (learning disabilities and language disorders), it seems plausible that NVLD and SPD may refer to different aspects of the same disability.

Children with NVLD are characterized as having well developed language skills in the context of poorly developed nonverbal skills (Badian, 1992; Johnson, 1987; Harnadek, & Rourke, 1994; Myklebust, 1975; Pennington, 1991; Rourke, & Fuerst, 1991; Rourke, 1995; Semrud-Clikeman, & Hynd, 1990; Teeter, & Semrud-Clikeman, 1997). Perhaps in compensation for perceptual difficulties, children with NVLD interact with the world almost exclusively through words. The volume of their verbal interaction can mask their difficulties with specific aspects of non-canonical language. Specifically, these children seem to experience difficulty with the semantic and pragmatic aspects of language. Similarly, children with documented right hemisphere lesions performed more poorly than those with LHD or controls on measures of emotional and linguistic prosody (Cohen, et. al., 1994). These linguistic difficulties would interact with poor social perception to compound poor social competence.

Social Competence

Social competence can be defined as, "The [socially] competent individual is one who is able to make use of environmental and personal resources to achieve good developmental outcome" (Waters & Sroufe, 1983, p. 81). This definition encompasses different resources possessed by individuals and the changing resources of an individual through time. The three areas of cognition, perception and language offer a slightly different conceptualization of the neuropsychological deficits that Rourke (1995) delineated as having a cumulative detrimental effect on socio-emotional functioning. An additional factor of emotional perception has been added to this model as making a separate contribution to poor social competence.

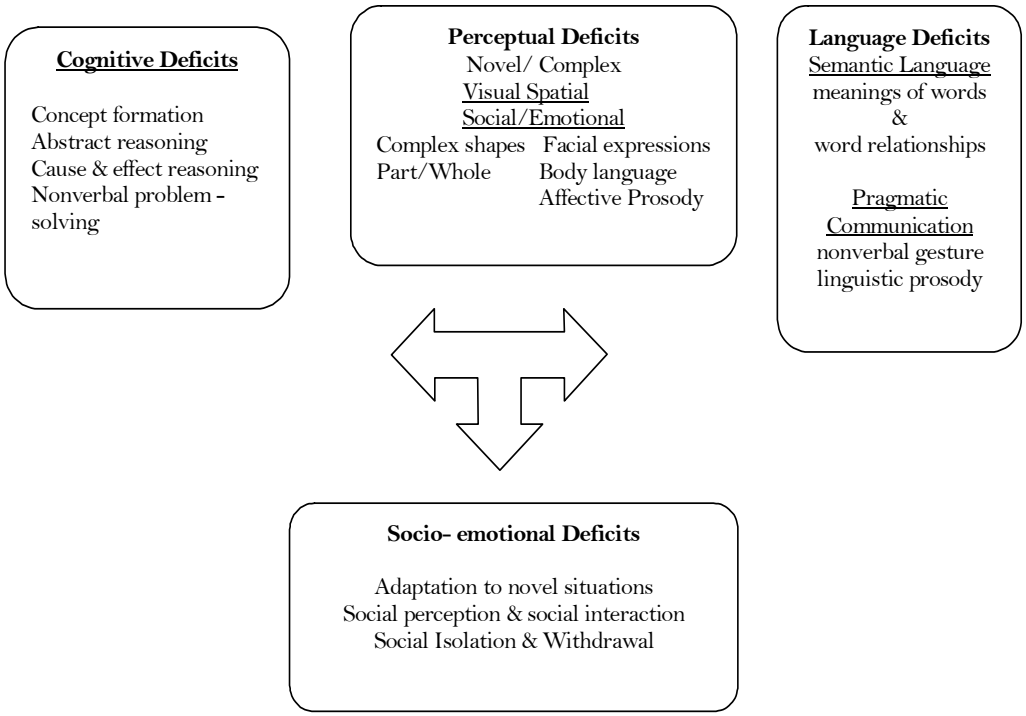

Figure 1. Factors contributing to deficits social competence reported in children with NVLD.

This model is a visual account of conceptualization of complex interactions outlined in this paper. It does not include additional contributing factors such as multiple environmental factors.

When Myklebust and Johnson first described children with nonverbal learning disabilities, they focused on the deficits in social perception, which they saw as playing a pivotal role in making meaning out of the social environment. Myklebust (1975) contended that the social imperception led to the primary and most debilitating aspects of NVLD. Semrud-Clikeman and Hynd (1990) specify the deficits associated with NVLD including poor social perception, disturbances in social relations, difficulty with temporal and spatial orientation, and math difficulties. They cite Krudek and Krile in listing empathy, and the ability to read social situations and act accordingly as playing an increasingly important role in social competence as children move from third to eighth grade. Cognitive skills necessary for these social abilities include divergent thinking and cause and effect reasoning. Necessary perceptual skills include recognition and identification of facial expression, prosody, and gesture, which are particularly problematic for children with NVLD (Masten, 1986).

For the purposes of this study, the deficits associated with NVLD have been relegated to distinct categories. However as Gross-Tsur, et. al. (1995) state, "Their emotional and social problems may be the expression of a complex interaction between neurological profile and environmental milieu" (p. 85). When considered separately, any one of the NVLD characteristics could be considered significant; interaction increases the complexity and impact of the deficit. For example, the interaction between difficulty with social perceptual skills, pragmatic language use, cause and effect reasoning, and processing novel or complex information add up to a tremendous deficit in social functioning which draws on all of these skills simultaneously. This interaction reflects Myklebust's (1975) concept of social imperception; these children do not have the

ability to process and thereby profit from the feedback that shapes social interactions. Thus, to children with NVLD, social interaction and responses may seem random and unrelated to their own behavior.

Many studies have associated poor social skills with learning disabilities and have achieved mixed results (Little, 1993; Semrud-Clikeman, & Hynd, 1990). These studies have often failed to differentiate between subtypes of LD. However, studies that do differentiate between subtypes have found more substantive evidence of a social skills deficit linked specifically with NVLD. In several studies, children with LD have more socio-emotional and behavioral difficulties; however, compared to control groups, children with NVLD, or both nonverbal and verbal disabilities, seem to be at greater risk (Badian, 1992; Dimitrovsky, et. al., 1998). Rourke and Fuerst (1991) found that children with NVLD demonstrated social-emotional difficulties at a much higher rate than do children with reading disorder. Nowicki and Carton (1997) surmised that children with difficulty processing nonverbal information are not only likely to have social interaction problems, but are less likely to be aware of the level of interference and thus are less able to remediate the difficulty.

Background Literature Regarding Humor

In order to discuss the effect of right hemisphere damage on humor, it is necessary to establish the components considered essential to "normal" humor abilities. Humor is commonly divided into humor comprehension, appreciation, and production. In this paper, humor appreciation and production may be mentioned in a limited way, but the focus will be on humor comprehension.

FUNCTION OF HUMOR

There are many theories as to the origin and evolutionary function of humor. The common thread through all is that humor in some way facilitates

social interaction. Hayworth (1928), and more recently, Weisfeld (1993), have presented arguments for the evolutionary development of humor as a tool of social interaction. Hayworth (1928) asserted that laughter served as a preverbal signal of safety to group members. He proposed the element of safety in the expression and appreciation of humor. Hayworth's ideas have found merit among researchers connecting humor to social interaction. Weisfeld (1993) proposed that "Humor evolved to induce the subject to seek out informative social stimuli and to reward others for providing such stimulation." (p.162).

Many theorists emphasize the social function of humor though few have studied the spontaneous humor in social interactions. Many list humor as one of the most flexible tools in social interaction serving a variety of functions including: enhancing relationships, increasing or maintaining group cohesion, relieving tension, saving face, and expressing aggression in a socially acceptable way (Chapman, 1976; Martineau, 1972; Masten, 1986). Kane, Suls, and Tedeschi (1977) assert that humor is a powerful social tool as it allows different interpretations simultaneously. Thus, humor can be used to probe intentions or values indirectly, to back down or "decommit" from a previous position, to save face, to ingratiate one's self, and to invite interaction. McGhee (1989) referred to humor as a "social lubricant," which makes social interaction easier and more pleasant. As he expressed, the effective communicator frequently uses humor to attract or maintain attention, and to express views otherwise difficult to communicate. These are some of the listed purposes of humor. However, in children, humor is also inextricably tied to development. Thus, for children, humor serves a social and a developmental purpose.

THEORIES OF HUMOR

The following section will outline the views that are most widely accepted as critical and non-exclusive aspects of humor development. These views include

the roles of incongruity and resolution, cognitive and affective mastery, and social/emotional interaction in humor development. Several researchers advance the superiority theory of humor; we laugh at situations in which there are victims in order to promote our superiority. Although clearly there are types of jokes that increase feelings of superiority, individual status, and group cohesion, Miller (1988) rejects the superiority model of humor as an oversimplification of complex cognitive and moral issues.

Incongruity-Resolution

Regardless of theoretical framework about the purpose of humor, most researchers agree that humor is related to either comprehending or producing an incongruity: the simultaneous occurrence of incompatible elements or sudden contradiction of expectations (Bariaud, 1988; Bernstein, 1986; Johnson, 1990, Johnson, & Mervis, 1997; McGhee, 1971a, b; 1974; Owens, & Hogan, 1983; Shultz, 1972; 1976; Shultz, & Horibe, 1974). Humor usually involves two phases: perception and identification of an incongruity, and reassessment to produce cohesion or resolve the incongruity (Suls, 1972; Shultz, 1972). Most researchers accept this two-stage model, though the language describing the model may vary (surprise/ coherence vs. incongruity/ resolution).

Many researchers assert that resolution is not necessary for the perception or experience of humor (Keith-Spiegel, 1972). For example, slapstick humor such as gags or practical jokes does not necessarily involve resolution. This type of humor is considered to be a less complex form of humor. Shultz and Horibe (1974), in a study of verbal humor, proposed that the transition from incongruity to incongruity plus resolution occurs between the ages of six and eight. Shultz (1972) found that younger children were less able to identify the incongruity critical to the resolution and would point to a non-critical incongruity, such as a funny expression. They would then develop a corresponding non-critical

resolution such as “because something’s wrong with his food.” Shultz (1972) proposed that a person enjoys a joke to the extent that incongruity can be detected and resolved and that the ability to detect critical incongruities and resolutions increases with development.

Cognitive and Affective Mastery Theory

The mastery theory of humor ties humor comprehension and appreciation to development. In humor development, children find pleasure in mastery. Thus, they express the greatest pleasure in a humorous stimulus that is right at the edge of their developmental stage. The cognitive congruency principle states that a humorous stimulus is less pleasurable when it is too simple or too complex in relation to the developmental stage (Zigler, Levine & Gould, 1966). For example, the enjoyment of joking riddles peaks in early elementary years and then declines as language use becomes more sophisticated. Humor reactions in younger children are primarily generated by visual or motor stimuli. Appreciation for verbal and abstract humor increases with development. This finding was particularly robust across studies and may support the theory that humor is generated by mastery, first of motor ability then of language (Bainium, Lounsbury & Pollio, 1984; McGhee, 1071; Sroufe & Wunsch, 1972)

In reviewing the cognitive mastery approach to humor, McGhee (1971, a) cites Kagen's (1967) theory that infants experience pleasure in assimilating stimuli into schemas. The pleasure is increased with a moderate mismatch between internalized schema and external stimuli. Kagen's theory is supported in his study of infant smiles in reaction to different representations of the human face (possibly the earliest perceptual schema). At four months, infants smiled most often at the most realistic faces (photographs and sculptures) indicating their uncertain grasp of the human schema. By thirteen months, the most smiles were

obtained in response to major distortions of human form (three headed man), indicating the full grasp of this schema.

McGhee (1971, a) asserts that these early experiences of pleasure develop into humor when children begin to engage in representational thinking, around eighteen months. Only when children develop a stable understanding of the 'real world' and are able to distinguish between fantasy and reality, can they truly experience the violation of expectation, which then leads to humor. McGhee maintains that the child's ability to identify cues as to which mode is relevant (fantasy assimilation or reality assimilation) is critical for the development of humor.

Bariaud (1988) points out that while cognitive theorists discuss mastery of cognitive concepts, Wolfenstein, following Freud's theories, advocates an affective mastery of anxiety theory. According to this theory, humor is generated as a response to anxiety and an attempt to overcome or master these uncomfortable feelings (Bariaud, 1988). The second concept in the affective mastery theory lies in the development of more complex jokes to conceal negative or socially inappropriate emotions or tendencies such as sex or aggression, a form of sublimation.

Social/emotional Interaction

Bariaud (1988) asserts that humor is both a cognitive process and an affective experience. In order for incongruity to generate humor rather than fear, confusion, or perplexity, the incongruity must be placed within a playful framework. This playful framework is constructed through communicative signals indicating playful intent. Although in adult humor these cues are very subtle, for children, the cues must be more obvious. Bariaud speculated that early dyadic social exchanges prime children to develop a “social intelligence” that allows them to identify and understand contextual cues of intent. In addition to a

playful framework, the participant in humor must engage in an "emotional complicity." Early humorous interactions may contribute to the development of emotional complicity and ultimately to the development of empathy. In conclusion, Bariaud emphasizes his addition of "emotional tonality" as playing a larger role in humor appreciation than does comprehension. He suggests that for a person to engage in emotional complicity, she must share the humorist's intention in order to fully enjoy the humorous stimuli.

HUMOR, RIGHT HEMISPHERE DAMAGE, AND NVLD

Although people generally don't lose an appreciation for more simple forms of humor, these forms become less utilized and responded to as other levels are added. This trend may be especially true for children, when humor is so directly tied to development. It is important to consider the differences between the study of humor in children and in adults. As will be discussed in the following sections, although children do display cultural and individual differences in terms of temperament, humor content, and responsivity, there are predictable stages to humor development that are very closely tied to the child's cognitive, perceptual, and linguistic development. By exploring these stages in normal development as well as the findings gleaned from studies of adults with RHD, it is possible to make inferences about the potential deficits that would be seen in children with NVLD.

In adults, having reached a common baseline of development, humor tends to branch out into more individualized preferences. The common aspects of humor in adults may best be understood through studies of adults with focal brain damage. In general, RHD leaves basic language abilities intact but has a strong negative effect on communication and social awareness, including the ability to comprehend and appropriately use humor. Both left hemisphere damage (LHD)

and RHD result in a decreased sensitivity to humor, but the decrement is significantly greater with RHD.

Cognition in Adults with RHD

Goldberg and Costa (1981) assert that in problem solving tasks, the left hemisphere utilizes previously learned information, while the right hemisphere incorporates all information as novel. Studies have suggested that adults with RHD display difficulty or an inability to shift their cognitive set to accommodate new information, which leads to deficits in inferential language and in humor (Brownell, Potter, Bihrle, & Gardner, 1986; Ozonoff, & Miller, 1996). In a study of humor comprehension in adults with RHD and LHD, Bihrle, et. al. (1986), found that RHD resulted in lower comprehension of humor and short narratives than LHD, though both groups of patients performed more poorly than controls. This difficulty affects the resolution stage of humor. When presented with nonverbal and verbal jokes, adults with RHD were able to identify the incongruence as an element of humor but lacked the ability to integrate the material in such a way that retained its coherence; adults with LHD showed the opposite pattern. This finding was significant in both the verbal and the nonverbal conditions of the test stimuli indicating an underlying cognitive deficit rather than a specific visual-spatial or language deficit. In a similar study, Brownell, et. al., (1986) found specific deficits associated with RHD in making inferences as compared to controls. Further, it was found that the inference deficits were due to cognitive rigidity rather than a memory deficit since the most errors were found when the *initial* information was misleading. This difference offers some explanation for the tendency of some adults with RHD to follow tangential associations. They can appreciate isolated meaning and associations but are unable to shift gears and be guided by context.

Perception in Adults with RHD

Social interaction difficulties require both visual-spatial and emotional perception, which would place subjects with RHD at a double disadvantage. Although the comprehension of spontaneous humor or humor in social settings has not been examined in adults with RHD, one might infer that lowered perceptual abilities of visual-spatial and emotional stimuli would decrease humor comprehension and appreciation. As with the studies reflecting cognitive rigidity, RHD appears to damage the ability to integrate visual information without verbal cues. In a study of cartoon humor, Gardner, et. al (1975) found that including captions aided the comprehension of adults with RHD whereas captions detracted from the performance of adults with LHD. Adults with RHD seem to have particular difficulty in picking out relevant details in complex visual stimuli, analogous to their difficulty in grasping the main point o f a conversation (Brownell, et. al., 1986). This observation suggests more of a problem with gestalt than with visual perception; the cartoons help direct attention to the gist of the joke.

In addition to poor visual spatial perception, RHD seems to result in deficits in emotional perception as well. Bowers et. al. (1985) found that the right hemisphere mediates both the recognition of facial identity and affect independently. Ostrove, et. al. (1990) also found that adults with RHD had more difficulty comprehending interaction scripts that had an emotional component. When faced with tasks requiring empathy or social perspective taking, adults with RHD seemed to note or predict *physical* states rather than *emotional* states indicating an overly literal interpretation of events (Brownell & Gardner, 1988). Thus, humor is affected by a lack of social perception as well as deficits in language and cognition.

Many studies implicate the right hemisphere in social judgment, the ability to determine and engage in emotional behavior appropriate to social context

(Brownell, & Gardner, 1988; Gardner, et. al., 1975; Ostrove, et. al., 1990). As an example of this "emotional inappropriateness," Brownell and Gardner (1988), refer to a patient who repeatedly interrupted the examiner to ask about her sexual activities during testing and referred to his wife as "the old sow" without sign of malice or humor. The authors point out that these patients do not seem aware of the offensive potential of their comments indicating a lack of social judgment and empathy. When these patients attempt to produce humor, they also display the same unawareness of social context. This anecdote provides an interesting parallel to the study by Schultz (2000) suggesting that children with AS and AD do not view the world through a social lens.

Language in Adults with RHD

The pragmatic language deficits associated with RHD also contribute to difficulties in humor. Several studies of adults with RHD have found decreased ability to understand the figurative language that plays a key role in humor comprehension, such as metaphors, idiomatic speech, and inference (Brownell, et al., 1986; Burgess, & Chiarello, 1996; Ostrove, et al., 1990). Winner and Gardner (1977) proposed that though adults with RHD can provide the correct linguistic response with prompting, their insensitivity to the surroundings and inappropriateness of emotional responses prevents the comprehension of context necessary to process metaphors. This interpretation suggests that difficulties with figurative language may be more related to emotional or social imperception than to specific linguistic deficits.

Alternatively, the deficit in comprehending figurative speech could be the result of the fast and rigid response of the left hemisphere (Burgess, & Chiarello, 1996), The left hemisphere retrieves information more rapidly and with more focus whereas the right hemisphere uses a broader field of semantic activation and does so more slowly, allowing more time to choose (Burgess & Chiarello, 1996).

This processing delay in the RH may allow a different interpretation of figurative language or provide the resolution of the incongruity in humor. Another research finding providing support for the second explanation indicated that adults with RHD are less able to determine meaning for specifics from the entire context. For example, they don't tend to use contextual cues to interpret ambiguous stimuli such as indirect requests (Ozonoff, & Miller, 1996).

ANATOMICAL SPECIFICITY OF HUMOR IN THE RIGHT HEMISPHERE

Brownell and Gardner (1988) argue, rather than a "humor center", humor deficits in adults with RHD develop as a result of damage to several component skills. However, in a critical study, Shammi and Stuss (1999) researched humor appreciation with greater anatomical specificity by studying adults with an acquired single focal brain lesion restricted to an identified brain region. The patients were divided into right frontal, left frontal, bifrontal, right posterior and left posterior and compared to matched controls. These groups were compared on the following tasks: verbal humor appreciation task, joke and story completion task, and nonverbal cartoon appreciation task. Although the authors defined the task as humor appreciation, it could also be considered a humor comprehension task. They found that the patients with right frontal and bifrontal lesions had difficulty on all three humor tasks, the left frontal and right posterior groups were only impaired on the nonverbal cartoon task, and the left posterior group showed no impairments. Specifically, these patients had diminished emotional responses and were less able to choose correct joke endings. In correlating performances across tasks, the authors found that the verbal tasks were correlated with measures of mental shifting, verbal abstraction, and working memory, and the cartoon task was correlated with measures of visual scanning and working memory.

Further, by using impairment on the verbal humor tasks as an independent measure and then examining location of lesions, Shammi and Stuss found that the

most impaired patients had lesions involving the right frontal anterior, superior area, particularly areas 8 and 9. These patients had no problem in choosing logical endings to complete a story but chose predominantly non-sequitur endings for the joke completion task demonstrating a deficit in the coherence stage of humor appreciation and comprehension.

Shammi and Stuss interpreted the findings of their study to support the right frontal lobe as primarily responsible for indirect interpretation and organizing and integrating information. Also, they discussed the potential role of episodic memory retrieval stating that humor appreciation depends on the interpretation of the stimuli in the light of past experience. In interpolating these results to shed light on the role of the right hemisphere in the development of humor, it must be noted that this study used adults that had acquired injuries; one must speculate as to the significance of these results when considering the more diffuse functioning of the developing brain.

HUMOR DEVELOPMENT AND NVLD

Cognitive Development, NVLD, and Humor

Children become increasingly more capable of enjoying and producing a wider variety of humor as they integrate increasingly richer knowledge and more complex cognitive mechanisms. Shultz (1972) found that in very young children, incongruity alone can produce a humor response and that the resolution phase plays an increasingly important role as children develop cognitively. Shultz and Horibe (1974) proposed in a later study on verbal humor that the transition from the stage of pure incongruity to incongruity plus resolution occurs between ages of six and eight.

Using a Piagetian theoretical framework, McGhee (1974) initially proposed that a child must enter the pre-operational stage of cognitive

development before the humor response could develop. "The acquisition of conceptual thought is prerequisite to the perception of humor in stimulus discrepancy or incongruity" (p. 721). Before this cognitive development, incongruities are perceived as *different* rather than *inconsistent*. McGhee asserts that children must have a stable understanding of the real world before being able to perceive humor. He has revised this position to include a primitive humor response when an event is assimilated into the "wrong" schema, which can occur in children as young as 18 months. The transition from pre-operations to concrete operations around age six, marks a developmental change in humor allowing a child to respond to more abstract or conceptual incongruities rather than only to perceptual incongruities.

Given the hypothesized right hemisphere deficit, it is possible that children with NVLD might also experience difficulty in establishing cohesion. One goal of this study will be to determine if children with NVLD have deficits in humor similar to adults with RHD. If the deficits are similar, these children, like adults with RHD would either be more likely to choose nonsense endings or to be unable to distinguish between the true joke endings and the nonsense endings, choosing both in equal proportions. An additional question to explore is the predicted progression of the deficit: would the children with NVLD lag behind normal development or fail all together to develop the resolution phase of humor comprehension/appreciation?

Development of Perception and Humor

Visual/spatial Perception

Johnson (1990) found a significant relationship between mental rotation, which involves visual-spatial imagery, and humor processing in adults. One clear developmental trend is that younger children predominantly respond to and

produce humor involving motor stimuli and that this humor becomes increasingly more verbal as children develop (Bariaud, 1988; McGhee, 1971; and Sroufe, & Waters, 1976; Sroufe, & Wunsch, 1972). Although this finding would imply that the verbal abilities of children with NVLD would aid in the development of humor, their pragmatic verbal deficits probably inhibit this progression. Before verbal humor, children first appreciate the incongruities in nonlinguistic contexts such as funny faces or slapstick actions (Bernstein, 1986). These early forms of humor require visual-spatial or tactile perceptual abilities. As illustrated in previous sections, early visual-spatial deficits are thought to interfere with early dyadic reciprocity, which in turn leads to poor social competence. It is unclear how much the comprehension of earlier forms of humor may predispose or build one's ability to perceive and utilize humor or what effect this deficit will have on later social functioning.

Emotional Perception

Bariaud (1988) added the playful framework to the incongruity-resolution model of humor. He asserted that for an incongruity to be funny rather than disgruntling, startling, or even scary, there must be cues that place the incongruity in a playful or safe framework. The younger the child, the more obvious these cues must be. The cues are more necessary for younger children who often display a relatively uncertain understanding of reality. The cues indicate that the behavior is not a mistake or a bizarre rule to be incorporated. For example, when adults play "I'm gonna git ya" games with infants, they use exaggerated faces and voices and often proceed in slow motion especially when they are unfamiliar to the infant. These exaggerated cues become subtler as the child develops his or her ability to read the context and for adults, the cues may be almost nonexistent in their subtlety (Bariaud, 1988). He also asserts that a mutual complicity or sharing of the playful intent is necessary for the experience of humor, adding an

affective component to the cognitive explanation. One question not well understood is the effect of early humor delays and related difficulties in social interaction on later adjustment and humor development.

Problems in facial recognition, processing and correctly labeling affect, difficult with prosody, poor development of empathy are among the several examples of right hemisphere deficits that could interfere with perception of the playful framework and the engagement in emotional complicity necessary to experience humor. The "emotional inappropriateness" seen in adults with RHD is also documented anecdotally in reports of children with NVLD. In a major southwestern university, the absence of mutual complicity was evident in one twelve-year-old child's response to teasing from a peer: the child responded with rage to a playful comment. When explored further, it was evident that he paid attention only to the words and was not able to derive intent from the tone of voice, facial expression, body language, and surrounding context. Although, later he was well able to accurately identify the emotion conveyed when asked about each segment separately, he was not able to integrate the pieces of information nor able to derive the playful motivation on his own even after reviewing each individual characteristic.

Development of Verbal Humor

Bernstein (1986) presented the developmental progression of riddles as reported by Fowles and Glanz (1977). She asserted that initially, children's humor depends on the context rather than the language. Young children often cannot identify the critical element in a riddle or joke that renders it funny. Later in development, children begin to focus on the language in processing humor. Studies reviewed by McGhee (1971) showed that children do not begin joking in reference to speech patterns until ages three to four when they have achieved a high mastery of language. Generally, verbal play begins in children by age three

and silly rhyming by age four. Age six heralds the beginning of pre-made jokes, which may signify mastery of language that begins to approach an adult level. Bernstein (1986) cited a study by Sutton-Smith that found that in early elementary school, children tell riddles based primarily on semantic classifications or multiple meanings of words. By the end of elementary school, around age 11, the riddles reflect children's growing understanding of language as a system.

Researchers have offered many different classifications and developmental hierarchies of riddles varying in complexity. Pre-riddles are generally thought to develop first. In this stage, the child is thought to have developed a riddle format but responses are arbitrary (non humorous non-sequiturs) and are told and appreciated by 1st and 2nd graders (Bruno, et. al., 1987). This early type of humor incorporates crude incongruency but offers no resolution.

Example: Knock knock:……Who's there?
Orange:……Orange who?
Orange banana head.

Between the ages of six and eight, children are able to comprehend the first type of true riddle structure, phonological riddles. These riddles are dependent on the specific sound changes resulting in a change in meaning. This developmental stage signals a full mastery of phonetics. Studies of children with learning disabilities have suggested that these types of riddles are most difficult for this population (Bruno, et. al. (1987). If one assumes that the majority of these children have reading disorders, the difficulties found are logical extensions of the poor reading and pre-reading skills of this group. Difficulty with this type of riddle but not with more sophisticated levels, in a child with a reading

disability, strengthens the hypothesized link between reading skills and problems with phonological riddles.

Example: When do astronauts eat?

At launch time.

Lexical riddles are based on dual word meanings and are the main form of riddle told by 3rd or 4th graders (ages 8-10). In this type of riddle, the resolution is dependent on making the cognitive shift to reinterpret the key word. The following example requires a reinterpretation of the word "flies" to refer to baseball rather than the more commonly applied referent, the insect.

Example: What has 16 legs and catches flies?

A baseball team.

Riddles with complex cognitive incongruities are told by the upper elementary and middle school grades (ages 10 to 14). In these riddles, the humor is derived from an illogical resolution. Thus the resolution is the realization of violated expectations.

Example: What did the newscaster say after he announced that the world had come to an end?

Answer: Stay tuned. News at eleven.

Many authors divide the cognitive incongruencies further into specific linguistic incongruities such as surface structure, deep structure, and metalinguistic structure. There are no developmental distinctions between these types of riddles as all are thought to develop around age 12 or between the ages of 10 and 14. There is no information to suggest that subtypes of LD would perform differently on these categories, so in this study they have been collapsed into the general category of cognitive incongruities.

Language Development and Humor

"To understand humor, the listener must disregard the literal interpretation of an utterance and go beyond it to derive meaning from what is not explicitly stated" (Bernstein, 1986, p. 65). Children with NVLD display a relative strength in verbal abilities, but this strength is deceiving. The source of verbal humor involves multiple meanings of words, metaphors, idioms, detecting ambiguity and appreciating the unexpected or a sudden shift in perspective. In using and understanding figurative language, a person must first recognize the discrepancy between the figurative words and the literal truth (Demorest, Silberstein, Gardner, & Winner, 1983). This discrepancy constitutes the incongruency aspect of humor. Secondly, the listener must identify the communicative purpose, a social cognitive task (Demorest, et. al., 1983). Again, the linguistic aspects of humor contain incongruity, resolution and emotional complicity. These latter two aspects of verbal humor would probably preclude children with NVLD from using their verbal abilities to assist in their grasp of humor.

Difficulty in perceiving and communicating emotional prosody may also be partially related to the difficulties in humor. Johnson (1987) reported that these children might have little inflection or may laugh or talk too loud. Sarcastic and teasing statements are often taken literally because these children do not get the nonverbal messages of humor conveyed by context and tone.

Processing figurative speech may be particularly difficult for children with NVLD because of the dual semantic and pragmatic processing involved. According to Burgess & Chiarello (1996), comprehension of figurative language involves a dynamic interplay between bottom-up, memory based, semantic activation of word meaning, and top down pragmatic constraints of the context. The right hemisphere activates more slowly, more broadly, and for a longer period of time, which results in a right hemispheric advantage in retrieving weak

or indirect word meanings as are found in metaphors and humor. The rapid and inflexible retrievals style of the left hemisphere also serves to limit individuals with RHD to the original interpretation of words and phrases.

The second dynamic contributing to difficulty is the top-down processing of the pragmatic information inherent in a social context. It seems that the RH has a distinct advantage in processing the cues that reveal the intent of the communication (Burgess & Chiarello, 1996). It is important to note that RHD patients could explain the context and the figurative language. For example, they could explain the difference between a lie as intended deceit and humor and they could explain metaphors when pushed to do so. This ability indicates that they may have the appropriate skills but they may not "know when to know" and suggests a combination of the rapid and inflexible response of the LH and the inability of the LH to adequately process context.

Social Competence and Humor

Several researchers have tied humor to social competence under the general categories of divergent thinking and social comprehension or through the connection specifically between humor and intelligence, motivation and peer relationships (Masten, 1986; Waters & Sroufe, 1983). By breaking down the areas of cognition, perception, and language, it seems that humor is related in a unique way to each of these developmental constructs. This delineation helps, perhaps better explain the role of humor in the social interaction of children. Humor in children is tied more closely to these constructs, as they are still experiencing major developmental changes.

Masten (1986) found that humor production, comprehension and mirth were positively related to academic and social competence. Her results suggested that cognitive abilities account for most of the relationship between academic and social competence and humor. Masten suggests that social awareness or "social

cognition" may mediate humor and overall social competence. Although humor was not thought to contribute directly to academic competence, mirth was significantly related to IQ and performance anxiety even when other factors were controlled. She concludes that intellectual ability or motivation towards mastery may mediate humor and competence. She also indicates that social competence and humor are positively related, each influencing the other.

HUMOR IN SPECIFIC POPULATIONS

Children with Learning Disabilities

A few studies have found support for poorer humor comprehension and appreciation in learning disabled populations, but these studies did not differentiate between different subtypes of LD (Bruno, et. al., 1986; Pickering, Pickering, & Buchanan, 1987; Short, et. al., 1993). Thus, it is unclear whether humor deficits may be associated with all LD or a specific subtype. In general, children with LD respond to humorous stimuli with less comprehension and do not differentiate between funny and non-funny stimuli in their display of mirth. Thus as children with LD lack the ability to distinguish between humorous and nonhumourous stimuli and develop a response set to stimuli generally perceived to be humorous to compensate for lower comprehension. One unexplored question is whether humor difficulties in the learning disabled population represents a deficit or a delay.

Autism, Down Syndrome, and Mental Retardation

One study of mental retardation (MR) and humor suggests that delays are proportionate to cognitive ability and do improve ipsatively over time, though the scores remain delayed when assessed normatively (Short, et. al., 1993). Another study comparing children with Down Syndrome and Autism found markedly

fewer humorous episodes for the autistic group despite significantly higher nonverbal cognitive abilities (St. James & Tager-Flusberg, 1994). Similarly, the children with Down Syndrome engaged in more episodes of verbal and nonverbal incongruity and produced the only jokes noted in the interactions. The group differences were wider at the older ages suggesting that, in autism, the problems with humor may represent a deficit rather than a delay.

Attentional Deficits

There are no studies specifically looking at humor and ADHD. However, Brodzinsky (1975) has studied children with different sets of conceptual tempos: Fast/slow tempo and accurate/ inaccurate responses. A fast tempo/ inaccurate response style may correspond to ADHD, hyperactive/impulsive type whereas slow accurate may correspond to ADHD/ inattentive type, though this attribution is less clearly defined. Similarly to the findings for LD children, Brodzinsky generally found lower comprehension and higher mirth for the fast/inaccurate group, indicating a "this is a joke" mindset (Brodzinsky, 1975; Brodzinsky, Tew & Palkovitz, 1979). It seems likely that any difficulties in humor comprehension by children with ADHD is due to a slight delay in emotional maturity and the disinhibition, which may lessen the attention and thus the comprehension.

There is a considerable overlap between some characteristics of ADHD and NVLD. Voeller, et. al. (1995) found that most of their children with profiles of developmental right hemisphere syndrome had concurrent ADHD. They did not differentiate between ADHD subtypes but the described slowness in routine performance suggests predominantly inattentive type (ADHD/PI). This overlap is an area for further research.

Summary

Although not previously studied, the proposed humor deficit in children with NVLD is interesting because it captures the essence of the social difficulties associated with these children. There is a strong connection between the appropriate comprehension and appreciation of humor and social competence (Masten, 1986). This connection has long been intuitive and is validated both through examination of the social functions of humor as well as the development of humor in children. Humor development in children is inextricably linked to their cognitive, perceptual and linguistic development. In examining these areas, it seems evident that children with NVLD experience a deficit in humor not just due to delayed development, but also due to the very deficits that define the disorder. The goal of this study was to examine whether a humor deficit exists in these children, and if so, the type and extent of the deficit.

Hypotheses

Research Question 1: Do children with NVLD show greater difficulty with humor comprehension as measured by performance on the humor test than children with VLD or the typically developing (TYP) group of children with no LD?

Hypothesis 1a: Children with NVLD will make more errors on the humor task (both joke and cartoons) than children in the TYP group.

Hypothesis 1b: Children with NVLD will make more errors on the humor task (both joke and cartoons) than children in the VLD group.

Research Question 2: Do children with NVLD show a difference in humor comprehension across modalities (verbal and verbal plus visual) as compared to children with VLD and a TYP group?

Hypothesis 2a: There will not be a difference in error rate on the verbal modality (Jokes) between children with NVLD and children with VLD.

Hypothesis 2b: Children with NVLD will make more errors than the VLD group on the verbal plus visual modality (cartoon).

Hypothesis 2c: Children with NVLD will make more errors than the TYP group on both modalities (cartoon and jokes) of humor.

RESEARCH QUESTION 3: Do children with NVLD choose more non-sequitur responses than children in the VLD or TYP group?

Hypothesis 3a: Participants in the NVLD group will choose a greater percentage of non-sequitur (NS) endings than the VLD group (as measured by NS endings divided by total number of errors.)

Hypothesis 3b: Participants in the NVLD group will choose a greater percentage of non-sequitur (NS) endings than the TYP group (as measured by NS endings divided by total number of errors.)

Hypothesis 3c: Participants in the NVLD group will choose a smaller percentage of straight answer (SA) endings than the VLD group (as measured by NS endings divided by total number of errors.)

Hypothesis 3d: Participants in the NVLD group will choose a greater percentage of straight answer (SA) endings than the TYP group (as measured by NS endings divided by total number of errors.)

RESEARCH QUESTION 4: Do children with NVLD differ in humor comprehension across verbal categories as compared to children with VLD and the TYP group?

Hypothesis 4a: Children with NVLD will make more errors than the VLD group on the jokes based on lexical and cognitive incongruities.

Hypothesis 4b: Children with NVLD will make fewer errors than the VLD group on the jokes based on the phonological errors.

Hypothesis 4c: Children with NVLD will make more errors than the TYP group on all three categories of verbal jokes.

CHAPTER III: METHOD

Chapter III is divided into four major sections: *Participants, Instrumentation, Statistical Analysis* and *Hypotheses.* The *Participants* section includes demographic information, criteria used to establish group membership and the data collection procedures. The second section, *Instrumentation,* includes the descriptions and associated psychometric properties of the independent measurement instruments used for group selection. The development and properties of the humor instrument used as the measure of the dependent variable is also discussed in this section. In the third section, *Statistical Analysis*, the parametric techniques that were used to test the hypotheses are presented. In the final section, *Hypotheses,* the research questions and hypotheses for this study are reviewed in terms of how they were tested.

Participants

DEMOGRAPHICS

Fifty-five students participated in the study. These subjects were chosen to represent three groups, those with visual spatial perceptual deficits (NVLD), those with language-based learning disabilities (VLD) and a control group of typically developing children (TYP). The number of participants was 20, 15 and 20 in each group respectively and included 41 males and 14 females between the ages of 12 and 15. Of this sample, 22 of the children were diagnosed with ADHD. The mean age was 12.96 and the mean IQ was 104.85 with a standard deviation of 11.55. Table 2 outlines the breakdown for ADHD diagnosis per group.

Table 2: ADHD Diagnosis Breakdown Per Group

	ADHD	No ADHD	Totals
NVLD	7	13	20
VLD	6	9	15
TYP	9	11	20
Total participants	22	33	55

RECRUITMENT

The majority of the 55 participants for this study (n = 35; 64%) were part of an ongoing research project at the University of Texas at Austin (UT). The research project is designed to provide information on social cognition in children with different types of learning disabilities or attentional deficits. The author of this study serves as a primary researcher on this aspect of the project under the direction of Margaret Semrud-Clikeman, Ph.D. The Institutional Review Board (IRB) form for this project is provided in Appendix C.

As outlined in the IRB, the referral sources for the project included: School personnel from the Austin Independent School District (AISD), Eanes Independent School District (EISD) and Rawson Saunders School; Austin Neurological Clinic (ANC); Children's Hospital of Austin (CHOA); and Community referrals.

The remaining 20 participants for the study (36%) were recruited through the Autistic Spectrum Disorder Clinic and the Neuropsychology Clinic of the Fairview Hospital System and University of Minnesota Medical School (UMN) as part of a study of Autism under the direction of Elsa Shapiro, Ph.D. and under the direct supervision of Teresa Harrison, Ph.D. The IRB form for this project is provided in Appendix C.

PROCEDURE

Data Collection

In the UT study, recruitment of participants was initially achieved through record review of children with known learning disabilities and later through community outreach with seminars about NVLD and other issues related to social cognition. Students were referred to or contacted by the investigator on the basis of suspected NVLD. The two comparison (VLD & TYP) groups were selected from the larger special education program, the ANC and from the general AISD population through referral. Following identification of potential participants, a letter inviting families to participate and parental consent forms were mailed or delivered to parents of potential participants. As this study has spanned several periods of IRB renewals, there have been changes made to the consent forms and letters. An example of the AISD letter and the most current consent form are included in Appendix D.

Parents who wished their children to participate in the study returned the registration form to UT or called the number provided. Once the form or phone call was received, a member of the research team contacted the parent(s) to determine if the student met age and symptom eligibility criteria. If criteria were met, a Parent Packet was sent to the family and the assessment was scheduled. The parent packet included behavioral questionnaires, a parent consent form, and a student assent form (see Appendix E). For all participants, the content of the consent and assent forms was individually reviewed to ensure full comprehension. All participants and their parents were informed that participation was voluntary and could be withdrawn at any time without penalty.

All data entry and analysis utilized coded identification numbers rather than student names in an effort to protect confidentiality. All protocols and questionnaires were secured in a locked file cabinet in the office of the lead

investigator for the overall UT study, Margaret Semrud-Clikeman, Ph.D. The computer database containing test scores (minus identifying information) was password protected on the computer of the lead investigator. The data used to qualify participants as meeting criteria (minus the identifying information) were secured in a locked file cabinet in the office of the lead investigator of this study. All interviews and assessments were conducted at either the student's school, home, or in the School Psychology Program assessment rooms depending on parent preference. Once testing was completed, a brief written report summarizing assessment results was mailed to the parents.

All children from the larger UT study were given the full assessment battery including the humor task (See Appendix F for list of measures), which took approximately three hours. Graduate students trained in standardized test administration conducted all testing. A small percentage of UT participants were given the humor test at the same time as the administration of the full test battery (N = 10). The remainder of the children were administered the humor measure on a separate day, before or after the battery administration.

In the other major recruitment resource (UMN), families evaluated by the Autistic Spectrum Disorders Clinic or the Neuropsychology Clinic signed a letter at the time of their initial visit indicating their willingness to allow their records to be reviewed for ongoing or future research purposes. Using archival data, participants were selected based on the study criteria and a letter was mailed informing the identified family that the principle investigator would contact them. In addition, flyers were posted on hospital bulletin boards and local community centers asking for volunteers. In the initial contact, the participants were informed that their decision to participate would not have an impact on their treatment or their relationship with the hospital or clinic.

Children in the control group generally did not have previous testing and were administered a short battery comprised of the measures used to identify the

appropriate group classification. This abbreviated test battery took approximately an hour and a half, including the dependent measure. Testing was conducted either by the lead investigator or by an assistant, a doctoral level graduate student trained in test administration and enrolled at the University of Minnesota (UMN). The assistant was supervised for the first test administration to ensure proper test procedures were followed and then paid per test battery administered.

All protocols and questionnaires were secured in a locked room in the Neuropsychology offices. Data used to qualify participants as meeting criteria were secured in a locked file cabinet in the office of the lead investigator. The computer database containing test scores, minus identifying information, was password protected on the computer of the lead investigator. All interviews and assessments were conducted at either the student's school, home or in the Pediatric Psychology Clinic assessment rooms, depending on parent request. Once testing was completed, a brief written report summarizing the test scores was completed and mailed to the parents.

Administration and Scoring

Test administrators had graduate level training and experience using all of the instruments. The independent measures were administered according to the standardized procedures developed for each. Additional training on test administration procedures for unfamiliar measures was provided for student researchers as needed. The humor measure was administered according to the procedure outlined in the measures section.

If assessment data on cognitive and academic ability was available and had been administered to the child after the age of eight years old, it was used to classify the participants into groups. Some students were re-administered measures in a one-on-one testing environment upon parental request or if the previously gathered data were thought to estimate ability inaccurately as

documented by assessment reports. For example, one participant had previous test scores that were thought to underestimate his cognitive skills due to ADHD and was re-administered the IQ test. Participants who had valid test scores were not asked to repeat those measures and the previous test scores were accepted.

Group Criteria

Participants selected for the study were required to earn a Full Scale IQ (FSIQ) score of 85 or higher. Research has shown that individuals with intellectual limitations may be limited in their ability to comprehend humor as well (Bruno, et. al., 1987; Masten, 1986 and McGhee & Chapman, 1980). Thus, participants who obtained IQ scores below 85 were excluded from the study. All participants were identified as being primarily English speaking and free of gross neurological, sensory, and psychotic disorders according to parental report of medical history. Children with pre-diagnosed Major Depressive Disorder, or severe anxiety disorders were excluded from all groups because both of these disorders can have a strong negative effect on learning, social interactions, and humor and could affect the results. Participants with multiple learning disabilities were also excluded to increase the homogeneity of the LD groups. All participants were pre-dominantly right handed, with one exception from the VLD group.

The age range of 12-15 was selected because by the age of 12, in typically developing children, humor is expected to include the more sophisticated linguistic and humor elements (McGhee & Chapman, 1980). Prior to age 12, group differences would be difficult to determine because several elements of humor are not expected to have developed. Additionally, in previous studies of humor conducted with children less than 12 years of age, differences between normally achieving children and learning disabilities were not pronounced (Bruno et al., 1987).

Eight additional children completed the humor measure for the study but their protocols were not included in the data set for the following reasons: two children had achievement scores suggesting multiple learning disabilities, one child had a diagnosis of Major Depressive Disorder, and one child showed a math disability but did not meet criteria for the NVLD group. The remaining four participants were administered the humor measure as part of the general test battery, but were excluded because they did not fit within the set age range.

There is debate on the relation between NVLD and ADHD. Subtypes of ADHD are thought to have a high co-morbidity rate with subtypes of LD, particularly with NVLD. There is little evidence that ADHD alone has a negative effect on humor comprehension, although some studies support delays in humor comprehension by children with fast, inaccurate response styles (Brodzinsky, 1975, 1977). Thus, children with the diagnosis of ADHD, as determined pre-referral or through the battery screening, were tracked and examined in post hoc analyses.

NVLD Group

There is extensive debate about what characteristics are associated with NVLD and clearly defined diagnostic criteria have yet to be established (Little, 1991; Semrud-Clikeman & Hynd, 1990). Criteria used in previous studies have included a split between verbal and nonverbal skills (VIQ > PIQ); delays in math skills, delayed visual spatial skills, delayed motor development, and delays in pragmatic language (Semrud-Clikeman & Hynd, 1990). In 1994, Harnadek and Rourke identified intact verbal skills with deficits in visual-perceptual organization and psychomotor coordination and complex tactile perceptual skills as the most discriminative features of NVLD. Based on Harnadek and Rourke's (1994) findings, these features were operationalized in consultation with a fellow researcher (Corlett, 2003). Given the comparison group of children with reading

disabilities, an additional criterion of age appropriate reading skills was also added. Participants selected for the NVLD Group were chosen based on meeting the following criteria:

1. Average cognitive functioning (FSIQ $\geq$ 85).
2. Age appropriate verbal skills as measured by an average standard score ($\geq$ 85) on the Vocabulary subtest of the WISC-III.
3. Age appropriate reading skills as measured by at least an average standard score of ($\geq$ 85) on the basic word reading subtest of one of the following standardized reading achievement tests: the WIAT, the WJ-R, or the WJ III, and no history of reading problems as documented by school records.
4. Impaired performance in at least two of three areas of functioning:
   - Visual spatial skills as measured by a below average standard score (< 85) on the Block Design subtest of the WISC-III.
   - Visual organizational skills as measured by a below average standard score (< 85) on the Rey Osterreith Complex Figure Drawing (ROCF).
   - Graphomotor skills as measured by a below average standard score (< 85) on the Beery Developmental Test of Visual Motor Integration (VMI).

Although poor social skills are considered a defining feature of NVLD, this study did not use this characteristic initially to define the groups because humor and social skills are not thought to be independent traits.

VLD Group

Participants for this group were selected on the basis of having a reading learning disability as assessed previously by their school district or according to

the assessment conducted as part of the larger research studies using the following criteria:

1. Average cognitive functioning (FSIQ $\geq$ 85).
2. Below average reading scores (<85) on a standardized achievement test (WIAT, WJ-R or WJ III), with a discrepancy of at least 16 points (IQ > Achievement) according to the Texas criteria for a LD in reading.
3. To restrict multiple learning disabilities, participants had age appropriate math skills as measured by a standard score of average or above average math composite scores ($\geq$ 85) on a standardized achievement test (WIAT, WJ-R or WJ III).
5. Performance within the normal range in at least two of three areas of functioning:
   - Visual spatial skills as measured by a standard score of $\geq$ 85 on the Block Design subtest of the WISC-III.
   - Visual organizational skills as measured by a standard score of $\geq$ 85 on the ROCF.
   - Graphomotor skills as measured by a standard score of $\geq$ 85 on the VMI.

TYP Group

Control participants were those children who did not meet criteria for NVLD or VLD, had no history of learning difficulties according to parental report and had at least average school performance. Math and reading screening subtests were administered to rule out undiagnosed learning disorders. Those students who achieved below average scores ($\leq$85) on one or both of these screeners were given the full battery to more fully assess academic functioning in math or reading using one of the following standardized achievement tests.

Participants for the TYP Group were required to demonstrate:

1. Average cognitive functioning (FSIQ $\geq$ 85).
2. Age appropriate verbal skills as measured by a standard score of $\geq$ 85 on the Vocabulary subtest of the WISC-III.
3. No history of learning difficulties as verified by parental report and at least average performance ($\geq$ 85) on an academic screener for math and reading in a standardized achievement test (WIAT, WJ-R or WJ III).
4. Performance within the normal range in at least two of three areas of functioning:
    - Visual spatial skills as measured by a standard score of $\geq$ 85 on the Block Design subtest of the WISC-III.
    - Visual organizational skills as measured by a standard score of $\geq$ 85 on the ROCF.
    - Graphomotor skills as measured by a standard score of $\geq$ 85 on the VMI.

Instrumentation

CLASSIFICATION MEASURES:

When available, scores from previous assessments administered after the age of eight were used to classify students. For measures not previously administered, assessment was conducted by graduate students trained in standardized testing procedures and specifically trained in administration of the instruments included in this battery.

Wechsler Intelligence Scale for Children- Third Edition: (WISC-III; Wechsler 1991)

The WISC III is an individually administered, standardized test battery that provides a comprehensive assessment of cognitive functioning. The full administration includes 13 subtests and its long administration time often precludes its use when testing time is limited such as for research purposes. Therefore, two specific subtests, block design and vocabulary, were used and the scores were totaled and prorated using tables in Sattler 2001 to determine an overall IQ score. The short form of the WISC-III consisting of two subtests vocabulary and block design has been found to have the highest overall correlation with the Full Scale IQ score (.91 and.86 respectively) with a reliability and to correlate adequately with the Full Scale IQ (Sattler, 2001). Thus, this abbreviated form of the WISC-III was administered to those test participants who did not have test results administered after age eight. In addition to establishing a prorated FSIQ, the block design and vocabulary subtests were used to establish whether age appropriate verbal skills existed in the presence of relatively lower visual spatial skills.

Wechsler Individual Achievement Test (WIAT, The Psychological Corporation, 1992)

The WIAT is an individually administered achievement test for children between the ages of five and nineteen that was co-normed with the WISC III. The WIAT consists of four subscales (Reading, Mathematics, Language, and Writing Composites), which combine to form a total composite or total achievement score. According to Spreen & Strauss (1998), split half reliability coefficients for subtest and composite scores were moderately high, ranging from .69 to .98 and correlation coefficients with other achievement tests were generally above .70. Sattler (2001) reported internal consistency reliability coefficients ranging from .79 to .95 for individual subtests and reported correlation coefficients ranging from .67 to .88 with other tests of achievement (Sattler, 2001).

Woodcock Johnson Psychoeducational Battery, Revised: Tests of Achievement (WJ-R, Woodcock & Mather, 1990).

The Woodcock Johnson Psycho-educational Battery, Revised: Tests of Achievement (WJ-R) is a standardized, individually administered achievement test with an age range from three to adulthood. The WJ-R consists of four subscales (Reading, Mathematics, Written Language, Academic Knowledge and Academic Skills). Split half reliability coefficients for subtests and clusters are high ranging from .80 to .90 (Sattler, 2001; Spreen & Strauss, 1998). Moderate to strong validity is reported with correlation coefficients ranging from 0.5 to 0.70 with other tests of achievement.

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

The Rey Osterrieth Complex Figure Drawing (ROCF) is a measure of visual-constructional ability. The full administration of the test (copy, immediate recall and delayed recall) permits assessment of a variety of cognitive processes including executive functioning skills as well as perceptual, visual-motor and memory functioning. However, for this study, only the copy portion of the test was administered to assess perceptual, visual-spatial and organizational skills. To assess accuracy and placement, the Taylor scoring system criteria was used to obtain standard scores. According to Spreen and Strauss (1998), test-retest reliability coefficients were moderately high (r=.76). Validity was assessed through comparison to a variety of tests measuring different aspects of the skills the ROCF purports to measure. A copy of the ROCF is included in Appendix G.

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

The VMI was selected to provide a measure of graphomotor skills. The participant is asked to copy 24 line drawings of geometric shapes presented in a developmental trend of increasing complexity, beginning with a vertical line and progressing to a three-dimensional cube with an age range from 3 years of age to adulthood. Validity studies of VMI that focused on correlations with other tests of visual motor integration have shown correlation coefficients ranging from .29 with the Comprehensive Tests of Basic Skills to .93 in some studies with the Bender Gestalt test. Spreen & Strauss (1988) reported an inter-rater reliability coefficient of .79. For this study, the 27-point scoring system from the 1997 VMI manual was used.

Child and Adolescent Social Perception (CASP, Magill-Evans, Koning, Cameron-Sadava & Maynk, 1996).

The CASP is a measure of social perception that was part of the larger UT study battery. The scores were used in this study post hoc to provide a means of dividing the NVLD group into those with and without social perception deficits. The CASP is a videotape of 10 vignettes of different social situations with alterations in the audio such that intonation is clear but the verbal content is not. The child was asked to tell the examiner what is happening in each vignette; what the characters are feeling and what information the child used to determine the emotions. For example, if the child responded that one of the characters was sad, he or she was asked how he or she could tell that the person was sad. The responses are then coded by trained examiners, generating two scores. The Total Emotion score (TES) measures the accuracy of facial emotion recognition. The Nonverbal Cues score (NCS) is based on the child's ability to accurately identify the salient nonverbal cues. Reliability is assessed to be moderately high with an internal consistency coefficient of 0.88 for the TES and 0.91 for the NCS. Test-

retest reliability coefficients ranged from 0.83 for the TES and 0.87 for the NCS. Inter-rater reliability coefficients ranged from 0.94 to 0.99 for the TES and 0.94 for the NCS. Information gathered on boys with Asperger Syndrome (AS), suggests that boys with AS perform 1.5 standard deviations below the mean on the TES and 3 standard deviations below the meaning the NCS.

Dependent Measure

The Humor Task is comprised of a verbal joke section and a cartoon with captions section (See Appendix H).

DESCRIPTION

The verbal joke section was adapted with permission from the humor task used by Bruno, et al. (1988). These jokes originally included three types of verbal humor (phonological, lexical, and complex cognitive incongruity) and a choice of two endings: a funny choice (correct) and a straightforward (incorrect) choice. For each item, a non-sequitur (nonsense) ending was added and tested as described below. Each item consisted of a joke stem, and a choice of three endings: funny choice (FC), straightforward choice (SC), and non-sequitur (NS).

The cartoon section is comprised of cartoons used with permission from the comic strip Calvin and Hobbes created by Bill Waterson (Andrews & McMeel, Universal Press). The examiner chose the items with the assistance of two normally achieving 13 year olds. The children were asked to pick out the funniest and most comprehensible of several hundred cartoon strips with a goal of picking 24 cartoons. For consistency, all cartoons chosen had four frames with the last frame containing the "punchline" (the incongruity and resolution). Distracter endings were developed for each item including a straight answer and non sequitur ending. The examiner developed error choices (SC and NS) based on humor literature and input from a fellow researcher. Each item included three

original frames and a choice of three endings: funny choice (FC), straightforward choice (SC), and non-sequitur (NS).

PILOT STUDIES

A pilot study was conducted in two phases. In the initial phase of the pilot study, 12 jokes adapted with permission from jokes used by Bruno, et. al., (1988) and 24 cartoons were shown to a convenience sample of 8 typically developing 11 to 14 year olds. The inclusion criterion for the pilot study was parental identification of the children as not having a diagnosis of LD.

In the first phase of the pilot study, participants were asked to rate the endings that made the jokes funny and asked which ending was the least related. Only items with non-sequitur endings rated least related by 7 out of 8 of the participants were included in the measure. During this phase, many of the initial jokes from Bruno, et. al. (1988) with the added non-sequitur endings did not result in a majority of the participants choosing the correct endings. Thus, additional verbal jokes were added for a total of 36 jokes and these were administered to the initial pilot participants. In the second phase of the pilot study, a convenience sample of 7 additional participants were administered the 36 jokes and 24 cartoons.

The results from all pilot participants were then combined for analysis. Pilot study participants included 5 males and 10 females with an average age of 13 years. The proportion of correct responses expected by chance with three choices is .33. Items with correct response rates of less than 75% from all pilot participants were discarded. Two of the jokes were discarded despite a high rate of correct responses because several of the participants expressed familiarity with the jokes. For six of the items, all participants made correct choices and these items were retained.

Error rates were calculated for all remaining items and those items with less than 85% correct responses were discarded. Of the jokes with 85% or higher correct responses, three were chosen to represent each of the three types of verbal humor for a total of 12 jokes. Nine cartoons met the above criteria. A reliability test of internal consistency was run using Cronbach's alpha with a resulting reliability coefficient of .82. Although no measures of humor comprehension were available for comparison, this measure correlated with FSIQ at .48, consistent with the .55 correlation coefficient reported by Masten (1986) between FSIQ.

ADMINISTRATION

For the humor measure, the administration procedure was based on a similar study of adults with brain damage, conducted by Bihrle, et. al. (1986). The items were presented in a booklet format so as to preserve consistency of presentation order (see Appendix H for the full measure). The joke task was presented first because it was less complex than the cartoon task. Within each modality (joke or cartoon), items were administered to each participant in the same random order. The order of the items and the individual item choices was determined using computer generated random numbers. In the pilot and final study administration, the children were asked to pick their favorite cartoon and joke and explain why their selected answer made the joke funnier. However, after several administrations, it was clear that the participants were largely unable to explain their responses and this procedure was discontinued.

For the joke section of the humor test, joke stems were listed followed by the three endings in a multiple-choice format. The participant was asked to "pick the ending that makes the joke funny." If more than one choice was indicated, the participant was instructed to pick the funniest response. In the cartoon task, for each item, the participant was presented with a three panel cartoon stem with

three different endings (FC, NS, & SA) underneath the stem and asked to "choose the ending that makes the cartoon strip the most funny."

To control for differences in reading ability between groups, the participant was asked to read each joke and cartoon stem as well as the three choices aloud. The examiner read any word that the participant paused on and read all items if the participant struggled with over 25% of the words (by examiner approximation). If the participant was reluctant to read the items aloud or missed a number of words, the examiner read all of the verbal material aloud.

All answers were recorded on a separate response sheet and scored according to number of errors (total, cartoons, and jokes), types of errors (straight answers, or non-sequitur answers), and number of errors for different joke types (phonological, lexical, or cognitive incongruity).

CHAPTER IV: RESULTS

Chapter IV is divided into three major sections. In the first section, the results of preliminary analyses[3] are reviewed, including individual characteristics of the participants such as age, IQ and ADHD status. Distribution of variables across groups was also examined in this section. In the second section, the results of tests of the hypotheses are presented. Primary analyses did not reveal significant findings, however, changes were made to the groups in post hoc analyses, which resulted in significant findings. The third section presents the post hoc analyses. Data analyses were conducted using SPSS, version 10.0 for the Macintosh (SPSS 2000).

Preliminary Analyses

DEMOGRAPHICS AND GROUP MEAN DIFFERENCES

The participants ranged in age from 12 years, 0 months to 15 years, 7 months with the mean age of 12 years, 10 months (SD = 9 months). The average FSIQ score was 104.85 (SD = 11.55). The median is provided for IQ because it is a better measure of central tendency given wide variability of scores.

As age and IQ can contribute to differences in humor comprehension, one-way ANOVAs were used to test for mean differences between the NVLD, VLD and TYP groups on these variables. As shown in Table 4, statistically significant differences were not found between the NVLD, VLD and TYP groups based on age; $F(2,55) = 0.93$, $p = 0.40$. However, a statistically significant difference was found for Group by IQ, $F(2,55) = 7.82$, $p = .001$. The Tukey HSD procedure was used as a post hoc analysis as a conservative measure to determine which pairs of

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

groups differed. A statistically significant difference was found at the .05 level between the TYP group and both the NVLD and the VLD groups. As shown in Table 3, the FSIQ scores for the TYP group were higher than the FSIQ scores of VLD or the NVLD group. Statistically significant differences were not found between the FSIQ scores of the VLD and NVLD groups.

Table 3: Group Differences on Age and IQ

	Group	Mean	Median	SD
IQ				
	NVLD	99.2 $_C$	97	11.66
	VLD	103.1 $_C$	101	8.27
	TYP	111.9	113.5	10.25
Age*				
	NVLD	13.6*	13.0	1.17
	VLD	13.5*	13.5	.99
	TYP	13.1*	13.2	.80

C = indicates that this group differs significantly from the TYP group.
* age was translated from months into years and months

To further explore group differences, chi-square tests were conducted on each of the following variables used to assess distribution of gender, ADHD diagnosis, and location of testing (UT or UMN) across the three groups (NVLD, VLD, and TYP). In addition, "time of administration" was coded into the categories of "simultaneous" and "separate" to indicate whether the participant was given the humor measure during the full battery (simultaneous) or in a separate administration (separate).

Results of the preliminary analyses showed no statistically significant associations between group membership and any of the first three variables (gender, ADHD diagnosis, or location). There was a statistically significant association between "time of administration" and group membership, χ^2 (2, N = 55) = 18.15, $p < 0.001$. The children in the two LD groups were more likely to

have available test scores and most did not require additional assessment, thus were more likely to have separate test administration whereas children in the TYP group were more likely to have simultaneous testing. 0nly nineteen children received the humor measure at the same time as the full three-hour test battery (simultaneous) and of those, eight children were in the TYP group. Six of the participants in the TYP group were recruited from the Minnesota location and all received the humor measure at the same time as they received the shortened battery (one and one half hours). Table 4 provides the breakdown of group membership and time of administration:

Table 4: Time of Administration by Group

	Administered simultaneously	Administered separately	Total
TYP	14	6	20
VLD	1	14	15
NVLD	4	16	20
Total	19	36	55

CORRELATIONS AMONG VARIABLES

Statistical analyses were conducted to determine the extent of the relationship between Age, IQ, and the dependent variables beyond group membership. Age was not significantly correlated with any of the dependent variables, as expected given the narrow age range. However, as expected, significant negative correlations were found between FSIQ scores and total number of errors, number of joke errors, number of cartoon errors, number of straight answers, number of non-sequitur responses, number of lexical joke errors, and cognitive incongruities, as listed in Table 5. The number of phonological errors was the only dependent variable not statistically significantly correlated with IQ. Given the moderate correlation of 0.48 between the FSIQ score and total error rate on the humor measure, FSIQ was included as a covariate for the primary analyses.

Table 5: Correlations of Dependent Variables with FSIQ

	Correlation	p
Total errors	-0.48	< .00
Joke errors	-0.42	.001
Cartoon Errors	-0.43	.001
Straight Answer Responses	-0.39	.001
Non Sequitur Responses	-0.47	< .00
Phonological Errors	-0.23	.096
Lexical Joke Errors	-0.42	.001
Cognitive Incongruity Errors	-0.41	.002

To further assess for factors that might contribute to differences in group scores, the participants were grouped by location, gender, ADHD, or time of test administration rather than by disability status (NVLD, VLD or TYP) and analyzed for differences on the dependent variables. Statistically significant differences were not found using Univariate Analysis of Variance (ANOVAs) for any of the dependent variables.

Tests of Hypotheses

Research Question 1: Do children with NVLD show greater difficulty with humor comprehension as measured by performance on the humor test than do children with VLD or the TYP group of children with no LD?

The results of the ANCOVA with FSIQ as a covariate showed no statistically significant differences between group means on total errors F (2, 55)= 0.12, p = 0.89. These findings failed to support the hypothesis that the NVLD group would have a higher error rate than the VLD group (Hypothesis 1a) or the TYP group (Hypothesis 1b). However, the standard deviation and range were quite large for the NVLD group compared to the other two groups and the Levene test of Equality of Error Variance was statistically significant, indicating differences in error variance between the groups. These findings suggested that one or more of the groups was less homogeneous than the other two groups. This

interpretation led to the need for several post hoc analyses, aimed at explaining the lack of significant findings. These analyses and results are reported in detail in the following section, *Post Hoc Analyses.*

Table 6 provides the descriptive statistics for each groups including the means, medians, standard deviations and sample sizes. The median is included in all of the following tables because it is a better measure of central tendency given the wide variability of scores.

Table 6: Descriptive statistics Total Errors by Groups with FSIQ as covariate*.

	TYP	VLD	NVLD	COMBINED TOTALS
Mean	3.30	4.20	5.30	4.27
Median	2.00	4.00	3.50	3.00
Std. Dev.	2.70	2.11	4.89	3.59
Range	9.00	7.00	15.00	15.00
N	*20*	*15*	*20*	*55*

* errors out of 18

RESEARCH QUESTION 2: Do children with NVLD show a difference in humor comprehension across modalities (verbal and verbal plus visual) as compared to children with VLD and a TYP group?

The results of the ANCOVA test with FSIQ as a covariate showed no statistically significant differences between group means on Joke Error Rate F (2, 55)= 0.11, p = 0.89. There was no statistically significant difference between the mean error rate of jokes between any of the three groups, as predicted in Hypothesis 3a, a finding that fails to support the research prediction that the two learning disabled groups would perform more poorly on the humor measure than the TYP group on joke modality (verbal humor). The Levene test of Equality of Error Variance was significant for number of joke errors, however, indicating

differences in error variance between two or more of the groups; *F (*2,55)= 4.07, p= 0.02.

The groups did not differ in error rates on the cartoon task (verbal plus visual modality); F (2.55)= .265, p= 0.08, resulting in a failure to reject the null hypothesis of no group differences. Table 7 provides the means, medians and standard deviations for each group. The median is included in all of the following tables because it is a better measure of central tendency with wide variability of scores.

Table 7: Descriptive Statistics of Joke and Cartoons Errors by Group:

	TYP	VLD	NVLD	Total
Joke Error Rate				
Mean	1.75	2.47	3.10	2.44
Median	1.50	2.00	1.50	2.00
Std. Dev.	1.74	1.88	3.06	2.37
Range	5.00	7.00	9.00	9.00
Cartoon Error Rate				
Mean	1.55	1.73	2.20	1.84
Median	1.00	2.00	1.50	1.00
Std. Dev.	1.47	1.28	2.14	1.70
Range	5.00	4.00	7.00	7.00

RESEARCH QUESTION 3: Do children with NVLD choose more non-sequitur (NS) responses than straight answers (SA) as compared to children in the VLD or TYP group as suggested by research on adults with RHD?

The results of the ANCOVA with FSIQ as a covariate did not show statistically significant differences between group means on Error Type for percent of non-sequitur error choices; F (2, 55)= 1.93, p = 0.38 or for percent of straight answer error choices; F (2,55)= 0.24, p= 0.79. The Levene test of Equality of Error Variance was significant when the group means for number of

SA choices were compared. Table 8 provides the means, medians and standard deviations of SA and NS responses for each group.

Table 8: Descriptive Statistics of NS and SA Responses by Group

	TYP	VLD	NVLD	Total
NS error choices				
Mean	1.5	1.20	2.35	1.73
Median	1.00	1.00	2.00	1.00
Std. Dev.	1.64	1.01	2.11	1.74
Range	5.00	3.00	7.00	7.00
SA error choices				
Mean	1.80	3.00	2.95	2.55
Median	1.00	2.00	1.00	2.00
Std. Dev.	1.58	1.60	3.24	2.36
Range	5.00	5.00	10.00	10.00

RESEARCH QUESTION 4: Do children with NVLD differ in humor comprehension across verbal categories as compared to children with VLD and the TYP group?

The results of the ANCOVA with IQ as the covariate did not show statistically significant differences between groups on any of the verbal categories: Phonological Errors $F(2,55)= 0.02$, $p= 0.98$; Lexical Errors $F(2.55)= 1.8$, $p= 0.18$; or Cognitive Incongruities $F(2,55)= 0.09$, $p= 0.92$. These results do not support the hypotheses that the groups differ on error rates of types of verbal jokes. The Levene test of Equality of Error Variance was significant for lexical errors, indicating differences in error variance between two or more of the groups. It should be noted that for each type of joke, the majority of participants made zero or one error. Thus, even using the percentages of verbal error types, the range was too restricted for significant differences to be detected.

Post Hoc Analyses

POST HOC ANALYSIS OF HOMOGENEITY OF GROUPS

The group responses were generally in the direction predicted in the hypotheses, with the NVLD consistently performing more poorly, committing more errors, than the other two groups. However, the differences observed were not statistically significant and the observed power for each analysis was very low (< 0.10). The NVLD group showed a wide variability of scores (error rates) for the dependent variables on all of the statistical analyses. Observations during the assessment suggested that the NVLD group included two groups of children who differed on at least one variable that had not been accounted for in the group classification criteria. Although all children in the NVLD group had poor visual spatial perception, some of the children had social deficits that were immediately apparent and others did not. Those children with more overt signs of social awkwardness also appeared to have greater difficulty with the humor measure.

This observation was also supported by theory and research suggesting that visual spatial deficits often co-occur with social skills deficits but that the relationship is not causal (Little, 1993 & Pennington, 1991). Although Rourke's model of NVLD suggests that the primary perceptual deficits of visual spatial, perceptual organizational, and graphomotor cause the secondary social deficits, many researchers have asserted there are children with the neuropsychological profile of weak visual spatial processing, poor graphomotor skills, and weak visual organization who do not have problems with social interactions (Pennington, 1991). To determine whether a social perceptual deficit might account for within group differences, additional information was gathered from the previously administered test batteries for the UT group, who had received a full battery that included the Child and Adolescent Social Perception (CASP). The total emotion score (TES) and the nonverbal cue score (NCS) from the CASP

were gathered for each of the UT participants to determine whether social perception would account for the within group variances observed in the NVLD group. Because only the UT group had been given this measure as part of the battery, the overall sample size was reduced from 55 to 31. The mean age for this adjusted data set was 12 years, 4 months and the mean IQ score remained 104.85.

CORRELATIONS

Correlations were computed among the CASP TES and NCS, FSIQ, and the dependent measures (total humor score, total joke errors, total cartoon errors, total NS and total SA responses). The humor scores were transformed into standard scores such that high scores represented fewer errors and low scores represented more errors. As Table 9 shows, statistically significant correlations were observed between the TEC, NCS, FSIQ and all of the dependent measures.

Table 9: Correlations between the CASP, FSIQ, and the Humor Task Scores

	1	2	3	4	5	6	7
1. FSIQ							
2. TES	.38*						
3. NCS	.41*	.79**					
4. Total Humor errors	.46*	.66**	.55**				
5. Joke errors	.48*	.50**	.43*	.92**			
6. Cartoon errors	.34*	.71**	.56**	.86**	.59**		
7. NS responses	-.45**	-.39*	-.42*	-.83*	-.88**	-.54**	
8. SA responses	.38*	.70**	.53**	.92**	.76**	.90**	-.53**

* $p \leq .05$ ** $p \leq .01$

The NVLD group appeared to differ in social functioning and some areas of research suggests that there are subgroups of NVLD with and without deficits in social perception (Little, 1993 & Pennington, 1991). These factors combined with the high correlations between the humor measure and the correlations found between the CASP scores (TES & NCS) and the humor measure, led to speculation that the variability in the NVLD group may be related to differences

in social perception. This speculation led to decision to split the NVLD group into two groups of children, a group with low social perception (NVLD/LSP) and another group with impaired visual spatial skills but intact social perception (NVLD). Impairment in social perception was defined as ≥ 1.5 standard deviations below the mean for the participant's age on both the TES and the NCS scores of the CASP (Schaffer, 2002). This division resulted in the following groups:

Table 10: Adjusted Sample Size for Groups

Group 1: TYP	12
Group 2: VLD	6
Group 3: NVLD	8
Group 4: NVLD/ LSP	5
Total participants	31

An ANOVA was utilized to assess whether the four groups differed on Full Scale IQ (FSIQ) and verbal IQ (VIQ) scores. No significant differences were found between the groups: FSIQ: $F(3,31) = 1.58$, $p = 0.21$) and VIQ $F(3,31) = 1.3$, $p = 2.93$.

POST HOC HYPOTHESIS TESTS WITH ADJUSTED GROUPS

Because of the correlation between the dependent variables, a MANCOVA with FSIQ as the covariate, was utilized to assess group mean differences on the dependent variables of total errors, total joke errors, total cartoon errors, percent of straight answer responses (SA) and percent of non sequitur responses (NS). A MANCOVA was used to increase the power given the smaller sample size. The types of joke errors were not included because of the restricted number of verbal errors. Statistically significant results were found for group differences using Wilk's Lambda; $F(15, 61) = 4.04$, $p < .001$. Levine's test of Equality of Error Variance was not significant for any of the dependent

variable. As shown in Table 11, tests of between participants effects indicated that the differences found in the MANCOVA were due to significant group differences on total errors, joke errors and cartoon errors. Statistically significant differences were not found between groups for percent of SA or NS responses.

Table 11: Tests of Between Subjects Effects

	df	F	Sig	Observed power*
Total errors	3	20.91	<.001	1.00
Cartoon errors	3	19.83	<.001	1.00
Joke errors	3	6.56	.002	.95
SA percent	3	.79	.51	.20
NS percent	3	.38	.77	.12

* computed using alpha = .05

Post hoc pairwise comparisons using the Scheffe test indicated that the NVLD/LSP group differed from the other three groups (TYP, VLD, and NVLD) on total errors, joke errors and cartoon errors. The NVLD/LSP group had a greater number of errors than the other three groups. Table 12 delineates specific group means and standard deviations.

Table 12: Group Means* and standard deviations

	Total Score		Cartoon Score		Joke Score	
	Means	SD	Means	SD	Means	SD
TYP	106.00	10.05	106.68	8.79	104.37	11.49
VLD	103.91	5.06	104.47	9.11	102.78	10.59
NVLD	109.48	8.36	109.62	6.32	107.53	10.57
NVLD/LSP	70.09	11.81	70.33	13.08	76.25	17.64

Evaluated at covariate: FSIQ = 104

* raw scores were transformed into standard scores.

As initially defined, support was not found for any of the proposed hypotheses. In adjusting the groups such that the NVLD group was divided into children with and without social perceptual deficits, these findings provide

support for a humor deficit, as defined by a poor score on the humor test, in children with NVLD *and* a social perception deficit.

To explore the lack of findings between group membership and error type more fully (Research question 3), a Repeated Measures ANCOVA was conducted with error type (non sequitur or straight answer) as the sole within-subjects factor and group as the sole between-subjects factor. Box's Test of Equality of Covariance was not significant for group differences, $F (9, 2389)= 1.57$, $p = .120$. Examination of the group means suggested that all participants chose more SA responses than NS responses, regardless of group membership. Thus, even for the adjusted groups, support was not found for Hypotheses 3a, b, c & d.

PREDICTORS OF HUMOR COMPREHENSION SCORES

A linear regression was used to determine which of the variables were significant predictors of humor comprehension as measured by the humor task. Independent variables considered in the equation were the CASP scores (TES, and NCS) and FSIQ. When all three variables were entered into the model together, they were estimated to account for 43% of the variance in total error scores. The regression equation was statistically significant with Total Errors as the dependent measure and FSIQ, TES, and NCS as the predictors; $F (3,30)= 8.44$, $p< .001$. The regression equation is $.552x_1 + .011x_2 + 0.25x_3 = y$. See Table 13 for the full model.

Table 13: Regression Model for the Total Error Scores

	β standardized coefficients	*T*	*p*
TES	.055	2.47	0.02
NCS	0.01	0.05	0.96
FSIQ	0.25	1.64	0.11

Similarly, for the Cartoon section, the regression model suggested that the three independent variables accounted for 45% of the variance in the scores. The regression equation was statistically significant: F (3,30)= 9.09, p< .001. As with the humor score, only the beta weight for TES was statistically significant (see Table 14).

Table 14: Regression Model for the Total Cartoon Errors

	β standardized coefficients	*T*	*p*
TES	0.67	3.05	0.01
NCS	0.01	0.04	0.97
FSIQ	0.08	0.52	0.60

In contrast, TEC, NCS, and FSIQ variables accounted for only 27% of the variance in total joke errors. The regression equation was still statistically significant at the p = .01 level: F (3,30)= 4.70, p = .009. However, none of the beta weights were statistically significant for jokes (see Table 15).

Table 15: Regression Model for the Total Joke Errors

	β standardized coefficients	*T*	*p*
TES	0.36	1.43	0.17
NCS	0.01	0.05	0.96
FSIQ	0.33	1.93	0.06

Further regression was conducted to determine whether the group differences may have reflected a quantitative difference in the degree of impairment rather than a qualitative group difference in humor comprehension. The scores from block design, the VMI and the ROCF were used as the predictors and the total standard scores on the humor measure, total cartoon scores and total joke scores, respectively as the dependent variables. Full Scale IQ was also entered as a predictor to control for the contribution of block design due to the contribution to IQ. These variables together accounted for 28% of the variance in

Total Errors and the regression equation for Total Errors was statistically significant at the p = .05 level: F (4,38)= 4.5, p = .005. However, the beta weights were only statistically significant for FSIQ (see Table 16).

Table 16: Regression Model for the Total Joke Errors

	β standardized coefficients	*T*	*p*
Block Design	0.26	1.83	0.08
Rey Osterreith	0.14	.64	0.53
VMI	-0.11	-.52	0.61
FSIQ	0.47	2.82	0.01

Practical Significance

For most of the initial analyses, the observed power was extremely low (<.10) suggesting that a sample size greater than 200 would have been required to detect significant differences. The ANCOVA for group differences on NS error choices had the largest effect size with observed power of .38, sufficient for the sample sizes, but the results did not support statistically significant group differences. Thus, although the null hypotheses were not rejected in any of the above analyses, only for the number of NS choices was power sufficient to find group differences.

In the follow up analyses, the NVLD group was divided into two groups: children with visual spatial deficits and with or without difficulties in social perception as measured by the CASP. For the MANCOVA, the observed power for group differences was very strong at 1.0 for total and cartoon errors and .95 for joke errors. The final regression suggests that these results were not simply due to a ceiling effect. This finding is particularly noteworthy given the very small sample size and the lack of findings prior to the inclusion of the CASP.

CHAPTER V: DISCUSSION

Chapter V is divided into two major sections. The first section was organized around the goals of the study and the findings in references to the four major hypotheses. The results of initial and post hoc analyses were considered in the context of existing research. In this section, the limitations of this study were also addressed. The final section, Future Directions, focused on how the findings may inform future research efforts.

Summary and Integration of Findings

This study was undertaken to explore whether a humor deficit exists in children with NVLD and, if found, the nature of the deficit. Although some studies have found lower humor comprehension and appreciation in children with learning disabilities, these findings have been characterized by a lack of subtyping, limiting generalizability to specific LD subgroups (Bruno, et al., 1987; Pickering, et al., 1987; Short, et al., 1993). Furthermore, studies of social emotional functioning in LD subgroups have found support for difficulties specifically associated with NVLD (Badian, 1992; Rourke, & Fuerst, 1991; Semrud-Clikeman & Hynd, 1990). In general, the hypotheses of this study predicted that children with NVLD would demonstrate a deficit in humor comprehension compared to children with VLD and typically developing children (TYP). The study was informed by theories of humor development in typically developing and learning disabled children, the role of humor in social interactions as well as studies of adults with right and left hemisphere damage.

DEFINING THE CHARACTERISTICS OF NVLD

Research on NVLD is complicated by the lack of consensus about the defining characteristics of the disorder (Little, 1993; Semrud-Clikeman & Hynd,

1990). A primary area of debate is whether NVLD represents a visual perceptual and visual organizational deficit with resulting social deficits as proposed by Rourke (1995) or whether visual perceptual/ visual organizational deficits represent a separate disorder that is frequently co-occurring but not causal, as suggested by Pennington (1991). The role that humor plays for these children has not been identified and this study was the first attempt to verify a deficit and explore the impact of the clinically observed deficit.

Initially, this study defined the NVLD group using the Rourke model, based on deficits in visual spatial processing, organization and visual motor integration. Using these criteria for NVLD, no group differences were found in humor comprehension, whether measured globally or specifically looking at modalities of humor (jokes vs. cartoons) or types of errors (straight answer or SA vs. non sequiturs or NS). However, when the NVLD group was further divided into two groups of children with and without deficits in social perception (NVLD & NVLD/LSP), statistically significant differences in humor comprehension were found even with markedly reduced sample sizes. These findings suggest that children with NVLD have difficulties with humor comprehension related to poor social perception but not necessarily related to visual spatial perception.

The children in the NVLD/LSP group demonstrated social difficulties that were immediately apparent in observation of body language and interactions; their behaviors exemplified the descriptions of poor eye contact, flat affect and vocal intonation, and oddly stilted speech. While their difficulties in basic humor comprehension might have been predicted by their stilted social interactions, this study provided empirical evidence on a task infinitely less complex than even basic social interactions. Their struggle on a multiple choice humor test with no time limit demonstrates the remarkable struggles they must face in daily social interactions, which are more complex, ambiguous, and often time limited for responses. In contrast, the children with visual spatial deficits but without deficits

in social perception on the CASP appeared more socially adept than the NVLD/LSP group.

There are several possible explanations for the differences between the two groups of children with nonverbal deficits (NVLD and NVLD/SLP). One possibility is simply a matter of degree; the children with problems in the visual spatial and social perceptual areas were the ones who were the most impaired in all areas of NVLD deficit and the ones who did not show a humor deficits were higher functioning and were able to develop compensatory strategies. There was some observational evidence for this hypothesis as some of the children in the pure NVLD group showed stilted social interactions but had clearly developed some skills in this area beyond those of the children in the NVLD/SLP group. This possibility is also supported by the lack of differences between the VLD and the Typ groups, which contradicts previous research. In other words, the lack of findings initially may be in part due to a ceiling effect for the humor measure. This explanation is not supported by the regression of total humor score with the variables used to form the NVLD group (Block Design, VMI, ROCF).

Another explanation could be the one supported by Pennington (1991) that the neuropsychological characteristics of NVLD represent a distinct disorder that frequently co-occurs with social imperception. Under this explanation the co-morbidity may be explained by proximity of functions in the right hemisphere. Shammi and Stuss' 1999 study of brain damaged adults suggested that the right frontal lobe was the area most associated with difficulty with humor comprehension. Gallagher, et. al. (2000) conducted a study that suggested that the medial prefrontal cortex is uniquely activated by tasks demanding 'theory of mind' or perspective taking ability. Other studies have also found that the right hemisphere is the primary site for processing the affective and pragmatic aspects of language. Finally, visual spatial processing is primarily attributed to right hemisphere in studies of adults and children (Worling, et. al., 1999). Rather than

these different functions being causally linked, it is possible that a subgroup of children has more diffuse maldevelopment that resulted in more global deficits.

LINKING HUMOR AND SOCIAL PERCEPTION

Additionally, and somewhat unexpectedly, these findings suggest that humor is significantly associated with social perception. Historically, humor has been found to be strongly correlated with cognitive functioning (Bruno, et. al., 1986; Masterson, 1987; and McGhee, 1974). However, in the second analyses, the results were independent of FSIQ or Verbal IQ, as there were no group differences in cognitive functioning. The regression analysis further suggests that social perception as measured by the CASP scores, particularly the correct identification of emotional expression in the social vignettes, accounts for differences in the humor comprehension scores well beyond the variance accounted for by IQ alone. These findings, while not necessarily predicted by previous studies, are suggested by previously developed theories that humor, while related to cognitive development is fundamentally a social phenomenon (Hayworth, 1928; Weisfeld, 1993). (Myklebust (1975) contended that although these children had several areas of deficit, it was social imperception that led to the primary and most debilitating aspects of NVLD.

Masten (1986) found a strong correlation between humor comprehension and social competence as defined by peer nominations. Humor, however has not previously been related directly to measures of social perception. This finding is particularly striking, given the differences between the CASP, a videotape measure of social perception, and the Humor Test, a multiple choice test of humor comprehension. This finding suggests that a common ability underlies both tasks. As Bauriaud (1988) emphasized the 'emotional tonality' as critical in humor appreciation, this study suggests that social perception may be a critical component of humor comprehension. While this interpretation is consistent with

the proposal that social perception deficits underlie humor deficits and thereby contribute to a social learning disorder, the extent of the relationship and the lack of connection with visual spatial perception was unexpected.

MODALITIES OF HUMOR

No study has previously examined the differences across modalities of humor (i.e. verbal vs. visual/spatial) in children with any type of learning disabilities. Most previous studies have studied verbal humor exclusively, presumably with children with largely language-based disabilities. In contrast, studies of adults with hemisphere damage have shown differences in performance on verbal and visual plus verbal tasks.

This study also explored whether adding a visual component to verbal humor assisted or inhibited humor comprehension in children with NVLD as compared to children with VLD and controls. As stated earlier, when defined primarily based on visual spatial deficits, no differences were found. It was not possible to compare errors on jokes and cartoons within groups for the post hoc analyses due to the reduced sample size. Examination of the means across tasks suggests that the scores did not vary across tasks for any group. However, the NVLD/LSP performed worse than the other groups on both the joke and cartoon portions of the humor task. Both tasks contained a verbal component and the groups did not differ in verbal ability or overall IQ, which suggests that the differences in group scores was related to a factor other than verbal ability. This finding is consistent with the initial hypothesis that children with NVLD will perform poorly on humor tasks regardless of verbal ability due to a general deficit in humor comprehension.

DEVELOPMENT OF HUMOR

As NVLD is often conceived as a right hemisphere disorder, research exploring humor deficits in adults with RHD was utilized to infer the nature of a deficit. Adults with RHD tend to make errors in humor comprehension that indicate difficulty in the resolution of an incongruity whereas adults with LHD make errors that indicate difficulty in detecting an incongruity (Bihrle, et. al, 1986). Humor development in children tends to naturally progress from finding humor in simple surprise (incongruity) to the added element of resolution, providing a more sophisticated, subtle level of humor. Some of the research on children with LD indicates that this pattern of development is delayed in children with LD (Bruno, et al., 1987; Pickering, et al., 1987; Short, et al., 1993).

The second aim of this study was to explore the possible nature of a humor deficit in children with NVLD by examining patterns of errors. These research findings did not support any notable pattern for the initial NVLD group nor, once divided by social perception, for the NVLD/LSP group. Children in all groups were more likely to choose the SA choices, representing resolution without incongruity. This finding contradicts expectations as well as previous research and may reflect limitations of the measure rather than a finding of practical significance.

TYPES OF VERBAL HUMOR

Finally, one study of verbal humor found that children with undifferentiated LD performed worse on phonological jokes than on jokes derived from multiple meaning (lexical jokes) or those based on cognitive incongruities (Bruno, et. al., 1987). Research suggests that this poor performance is directly linked to reading and pre-reading skills. As such, children with NVLD, who did not have a reading disability, were not expected to show differences across linguistic categories; while those with VLD were expected to make more errors

on phonological jokes than the other types of verbal humor. Children from the three initial groups (NVLD, VLD and TYP) were compared across linguistic categories (phonological, lexical and cognitive incongruity). No significant differences were found across groups. Examination of the scores suggested that there were not enough errors on the joke task across groups to adequately assess the responses for a pattern of deficits. Thus, the restriction in range prohibits interpretation of these findings regarding verbal types of humor. This hypothesis was not examined in the secondary analyses with the divided NVLD group due to an even greater restriction of range with the reduced sample size.

Implications

There are three major implications of this study: empirical evidence for a humor deficit in children with poor social perception, humor comprehension deficits in children with NVLD is more strongly related to social perception than visual spatial deficits or IQ; and the possibility that assessment of humor comprehension might provide a quick screening tool for social perception.

This study provides support for the clinical observation of a humor deficit in children with NVLD above and beyond IQ. The deficit is not necessarily due to poor problem solving as would be expected were the relationship with IQ stronger, but appears to involve the more complex issue of social perception-especially given the vastly different natures of the tasks. The relationship with social perception was strongest for the cartoon task, which incorporates the recognition of facial expressions, albeit simplified line drawings of facial expressions. In examining individual responses, the NVLD/LSP participants often chose the responses with obvious over-reactions without appreciation for the subtler aspects of incongruity. This result can be applied to social interactions that require multiple subtle judgments of the emotional states and responses of others as well as the integration of verbal content with the specific situation.

This study supports the view that the impaired social perception associated with NVLD is not simply, or even primarily, the product of visual spatial perceptual deficits. Clearly there is a strong overlap between the neuropsychological profile associated with NVLD and social difficulties, but these findings suggest that the relationship may be co-morbid or additive rather than causal. It is possible that the group of children who comprised the NVLD/LSP in this study reflects the typical child with both visual spatial and social deficits referred for study and intervention, while children with visual spatial deficits without clear social deficits are not referred for assessment and thus not as frequently included in research. Alternatively, it is possible that the children in the NVLD group without LSP as measured by the CASP represent the high functioning end of the continuum and the CASP and humor measures were not able to capture the more subtle aspects of deficits in this group of children.

In addition to the implications for defining and understanding NVLD, this study provides some information towards intervention as well. Clearly more research is needed to further explore the overlap between visual spatial and social deficits. However, regardless of whether the NVLD and the NVLD/LSP groups represent a continuum of a single disorder or separate entities, the differences in this study suggest different levels of intervention. In Glass, Guli, & Semrud-Clikeman (2001), the authors describe an intervention program for children with difficulties in social competence based on the premise that a subset of children with poor social skills were struggling at the level of social perception rather than at the level of social skills as presumed by many social intervention approaches. This study supports that premise for the group of NVLD/SLP children who do need intervention at the basic social perceptual level. The program uses a variety of theatre exercises to build these fundamental skills. This study suggests that this and other social intervention programs may be strengthened by the addition of essential and basic elements of humor even at the basic riddle or joke level.

The humor task was very quick, easy, and enjoyable. Given the overlap between social perception and this measure of humor comprehension, further refinement of this measure or development of a similar measure might lead to an efficient research tool. One of the most difficult aspects of studying or intervening with deficits in social interactions is the difficulty in measurement beyond parent or child report. While valuable resources, rating scales are inextricably tied to the perception of the rater. Children may over or under-estimate their competence consciously or unconsciously. Similarly, parents and teachers may not be aware of social skills or deficits in a peer setting unless the issues are glaring. The CASP represents a good effort to measure social perception in a manner that more closely resembles the social problem solving involved in social interactions. The humor measure, once further refined and studied, may provide a quicker, easier means to assess basic social perception for research purposes.

Future Directions

One of the most exciting implications of this study is the evidence that humor and social perception are related by a factor beyond IQ. This research study examined the roles of cognitive development, language, visual spatial perception and emotional or social perception in the development and comprehension of humor. The results of this study suggest that the last factor might be the most salient area of future study, which directly contrasts with the majority of studies suggesting that cognitive skills are the primary source of humor comprehension. In this study, IQ was clearly correlated with both humor comprehension as defined in this study as well as social perception as measured by the CASP. This strong relationship has been well documented by previous research and is intuitive when one considers the aspects of problem solving inherent in both humor comprehension as well as perception of emotional cues.

However, when included in a regression, IQ contributed significantly less to the ability to comprehend jokes and cartoons than did the ability to accurately perceive emotions based on facial expressions and body language.

In contrast to the study of humor and cognitive development, the relationship between emotional perception and humor has been relatively unexplored. This study provides an impetus for further exploration of this interesting relationship and other factors, shared and unshared, which may lead to strengths and weaknesses in social relating.

For example, Tsatsanis (2000) used a videotape of abstract shapes to explore the nature of how people with and without high functioning autism or Asperger syndrome interpreted actions as social. It would be interesting to explore the presence of a basic social filter used to interpret movement and humor comprehension as conceptualized in this study to determine whether there is a correlation between the two variables. Although humor has been divided into aspects of incongruity and resolution, this study suggests that, even when only comprehension, as opposed to appreciation or the generation of humor, is being measured, humor is fundamentally a social experience.

Another, related area of research that should be further explored is the overlap of diagnostic criteria between NVLD and disorders in the autism spectrum. Additionally, these findings suggest that the role of visual spatial perception and language may be less primary than previously credited. The lack of relationship between humor and visual spatial deficits in this study may be related, as mentioned, to a ceiling effect for higher functioning children with NVLD or it may reflect two different but overlapping diagnostic categories. It would be interesting to compare children with the neuropsychological profile of poor visual spatial abilities and intact social perception, to children with visual spatial abilities and impaired social perception and children with the profile of

social impairment but intact visual spatial abilities on measures of humor and emotional perception.

This study focused on the visual spatial aspects of NVLD as the primary neuropsychological characteristics defining NVLD. However, no measure of language was included beyond VIQ. Future studies should be conducted that include an assessment of semantic and pragmatic language systems. This area of exploration may provide further illumination into the nature of humor deficit in this group of children and would also serve to inform the potential differences between the diagnosis of NVLD and Semantic Pragmatic Language Disorder, if a distinction can be made. In this study, there was an association between the scores on the humor test and VIQ, but the relationship was smaller than expected. It may be that the unexpected results reflected the differences between the verbal knowledge and expression required for an average score on the Vocabulary test of the WISC III doesn't capture the semantic and pragmatic deficits associated with NVLD. These more subtle areas of language deficit might be another contributing factor to the impaired scores on the humor test in the NVLD/ LSP group.

Humor research is relatively scarce; the 1980's saw a surge of interest in humor particularly in humor development in children, with the work of Paul McGhee among others. In more recent years, however, research on humor in children has centered primarily on the use of humor in therapeutic interventions or teaching. In contrast, studies of depression and anxiety proliferate. This lack of attention to such a quintessential human trait may result in a fundamental gap in our understanding of the complexities of social relating. This gap may be particularly salient for those disorders in which impaired social relating lies at the heart of the disorder. Previous studies have shown that mirth is strongly associated with social interactions, such that mirth responses are greatly dependent on the presence and response of others. This study suggests that

beyond appreciation, humor comprehension may be fundamentally, a social phenomenon. This rich, untapped resource may very well provide a key component to understanding children with social impairments such as those considered to have NVLD.

Strengths and Limitations

STRENGTHS

One of the strengths of this study was the development of a measure that provides an assessment of humor comprehension in children. In attempting to study humor, one of the greatest drawbacks is the lack of measurement tools. While this instrument is a crude measure which needs refinement, it yielded strong reliability and provides a foundation for further development

Another strength was the inclusion of ADHD as a factor to be tracked. Little research has been conducted with ADHD and humor. Given the high co-morbidity of attentional problems with learning disorders, the presence or absence of ADHD was critical in assessing the meaning of the results. Although clinically, children with ADHD are observed to have immature social skills, the diagnosis of ADHD was not related to scores on the humor task. These results suggests that while children with ADHD may have difficulty with using humor appropriately in social contexts, they may not necessarily have an underlying deficit in humor comprehension. This finding also lends further support to the need to study the source of humor deficit in addition to the use of humor in social situations.

Another strength was the examination of a loosely defined group through an unexplored lens. Most research on humor was conducted in the 1980s on typically developing populations with the goal of understanding the path of normal humor development. Current research on humor in children, where it

exists, is primarily focused on the role of humor in intervention. While this research direction is interesting and promising, it is equally important that we continue to study the development of humor and the skills that underlie comprehension and usage in typically developing and atypically developing populations.

LIMITATIONS

The primary limitation of the study was evident in the need to redefine the groups. The lack of a social measure initially resulted in no findings in the initial analyses. This limitation became a strength, however, in that the contrast between the initial results and the post hoc analyses supports one of the major findings that would not have been addressed had the social measure been included from the beginning.

The concern for group criteria also extends to the method of defining the VLD group. The lack of differences between the VLD and TYP group suggests that the inclusion criteria for the VLD group may have been too liberal. Bruno, et. al. (1986), found significant differences between typically developing children and LD kids using more stringent criteria than did this study. That study selected LD students who were in resource placement at least two hours weekly, whereas in this study children who were currently receiving services were not differentiated from those in regular classrooms with a history of a language based learning disorder. It should also be noted that the study by Bruno, et. al. (1986) included younger children as well. This study included children with early reading disabilities without exploring their current level of reading. In choosing a less stringent criteria for VLD classification, it was reasoned that children who were still receiving intensive support for reading issues might represent a different, lower functioning group than the average child with a VLD that had made advances with support. However, the use of more liberal criteria probably

contributed to a ceiling effect for that group and did not result in the differences expected based on previous research.

Small sample size is perhaps the clearest study limitation, particularly given the reduction in sample size from 55 to 31 with individual group sizes of only 5 to 12 subjects. This limitation resulted in the inability to test one of the hypotheses due to range restriction. In addition, the small sample size limits that generalizability of the findings, although this was somewhat mitigated by the strength of the association found even with the small group sizes.

The humor measure also imposed limitations on the interpretation of the results. Even with the reduced sample size, the reliability of the measure remained fairly robust at r = .79. However, there are clear areas for improvement. Examination of the data suggests that there was a ceiling effect for the VLD, TYP and NVLD (without low social perception). Thus, a significant effect was found, but only for the most severely socially impaired children. It is critical to the understanding of humor in NVLD that this issue be explored more thoroughly with a more subtle measure of humor comprehension. It is possible that would be an association between poor humor comprehension and the neuropsychological profile of NVLD if the concept were explored with a lens more fine-tuned to examine subtle differences.

Additionally, the measure requires further refinement of the distractors. Significant differences were not found between the groups on types of errors (SA vs. NS). The trend of responses suggested that all of the children chose the straight answer (incongruity removed) responses more frequently than the non sequitur responses, in contradiction to the current theories and previous research findings about normal humor development. Additionally, although all responses were chosen at least once, even when the sample size was reduced to 31, some responses were poor distracters resulting in items with nonsignificant correlations to the total score.

Finally, due to the need to split the NVLD group into two groups, extensive analyses were conducted on this sample. While this 'over fishing of the pool' was compensated for by reducing the alpha level for significance to .01, it would be important to replicate this finding given the possibility of a type one error due to over-analysis of the same population.

APPENDIX A

The NLD Syndrome and the White Matter Model

PRIMARY NEUROPSYCHOLOGICAL

ASSETS	DEFICITS
Auditory Perception	Tactile Perception
Simple Motor	Visual Perception
Rote Material	Complex Psychomotor
	Novel Materiel

SECONDARY NEUROPSYCHOLOGICAL

Auditory Attention	Tactile Attention
Verbal Attention	Visual Attention
	Exploratory Behavior

TERTIARY NEUROPSYCHOLOGICAL

Auditory memory	Tactile Memory
Verbal Memory	Visual Memory
	Concept Formation
	Problem Solving

VERBAL NEUROPSYCHOLOGICAL

Phonology	Oral Motor Praxis
Verbal Reception	Prosody
Verbal Repetition	Phonology-Semantics
Verbal Storage	Content
Verbal Associations	Pragmatics
Verbal Output	Function

ACADEMIC

Graphomotor (Late)	Graphomotor (Early)
Word Decoding	Reading Comprehension
Spelling	Mechanical Arithmetic
Verbatim Memory	Mathematics
Science	

SOCIOEMOTIONAL/ADAPTIVE

ASSETS	DEFICITS
???	Adaptation to Novelty
	Social Competence
	Emotional Stability
	Activity Level

APPENDIX B:

CRITERIA FOR AUTISM AND ASPERGER SYNDROME

Diagnostic Criteria for Autistic Disorder

A. At least two from (1), one each from (2), and (3) for a total of six criteria.

(1) Qualitative impairment in social interaction, as manifested by at least two of the following:

(a) Marked impairment in use of multiple nonverbal behaviors such as eye-to-eye, facial expression, body postures, and gestures to regulate social interaction.

(b) Failure to develop peer relationships appropriate to developmental level.

(c) A lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g. by a lack of showing, bringing, or pointing out objects of interest.

(d) Lack of social or emotional reciprocity.

(1) Qualitative impairments in communication as manifested by at least one of the following:

(a) Delay in, or total lack of, the development of spoken language (not accompanied by an attempt to compensate through alternative modes of communication such as gesture or mime.)

(b) In individuals with adequate speech, marked impairment in the ability to initiate or sustain a conversation with others.

(c) Stereotyped and repetitive use of language or idiosyncratic language

(d) Lack of varied, spontaneous make-believe play or social imitative play appropriate to developmental level.

(3) Restricted repetitive and stereotyped patterns of behavior, interests, and activities as manifested by at least one of the following:

(a) Encompassing preoccupation with one or more stereotyped and restricted patterns of interest that is abnormal either in intensity or focus.

(b) Apparently inflexible adherence to specific, nonfunctional routines or rituals.

(c) Stereotyped and repetitive motor mannerisms (e.g., hand or finger flapping or twisting, or complex whole-body movements)

(d) Persistent preoccupation with parts of objects.

B. Delays or abnormal functioning in at least one of the following areas, with onset prior to age 3 years: (1) social interaction, (2) language as used in social communication, or (3) symbolic or imaginative play.
C. The disturbance is not better accounted for by Rett's Disorder or Childhood Disintegrative Disorder.

DIAGNOSTIC CRITERIA FOR ASPERGER DISORDER

A. Qualitative impairment in social interaction, as manifested by at least two of the following:
   (1) Marked impairment in use of multiple nonverbal behaviors such as eye-to-eye, facial expression, body postures, and gestures to regulate social interaction.
   (2) Failure to develop peer relationships appropriate to developmental level.
   (3) A lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g. by a lack of showing, bringing, or pointing out objects of interest.
   (4) Lack of social or emotional reciprocity.
B. Restricted repetitive and stereotyped patterns of behavior, interests, and activities, as manifested by at least one of the following:
   (1) Encompassing preoccupation with one or more stereotyped and restricted patters of interest that is abnormal either in intensity or focus.
   (2) Apparently inflexible adherence to specific, nonfunctional routines or rituals
   (3) Stereotyped and repetitive motor mannerisms (e.g. hand or finger flapping or twisting, or complex whole-body movements)
   (4) Persistent preoccupation with parts of objects
C. The disturbance causes clinically significant impairment in social, occupational, or other important areas of functioning.

There is no clinically significant general delay in language (e.g. single words used by age 2 years, communicative phrases used b age 3 years).

D. There is no clinically significant delaying cognitive development or in the development of age-appropriate self help skills, adaptive behavior (other than in social interaction), and curiosity about the environment in childhood.
E. Criteria are not met for another specific pervasive Developmental Disorder or Schizophrenia.

APPENDIX C

UT IRB FORM

TITLE: ASSESSMENT AND INTERVENTION OF NONVERBAL LEARNING DISABILITIES IN SCHOOL AGE CHILDREN

1. Participants for this project come from two sources: school personnel from the Austin Independent School District (AISD) and from parent referrals. This project was proposed to AISD in the spring of 1997. Its purpose is to provide teachers, administrators, and parents with assessment and intervention information that will assist them in managing the educational and social needs of students suspected of having nonverbal learning disabilities (NVLD). Educators and psychologists are just beginning to understand NVLD. The characteristics typically associated with the disorder include difficulty with math calculation, visual-spatial deficits, poor social skills, inattention, and poor conceptualization and abstraction abilities. Frequently, children with NVLD are misdiagnosed or they go undiagnosed, resulting in years of frustration for them, for their parents, and for their teachers. This project focuses on children between ages 9 through 14. The diagnosis is difficult to make in children younger than seven or eight, and we are trying to begin intervention prior to age 14. AISD has estimated that there may be as many as 1000 students who meet criteria for NVLD in the District. Although some researchers suggest that girls and boys are equally affected, our own research suggests a ratio of three boys to one girl. Students who meet generally accepted criteria (determined mainly by test scores as explained below) are included in the project. Students with sensory or motor impairments will be excluded if these disorders are thought to be related to NVLD. Students with chronic illnesses can be included as many chronic illnesses are associated with NVLD. Because this is a service project as well as a research project, we want to make these services available to as many students as possible. In all cases, parental consent and student assent forms are completed before any student is considered for participation.

2. As noted above, participants come from two sources, AISD referrals and independent parent referrals. During the 1997-1998 school year, teachers in the AISD will be made aware of the project and they will be asked to refer students between ages 9 and 14 who are thought to meet criteria for NVLD. Once a student is identified, school personnel will contact parents to request their permission to include the student in the project. Once parents agree, they will be mailed the PARENT PACKET that includes

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

3. There are no known risks to any of the procedures used in this project. All assessment instruments are standardized, published materials that are used routinely in schools and other agencies charged with evaluating and developing intervention plans. No new, unpublished, nor experimental procedures will be used in any part of this project. In addition to the PARENT PACKET, the following instruments are used to generate data for the project.

The following materials will be used during the assessment phase of the project:

- Parent Packet
  - BASC Parent Rating form
  - Developmental History Questionnaire
  - Parent Consent Form
- Parent Interview
  - Structured Interview for the Assessment of Children (SIDAC)
- Teacher Packet
  - BASC Teacher Rating Form
- Student Assessment
  - Wechsler Intelligence Scale for Children–Third Edition (WISC-III)
  - Woodcock-Johnson Tests of Achievement--Revised
    - Letter-Word Identification
    - Passage Comprehension
    - Calculation
    - Applied Problems
  - Woodcock-Johnson Tests of Cognitive Ability–Revised
    - Analysis/Synthesis
    - Concept Formation
  - Judgment of Line Orientation
  - Rey Osterrieth Complex Figure Test

California Verbal Learning Test-Children's Version
Finger Tapping
Purdue Pegboard
Developmental Test of Visual Motor Integration–Fourth Edition
Stroop Color Word Test
D2
Test of Memory and Learning
    Stories
    Facial Recognition
Wisconsin Card Sort Test
Children's Category Test
Rorschach
Child and Adolescent Social perception test (CASP)
Humor Test
DANVA II

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

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

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

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

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

8. Not Applicable

9. Not Applicable

10. NO

University of Minnesota

Request For The Approval For The Use Of Human Subjects in Research

Health and Biological Sciences

INSTITUTIONAL REVIEW BOARD

Version 2/2001

Project Title:	**Humor Comprehension in Children with Nonverbal Learning Disabilities**

Principal Investigator: Including middle initial and highest earned degree	**Kimberly L. Glass, M.A.**		
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Mailing Address:	**University of Minnesota Gateway 200 Oak St. S.E., Suite 160**		
E-mail Address:	**glass032@umn..edu**		

Name, phone number, and E-mail address of person preparing this form:
same as above

As Principal Investigator of this study, I assure the IRB that the following statements are true:

The information provided in this form is correct. I will seek and obtain prior written approval from the IRB for any substantive modifications in the proposal, including changes in procedures, co-investigators, funding agencies, etc. I will promptly report any unexpected or otherwise significant adverse events or incidents that may occur in the course of this study. I will report in writing any significant new findings which develop during the course of this study which may affect the risks and benefits to participation. I will not begin my research until I have received written notification of final IRB approval. I will comply with all IRB requests to report on the status of the study. I will maintain records of this research according to IRB guidelines. The grant that I have submitted to my funding agency which is submitted with this IRB submission accurately and completely reflects what is contained in this application. If these

conditions are not met, I understand that approval of this research could be suspended or terminated.

	Psychology Intern	**3/3/02**
ORIGINAL SIGNATURE OF PI	**TITLE OF PI**	**DATE**

If Principal Investigator is faculty or staff, a Department head signature is required. **As Department Head, I acknowledge that this research is in keeping with the standards set by my department and I assure that the Principal Investigator has met all departmental requirements for review and approval of this research.**

Typed Name of Department Head, or Director of Research Fairview	Date
Original Signature of Department or Fairview Official	Date

Co-Investigators responsible for, or working on this project should be listed below. Include any individual who will have responsibility for the consent process, direct data collection from subjects, or follow-up. If there are more than two Co-Investigators, please attach additional pages containing the following information.

Co-Investigator: Including middle initial and highest earned degree			
Telephone Number:		**Pager or Cell Phone:**	
Fax:			
Department Name:	☐ University ☐ Fairview ☐ Other:		
Mailing Address:			
E-mail Address:			

Original Signature of Co-Investigator	Date

Co-Investigators responsible for, or working on this project should be listed below. Include any individual who will have responsibility for the consent process, direct data collection from subjects, or follow-up. If there are more than two Co-Investigators, please attach additional pages containing the following information.			
Co-Investigator: Including middle initial and highest earned degree			
Telephone Number:		**Pager or Cell Phone:**	
Fax:			
Department Name:	☐ University ☐ Fairview ☐ Other:		
Mailing Address:			
E-mail Address:			
Original Signature of Co-Investigator			**Date**

Research Staff are any personnel you wish to be included in correspondence related to this study e.g. study coordinators.

Name:	
Department Name:	☐ University ☐ Fairview ☐ Other:
Address:	
Telephone Number:	
E-mail:	

☐ **Check here if this is Fairview System Research (not University faculty/staff/student).**

Student Research requires the approval of an Academic Advisor. As Academic Advisor to the Student Investigator, I assume responsibility for ensuring that the student complies with University and Federal Regulations regarding the use of Human Subjects in research.	
Advisor's Name:	**Terry Harrison**
University Department:	**Pediatric Neurology**
Address:	**Box 486, 420 Delaware St SE**
Telephone Number:	**(612) 625-7466**
E-mail:	**harri107@umn.edu**
Original Signature of Academic Advisor	**Date**

Length of Study
How many months do you anticipate this study will last from the time final approval is granted?
12

Funding	
Is this research funded by an internal or external agency?	
☐ **Yes** **Attach Appendix A**	☒ **No**

Peer Review		
Is this research subject to review by another Committee? **(If so complete the requested information)** **It is the responsibility of the PI to secure the appropriate approval from these Committees and document that approval to the IRB.**		
Committee		**Date of Submission**
Institutional Animal Care and Use Committee (IACUC)		
Cancer Protocol Review Committee (CPRC)		
All University Radiation Protection Committee		
Conflict Management Committee		
Nursing Research Committee		
General Clinical Research Center		
Other IRB (name) (i.e., if you are participating in a multicenter trial which requires the approval of other IRB's)	**University of Texas at Austin, IRB**	**04/22/01**
Other (specify)		

Conflict of Interest

Federal Guidelines have been revised to require IRBs to assure that there are no conflicts of interest in research projects which could affect human subject participation. If this study involves or presents a potential conflict of interest, additional information may need to be provided to the IRB. Examples of conflicts of interest may include, but are not limited to:

1) A researcher or family member participating in research on a technology owned by a business in which the faculty member holds a financial interest
2) A researcher participating in research on a technology developed by that researcher
3) A researcher or family member assuming an executive position in a business engaged in commercial or research activities
4) A researcher or family member serving on the Board of Directors of a business from which that member receives University-supervised Sponsored Research Support

University of Minnesota Researchers, please refer to the Web site for further information:
http://www.ospa.umn.edu/policy/respolcy.htm#Regents
Fairview Health System Researchers, please refer to the Web site for further information:
http://www.fairview.org/prof/research

Do any of the Investigators or personnel listed on this study have a conflict of interest associated with this study?

☐ **Yes. Continue on with the next question.**	☒ **No.**

If yes, has this conflict of interest been disclosed as per the relevant policy?

<table>
<tr><td colspan="2">☐ Yes.
Is there a management plan in place?</td><td rowspan="2">☐ No. Please contact your department head for further instructions. The IRB cannot review a study before a conflict has been disclosed to the appropriate department head.</td></tr>
<tr><td>☐ Yes. Please provide a copy of the plan for IRB review.</td><td>☐ No. Please contact your department head about developing a management plan.</td></tr>
<tr><td colspan="3">The IRB may require disclosure of the potential conflict of interest in the consent documentation for study participants.</td></tr>
</table>

1. **What is your research question? (Hypothesis). Please note that the following questions must be answered in lay language or language understood by a person unfamiliar with your area of research. Area-specific jargon should be avoided or explicitly explained. Do not say "see protocol".**

The research literature indicates that children with Nonverbal Learning Disabilities (NVLD) have poor humor comprehension and that difficulty contributes to their documented problems with social interactions. I am looking at whether there is a difference in humor comprehension in children with NVLD, Verbal Learning Disabilities (VLD) and a control group with no learning disabilities. The NVLD group will also include children with the diagnosis of Asperger Syndrome (AS) based on research that suggests that the two groups have the same types of social deficits. My hypothesis is that the children with NVLD will show poorer humor comprehension than children in the other two groups. I also have specific hypotheses about how the difficulties will manifest in the two learning disability groups: children with NVLD will do equally poorly on the joke and cartoon situations, children with VLD will only do poorly on a specific type of verbal joke, and children with NVLD will demonstrate a specific type of error.

2. **What research methods will you use? (How will you ask the question?) Attach a protocol if applicable.**

I plan on using a multiple choice measure of humor comprehension adapted from previous studies with a newly developed section of cartoons. The children will be asked to look at a number of joke and cartoon stems. Each stem will also include three ending choices and the children will be asked to choose the funny ending (see attached examples of jokes and cartoons). In addition to the humor measure, standardized tests will be utilized to sort the children into groups. If any of these children have had any of these tests previously, that data will be used to sort the groups, otherwise they will get the tests outlined below.

3. What will the subjects be asked to do?

1. The Wechsler Intelligence Scales for Children, Third Edition (WISC-III). This test is a commonly administered instrument to determine a child's Intelligence Quotient (IQ). The administration should take approximately 45 minutes to one hour to complete. This test will be administered to all participating children.
2. The math and reading sections of the Wechsler Individual Achievement Test will be given to all participating children to assess academic functioning. This test can take approximately 45 minutes to an hour to complete.
3. Two subtests from the Woodcock Johnson Tests of Cognitive Ability- Revised (WJ-R). This test is another commonly used measure of IQ. Two subtests (Analysis/ Synthesis and Concept Formation) have been chosen to estimate cognitive reasoning ability and generally take 20-30 minutes to administer. These tests will be administered to children suspected of having NVLD or AS.
4. The Judgment of Line Orientation (JLO) will be administered to children screened for the NVLD group. This test is a measure of visual spatial perception and generally takes 10 minutes to administer.

If none of these measures have been administered previously, children from the NVLD/AS group will be assessed for approximately 2 1/2 to 3 hours. Those children screened for the Verbal Learning Disabilities group will be tested for approximately 2 hours and those forming the control group with no learning disabilities will be tested for approximately an hour and a half. These times are general estimates as individual administration times can vary.

4. Subject Population

4. a)

Number of Subjects					
How many subjects will you enroll?					
Male:	**35**	**Female:**	**15**	**Total:**	**50**
If this is a clinical trial, how many people do you estimate you will need to take through the consent process (but not necessarily enroll) to get the data sets you need?					
Male:		**Female:**		**Total:**	

4. b)

Age Range (Check all that apply)
☐ **0-7 (Submit parental consent form and Appendix B)**
☒ **8-17 (Submit child's assent form, parental consent form and Appendix B)**
☐ **18-65**
☐ **65 and older**

4. c)

Location of Subjects During Research Data Collection (Check all that apply)		
☐ Elementary/Secondary Schools		
☐ Community Clinic	Specify:	
☐ Prisons/Halfway houses		
☒ Fairview University Medical Center		
☐ Fairview Southdale Hopital		
☐ Fairview Ridges Hospital		
☒ Other Fairview Facilities	Specify:	Pediatric Neuropsychology Clinic in the Phillip Wangenstein Building and the Autism Clinic within the Center for Neurobehavioral Development
☐ Other Hospitals	Specify	
☐ University Campus (nonclinical)		
☐ Other Special Institutions	Specify	

4. d)

Subject Characteristics (Check all that apply)
☐ Inpatients
☒ Outpatients
☐ Normal Volunteers
☒ Controls

4. e)

Inclusion and Exclusion of Subjects in this Research Study	
It is necessary that the inclusion and exclusion of minors be scientifically justified. Provide justification in Appendix C. It is also necessary to provide scientific justification for uneven gender enrollment.	
List criteria for inclusion and exclusion of subjects in this study	
Inclusion Criteria:	Subjects will be children between the ages of 12 and 15, of average or above average IQ, fitting the inclusion criteria for one of the three groups as listed below: The children in the NVLD group will meet three out of the four following criteria: have a split of 12 or more points between their verbal and nonverbal IQ scores as measured on the WISC III, a visual spatial deficit as defined by below average scores on the Judgment of Line Orientation or the Block Design subtest of the WISC-III. Below average score on the Woodcock Johnson Tests of Cognitive Abilities- Revised, or a math disability as defined by below average scores on the mathematical composite of the WIAT and a significant discrepancy from their IQ score. The VLD group will be chosen based on below average reading scores, with a 15 point discrepancy from their IQ score and average or above math composite scores. Children with a 12-point split between their verbal and nonverbal IQ scores with the verbal score higher, will be excluded from this group.

	The normally achieving subjects will have an average or above average IQ score and average or above average achievement scores in both reading and math. Gender is not an inclusionary or exclusionary factor; the differences in expected rates of gender selection is based on the research data suggesting a higher percentage of males with learning disabilities.
Exclusion Criteria:	**No subject will have a positive history of fully diagnosed autism , head injury, progressive neurological disorder, or mental retardation (IQ < 70).** **All participants will have an IQ score at least in the average range of intellectual functioning (FIQ > 85).** **To reduce a confound of language, only children with English as their primary language will be included.** **Children with multiple learning disabilities will be excluded.** **Children with pre-diagnosed depression or anxiety disorders will be excluded from all groups as both of these disorders can have a strong negative effect on learning, social interactions, and humor and could cloud the results.**

4. f)

Special Populations To Be Included In This Study **(Check all that apply)**		
☒ **Minors under age 18** *Appendix B* **must** *be attached*		
☐ **Patients**		
☐ **Mentally/Emotionally/Developmentally Disabled Persons.**		
☐ **Minority Group(s) and Non-English Speakers**	**Specify:**	
☐ **Pregnant Women** *Appendix C* **must** *be attached*		
☐ **Fetus/Fetal Tissue**		
☐ **Elderly Subjects (65 and over)**		
Provide rationale for using special populations		
These groups are considered "vulnerable" or require special consideration by the federal regulatory agencies and by the IRB. Suggestion: Researchers should not		

select subjects on the basis of discriminatory criteria. Selection criteria that exclude one sex or racial group require a clear scientific rationale for the exclusion (See Appendix C).	
Rationale:	**The age range of 12-15 was selected because that is the age at which humor is expected to have developed to include the more sophisticated linguistic and humor elements. Prior to that a group difference would be difficult to determine because several elements of humor are not expected to have developed. Beyond age 15, individual differences in humor become more pronounced and humor becomes less of a developmental construct and more tied to individual personality traits. Since the hypothesis is centered around whether there is a developmental lag or a deficit in humor in certain groups, it is necessary to study this critical period of time.** **Although uneven ratios of males: females is predicted based on previous incidence studies, there will be no exclusions on the basis of gender.**

5. Recruitment

5. a) Describe how subjects will be identified and recruited. Attach a copy of any and all recruitment materials to be used e.g. advertisements, bulletin board notices, e-mails, letters, or phone scripts.

Subjects will be identified through four sources: 1. Access to the Autistic Spectrum Disorder Clinic program database through Dr. Terry Harrison and Dr. Elsa Shapiro; 2. Access to the Neuropsychology Clinic database through Dr. Terry Harrison and Dr. Elsa Shapiro; and 3. Referral from Dr. Jeff Wozniak and Dr. Hal Pickett through the Department of Child and Adolescent Psychiatry archival records and current patients, based on the inclusionary criteria listed above. For each of these sources, the prinicple investigator will review the referred records to determine if the child is a potential subject based on age (12-15), diagnosis(NVLD, AS, or VLD), and relevant test data if available. For selected children, a letter will be sent informing the identified family that they will be contacted by the principle investigator about this research (see attached).

In addition, flyers will be posted on hospital bulletin boards and community centers that will ask for volunteers (see attached).

5. b) Initial Contact

Describe who will make initial contact, and how it will be made. If subjects are chosen from records, indicate who gave approval for use of the records. If records are "private" medical or student records, provide the protocol, consent forms, letters, etc. for securing consent of the subjects of the records. Written documentation for the cooperation/permission from the holder or custodian of the records should be attached. (Initial contact of subjects identified through records search must be made by the official holder of the record, i.e. primary physician, therapist, public school official.)

The principle investigator (Kimberly Glass) will make initial contact based on records review and recruitment efforts described above through phone call or letter (see attached). Dr.s Harrison and Shapiro will give approval for the use of records.
In each of the above listed sites, parents sign a consent form that allows the records to be used for research and teaching purposes (see attached).

5. c) Is the study sponsor offering *any* incentive connected with subject enrollment or completion of the study (i.e. finders fee, recruitment bonus, etc.) that will be paid directly to the research staff?

☒ No ☐ Yes. If yes describe.

5. d) Will subjects receive inducements before or rewards after the study?

☐ No ☒ Yes. If yes, please describe.

Please note that this information must be included in the consent form, under the heading "Compensation", and not in the "Benefits" section. Also, payments for multiple visits should be prorated.

Children participating in the study will receive a coupon for a free movie rental.

5. e) Will the subjects be charged for research related procedures? If yes, explain
charges, including estimated amounts. This information must be specified in the consent document.

☒ No ☐ Yes. If yes, please describe.

6. Risks and Benefits

6. a)

Does the Research Involve: (Check all that apply)
☐ **Any surgical process**
☐ **Administration of drugs, chemical, or biological agents, or devices. Attach Appendix E**
☐ **Use of controlled substances**
☐ **Use of radioisotopes or other sources of ionizing radiation (including X-rays)**
☐ **Administration of physical stimuli (beyond what is described on the Social and Behavioral Sciences form)**
☐ **Major changes in diet or exercise**
☒ **Use of private records (medical or educational records)**
☒ **Possible invasion of privacy of subject or family**
☐ **Deprivation of physiological requirements such as nutrition or sleep**
☐ **Manipulation of psychological or social variables such as sensory deprivation, social isolation, psychological stresses**
☐ **Any probing for personal or sensitive information in surveys or interviews**
☐ **Use of a deceptive technique, e.g., placebo, double-blind, etc. (suggestion: if deception is part of the experimental design, the protocol must include a debriefing procedure, which will be followed upon completion of the study or upon withdrawal of a subject. Attach a description of the debriefing protocol and any related materials.)**

☐ **Presentation of materials which subjects might consider offensive, threatening, or degrading**		
☒ **Other risks**	**Specify:**	**Anxiety about being tested, either being singled out or just general test anxiety is always a risk in assessing children.**

6. b) Describe the precautions that will be taken to minimize the risk to the subjects.

Medical records will only be accessed to identify possible subjects and these subjects have already signed a consent form allowing the records to be accessed for that purpose. Initial contact will be made through the faculty of the different centers and will offer reassurances that there will be no negative consequences in their care or association with the clinics based on their decision to participate or not to participate. If they agree to be contacted, an additional consent form will be provided that outlines the procedure and reiterates that their association with the Clinics will not be affected in any way based on their decision to participate or not to participate. They will also be informed verbally and through the consent form that they are free to withdraw from the study at any time with no consequences. Although anxiety about the assessment itself can be a risk, the individual administration of these types of tests is expected to alleviate these concerns. If a child appears too anxious or uncomfortable, he or she will be reminded that they may withdraw from the test at any time. The child will be asked to sign an assent form that recognizes the potential for discomfort and indicates that he or she can withdraw from the study.

6. c) Why are the risks and inconveniences mentioned above reasonable? What is the expected scientific yield from the project? Please justify the risks in relation to the anticipated benefits to the subjects, and in relation to the importance of the knowledge that may reasonably be expected to result from the research.

The principle investigator is a graduate student/intern within this system with graduate level training in the ethics of research and patient care.

The parents sign a consent form allowing access to records for research purposes when they are initially seen in the different clinics. Any additional risk of invasion of privacy should be covered by the letter sent by the associated professionals asking if the families are willing to cooperate and the information covered in the second consent form should

provide the amount of information that they need to make the decision whether or not to participate.

6. d) Benefits of Participation

List any anticipated *direct* benefits to participation in this research project. If none, state that fact here and in the consent form. The benefit of receiving
treatment is not necessarily a benefit to participation in the research project.
That distinction is central to the informed consent process.

Parents will receive a summary statement of test results of any standardized measures given (The results from the humor measure will not be provided because it is not a standardized measure).

7. Biological Samples

7. a) Blood drawing, marrow biopsy sampling, biopsy of other tissues, etc.

If samples of body fluids or tissues are taken as part of this research project,
state how much and how often the samples are taken. The consent form must include lay term equivalents for the amounts, e.g. teaspoons etc. Please
distinguish procedures that are diagnostic from procedures that are performed solely for research.

7. b) Will DNA be collected?

☒ No ☐ Yes. If yes, attach Appendix D.

7. c) Will tissue/blood samples be stored with identifiers?

☒ No ☐ Yes. If yes, attach Appendix D.

8. Care of subjects in case of an accident

Select from one of the following compensation options listed below. This language *must* be included in the consent form. If a special contract to pay for research related injuries exists, attach documentation for IRB record.

☐ **Non-sponsor-funded compensation**

In the event that this research activity results in an injury, treatment will be available, including first aid, emergency treatment and follow-up care as needed. Care for such injuries will be billed in the ordinary manner, to you or your insurance company. If you think that you have suffered a research related injury let the study physicians know right away.

☐ **Sponsor funded compensation:**

In the event that this research activity results in an injury, treatment will be available, including first aid, emergency treatment and follow-up care as needed. Care for such injuries will be billed in the ordinary manner, to you or your insurance company. The sponsor of the study has some funds available to pay for care for injuries resulting directly from being in this study. If you think that you have suffered a research related injury and that you may be eligible for reimbursement of some medical care costs, let the study physicians know right away.

☐ **If the preferred injury compensation language is unacceptable to the study sponsor, the following alternative language may be used:**

Under some circumstances the sponsor of the study will pay for care for injuries resulting directly from being in the study. If you want information about those circumstances or if you think you have suffered a research related injury let the study physicians know right away.

9. Confidentiality of Data

9. a) Describe provisions made to maintain confidentiality of the data.

The principle investigator is a staff member (intern) within this system with graduate level training in the ethics of research and patient care.

Study records will only contain the data essential to the study. The records will be coded to remove identifying information. Identifying information will be password protected if on computer and any actual records will be kept in a locked room with

access limited to the investigator and the faculty sponser.

9. b) Where will the data be kept and for how long will it be kept?

The standardized test protocols will be added to the patient's clinic chart. The identifying information will be kept until the dissertation is defended (expected in September of 2002) and then destroyed. The data without identifying information will be kept for approximately five years with the principle investigator, then erased.

9. c) What security provisions will be used? Who will have access to the collected data?

Data will be kept in a file cabinet that is locked from any access other than the principle investigator. A doctoral level student may be hired by the principle investigator to test children. Any data collected will be turned over to the princple investigator within one week of testing. Data stored on computer file will be password protected with passwords known to the faculty sponser, the principle investigator and research assistant (if hired). The need and feasibility of hiring an assistant is still under review. If hired, due to the need for standardized test administration, the student will be a doctoral level trainee who has completed at least one course in resarch ethics.

9. d) Will data identifiying the subjects be made available to anyone other than the Principal Investigator, e.g., FDA, study sponsor?

☐ **No** ☒ **Yes. Please explain below and in the consent form.**

The need and feasibility of hiring a student assistant is still under review. If hired, he or she will have access to the identifying information of the subjects for the purposes of conducting the assessments. Upon completion of the assessment, identifying information will be turned over to the principle investigator to file in the patient's chart or to keep in a locked file cabinet.

9. e) Will the data be part of the medical chart or other permanent record?

☐ **No** ☒ **Yes. Please explain below and in the consent form.**

Any standardized tests administered will be filed in the patient chart to provide information for future care. The parents will receive a summary of standardized test scores to distribute as they wish to (i.e. to share with their school or other institutions.) The summary will contain only test scores, no interpretation of the data.

10. Expedited Review

Expedited Review Request

After careful consideration of risks and review of the expedited review categories it has been determined that this research fits the precise requirements of category # ___ of the "Expedited Review" provision of 45 CFR 46, (see page vii.). The research could be considered of "minimal risk" to participants based on those guidelines. (Note: Most research will not fit the categories for expedited review.) The decision to route the study via expedited review process will be determined upon review of the completed application by the IRB.

11. Informed Consent Process

11. a) Prepare and attach a consent form for IRB review.
Please see the sample consent form and follow it carefully. Do not submit sponsor prepared forms without editing the form to include IRB standard language. See the IRB Web site for the informed consent tutorial: www.research.umn.edu/subjects.htm.

11. b) Describe what will be said to the subjects to introduce the research.
Do not say "see consent form". Write the explanation in lay language. If you are using telephone surveys, telephones scripts are required.

The participants will be given the principal investigator's title and association with the University of Minnesota Medical School Psychology Internship and the University of Texas at Austin, school psychology doctoral program. They will be told that we are exploring humor comprehension in children with different types of learning disabilities. To that end, we are asking parents of children with and without learning disabilities to participate by allowing their children to take a series of standardized tests as well as the humor measure created for this study. They will be told the name of the standardized tests and offered the

results of any tests that their child is administered. They will be told that the test administration will take up to 3 hours depending on the group and that the child will receive a coupon for a free video for their participation. If they are recruited directly from patient records, they will be informed that their choice to participate or not to participate will in no way affect their care at the University of Minnesota. They will be offered the opportunity to ask questions and given a phone number that they can use to reach the principal examiner should they have further questions. (for further details, see the consent and assent form).

11. c) What questions will be asked to assess the Subjects' understanding?

Please answer how you will assess subjects' understanding of the consent process. Questions requiring "yes/no" answers do not do that very well. Please ask subjects to explain the purpose of the study to you along with the risks and the benefits to themselves as participants. Their answers to these questions should allow you to determine if they understand the study and their part in it. If they do not understand, informed consent has not been achieved even if the subjects signed the consent document.

The consent and assent forms will be provided to every participant. For each major section, the parents and children will be asked whether he or she understands the statement. If the parent or child does not seem to completely understand the form (either sounds tentative or looks puzzled) then further details about the questions or paragraph will be provided. children will be asked to paraphrase what they understand about their participation and their right to withdraw from the project.

11. d) In relation to the actual data gathering, when will consent be discussed and documentation obtained?
(e.g., pre-operatively, or several days before?) Be specific.

Verbal consent will be obtained prior to scheduling the assessment. The consent and assent forms will be reviewed prior to commencing testing.

11. e) Will the investigator(s) be securing all of the informed consent?

☐ Yes ☒ No. If no, please name the specific individuals who will obtain informed consent and include their job title and a brief description of your plans to train these individuals to obtain consent and answer subjects' questions.

At this point in time, the primary investigator will be securing all informed consent. The addition of a research assistant to gather data is under review at this time. If a research assistant is added, that person will be a doctoral level student who has had at least one course in research and professional ethics. That person will be further trained to obtained informed consent and ask questions about comprehension as it pertains to this study.

You have reached the end of this form. Please make sure that you have responded to *every* question on this application (even if your response is "not applicable"). Submit 12 copies plus the original for Full Review, and 3 copies plus the original if you are requesting Expedited Review. Please send the application to:

Research Subjects' Protection Programs
IRB
D528 Mayo Memorial Building
MMC 820
420 Delaware Street S.E.
Minneapolis, MN 55455

See the meeting "Meeting Dates and Deadlines" page on the Research Subjects' Protection Programs' Web page: http://www.research.umn.edu/subjects/index.html **to find out the date of the meeting at which your application will be reviewed. If you have any questions, please call us at 612-626-5654.**

APPENDIX D

The Humor Task

Verbal Joke Examples

Phonological: What do you call a chocolate covered sheep?

- A brown sheep (SC).
- A Hershey baa (FC).
- Molly (NS).

Lexical: Why did little Mary hit the egg against the table when she made a cake?

- Because the recipe said to beat the egg (FC).
- To crack the egg so she could dump it in the bowl (SC).
- Because she was a girl (NS).

Cognitive Incongruity: What did the newscaster say after he announced that the world had come to an end?

- Stay tuned, news at eleven (FC).
- Please don't panic (SC).
- I had a hamburger for dinner (NS).

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VITA

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