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A neuropsychological analysis of the psychosocial functioning of two learning disability subtypes

W. Jean Cronin
Loyola University Chicago

LOYOLA UNIVERSITY CHICAGO

A NEUROPSYCHOLOGICAL ANALYSIS OF THE PSYCHOSOCIAL FUNCTIONING OF TWO LEARNING DISABILITY SUBTYPES

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W. JEAN CRONIN

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CHAPTER I

INTRODUCTION

The psychosocial functioning of children with learning disabilities has become of increasing interest to researchers. Various approaches and methods have been utilized to ascertain if, in addition to academic deficits, learning disabled children have concomitant difficulty with social interaction.

There is much agreement that deficits in this area exist. Low social acceptance has been a common finding (Pearl & Cosden, 1982; Siperstein, Bopp, & Bak, 1978). Children with learning disabilities have been found to receive lower teacher ratings (Margalit, Raviv, & Pahn-Steinmetz, 1988), peer ratings (Stone & La Greca, 1990), and parent ratings (Dudley-Marling & Edmiaston, 1985; Strag, 1972) than their normal classmates, as well as lower peer ratings than low achievers (La Greca & Stone, 1990).

There is less consensus regarding why these children receive such poor ratings. Various methods, ranging from evaluating facial perception to direct reporting of differences in the natural setting, have been employed to explore possible causes. The results have shown that the learning disabled have difficulty recognizing facial emotions (Holder & Kirkpatrick, 1991), perceiving nonverbal cues in social interactions (Axelrod, 1982; Gerber & Zinkgraf, 1982;

Jackson, Enright & Murdock, 1987), empathizing (Bachara, 1976), generating alternative solutions during problem solving (Toro, Weissberg, Guare, & Liebenstein, 1990), and formulating useful descriptions when speaking (Bryan, Donahue, & Pearl, 1981).

Research in the area of learning disabilities, however, has been marked by methodological shortcomings and has come under increasing criticism, raising skepticism regarding findings. Definitions of learning disabilities tend not to be clearly specified (La Greca, 1987; Rourke & Fuerst, 1991). Additionally, external validation of laboratory testing with naturalistic observations, or peer or teaching ratings, has often produced weak correlations, or has not been attempted at all (Van Hasselt, Hersen, & Bellack, 1981). But, perhaps the most serious research problem has been the treatment of learning disabled children as a homogeneous group, with comparisons to non-learning disabled peers. Research has demonstrated consistently that the learning disabled are a heterogeneous group (Fletcher & Satz, 1985; Rourke, 1985). Thus, results utilizing a unitary concept are not very meaningful or informative.

Rourke & Fuerst's (1991) review of the literature concluded that there are three hypotheses which have guided research examining the social problems experienced by children with learning disabilities. The social difficulties have been viewed as: (1) an antecedent of the learning disability; (2)

a consequence of the learning disability, or (3) a result of central processing abilities.

The first hypothesis, that the social emotional disturbance produces the learning disability, is not particularly pertinent to a discussion of learning disabilities. According to federal law, The Education for All Handicapped Children Act of 1975, the definition of learning disabilities excludes anyone with a primary emotional disturbance. Therefore, children experiencing learning problems secondary to psychosocial deficits would not meet formal guidelines for inclusion as learning disabled.

It has been typical historically to explain the social difficulties of children with learning disabilities according to the second hypothesis, as a consequence of school failure. However, not all learning disabled children experience social problems. In fact, it has been found that anywhere from 30% (Speece, McKinney, & Applebaum, 1985) to 50% (Rourke & Fuerst, 1991) function normally in this area. Also, it might be expected that if poor academic experience produced the social problems, the social problems would increase as learning disabled children grow older and have experienced more academic difficulty. However, Fuerst and Rourke's (cited in Rourke & Fuerst, 1991) cross sectional analysis of seven to thirteen year old learning disabled children found, in general, no evidence of increased pathology in older children. There was no greater diversity or increased severity of pathology in the older children than had been identified at younger ages.

The third hypothesis represents a neuropsychological approach and has been the focus of much attention recently. Although a neuropsychological perspective was endorsed early by Johnson and Myklebust (1967), professionals have been relatively slow to consider that the same brain mechanisms negatively affecting academic performance might also adversely affect social behavior (Wilchesky & Reynolds, 1986). But, as it was demonstrated that there are different central processing and academic subtypes of learning disabled children, and that a relationship exists between patterns of central processing and academic performance (Rourke, 1985), interest was raised regarding the possibility of similar differences and relationships in the area of social functioning.

Thus, there is much research to support that some learning disabled children have difficulty interacting socially. Efforts to better understand this problem have increased. Neuropsychology has provided a framework for the overall conceptualization and analysis of learning disabilities and offers a new perspective for the analysis of social functioning. However, to date, there has been limited utilization of such an approach. Therefore, research directed at analyzing the psychosocial functioning of learning disabled children from a neuropsychological perspective appeared clearly warranted and was the focus of this study. Specifically, the purpose of this research was to further explore Rourke and Fuerst's (1991) hypothesis that the same brain mechanisms which produce academic deficits also produce psychosocial deficits in children with learning disabilities. The affective processing and social interactions of two academic subtypes of learning disabled children were investigated.

CHAPTER II

REVIEW OF RELATED LITERATURE

Introduction

Neuropsychology is the study of the relationship between the brain and behavior (Kolb & Whishaw, 1985). However, there is limited validation of specific brain-behavior relationships. As technology is becoming more sophisticated, with the development of such techniques as event related potentials, positron emission tomography, and single photon emission computed tomography, more knowledge is being acquired. But, the current emphasis in neuropsychology is on the inter-relationship of behaviors.

A. R. Luria (1973), a Russian neuropsychologist who worked extensively at refining clinical evaluations of the behaviors of brain damaged patients, theorized that mental activity is a complex functional system which is not localized in narrowly prescribed areas of the brain. Rather, it consists of groups of functional units which work together as a whole. He stressed the importance of determining the basic functions of the brain and the role of each in complex mental processing. Therefore, in order for a behavioral analysis to be potentially reflective of the status of the central nervous system, the various areas of functioning, as well as the inter-relationship of these areas of functioning, need to be considered.

Luria's work is very much apparent in neuropsychology today. The basis of neuropsychological assessment is the measurement of ability functions across a broad range of cognitive and behavioral areas, and the subsequent analysis of relationships among those areas of functioning. This measurement is considered reflective of the integrity of the central nervous system (Fletcher & Taylor, 1984).

Fletcher and Taylor (1984) have developed a functional model of neuropsychological assessment which not only looks at the relationship between ability and the brain, but also recognizes the importance of developmental factors and environmental influences on behavior. This assessment model is comprised of four factors. The first factor is the manifest disabilities, which are the presenting problem(s), such as learning or behavioral problem(s). The second component is basic competencies, which are the processing abilities, such as attention and memory. The third factor is the moderator variables, which relate to the personal or environmental influences. The fourth component is the biological indices, which represent the central nervous system. According to this model, the biological indices have a direct influence on the basic competencies and the manifest disabilities. The manifest disabilities and the basic competencies are directly related, with the moderator variables indirectly influencing the relationship between them.

The functional approach utilized in neuropsychology today will be employed to conceptualize and develop an analysis of the previously discussed third hypothesis regarding the etiology of social problems in the learning disabled. Specifically, it will provide a framework for examining the relationship between central processing (basic competencies) and academic and social deficits (manifest disabilities) in children with learning disabilities. Support in the literature for such relationships will be discussed, as well as support for these relationships being reflective of brain functioning.

Patterns of Central Processing and Academic Performance in Learning Disabled Children

There have been numerous studies directed at determining patterns of central processing that differentiate learning disabled children. This research has consistently produced three general groups of children. These groups, identified by their areas of deficit, consist of an auditory-linguistic, visual/spatial and mixed group (Lyon, Stewart, & Freedman, 1982; Rourke, Young, & Flewelling, 1971). These groups appear to have construct validity within a neuropsychological perspective (Hartlage & Telzrow, 1983).

Thus, there is support for variation in patterns of central processing in children with learning disabilities.

But, to further evaluate the third hypothesis, it would be necessary to demonstrate a relationship between central processing and different patterns of academic functioning.

The examination of academic patterns among the learning disabled has primarily utilized the Wide Range Achievement Test (WRAT; Jastak & Jastak, 1965). One of the earliest studies, which served as a stimulus for much additional research, was performed by Rourke and Finlayson (1978). Their comparison of the performance of children with learning disabilities on the WRAT produced three distinct subtypes. Group 1 (RASD) subjects were uniformly deficient in reading, spelling and arithmetic. Group 2 (RSD) subjects had impaired reading and spelling compared to arithmetic. Group 3 (AD) subjects had impaired arithmetic compared to spelling and reading. Of note, arithmetic performance was below age level across all groups. A qualitative analysis of arithmetic errors revealed that the RSD subjects were inexperienced with the subject matter. This was attributed to emphasis in the classroom on reading and spelling skills at the expense of math skills. In contrast, the AD children exhibited difficulty with spatial organization, visual discrimination, shifting psychological set, graphomotor skills, and judgment and reasoning.

Further examination by Rourke and Finlayson (1978) of these three groups of learning disabled children demonstrated that the RSD group had a lower verbal intelligence score (VIQ) than performance intelligence score (PIQ), with the reverse true for the AD group. Additional analysis of performance on sixteen dependent measures demonstrated that: (1) The AD group was deficient on measures of visual/perceptual and visual/spatial abilities, and (2) the RSAD and RSD groups were deficient on measures of verbal and auditory/perceptual abilities. Similar results were obtained from subsequent research focusing on only the RSD and AD groups (Ozols & Rourke, 1988).

Rourke & Strang (1978) compared the three groups of children on measures of motor, complex psychomotor and tactile perceptual functioning. No significant differences were found on simple motor tasks. However, the RSD group had relatively poorer right hand then left hand performance on tactile perceptual tasks. The AD group demonstrated impairment bilaterally on two measures of psychomotor ability and more impaired left than right hand performance on tactile perceptual tasks.

A third study (Strang & Rourke, 1983) comparing the three groups revealed that the AD group had difficulty with nonverbal concept formation and reasoning. It was also found that these children did not benefit from experience. It was hypothesized that these difficulties contribute to problems with an appreciation of math concepts and might also be expected to result in an inability to profit from social interactions.

Thus, subtyping research of learning disabled children has demonstrated not only different patterns of central processing and academic ability among the learning disabled, but also a relationship between these patterns. In general, children who have more difficulty with auditory/linguistic than visual/spatial functioning, and who perform more poorly on the verbally- than the visually-mediated tasks of intelligence tests, have problems acquiring reading skills. Children who experience more problems with visual/spatial than auditory linguistic functioning, and who have more difficulty with the visually- than the verbally-mediated tasks of intelligence tests, tend to have difficulty acquiring math skills. This knowledge regarding the different central processing and academic subtypes in learning disabled children resulted in increased interest in exploring whether there were psychosocial subtypes as well.

Psychosocial Subtypes of Learning Disabled Children

Various measures and statistical techniques have been employed to examine the psychosocial functioning of learning disabled children. This research has consistently demonstrated that not all learning disabled children have psychosocial problems, and that those who do, vary in terms of the type of difficulties they experience.

Porter and Rourke (1985) examined the scores of one hundred learning disabled children on the Personality

Inventory for children (PIC; Wirt, Lachar, Klinedinst, & Seat, 1977). The sample consisted of eighty-seven males and thirteen females from the ages of six and one-half to fifteen who had Wechsler Intelligence Scale for Children (WISC; Wechsler, 1949) scores between 85 and 115, and at least one score on the WRAT equal to or less than the 25th centile. When the learning disabled children were examined as a whole, there were no significant elevations on psychopathology scales, only on scales relating to intelligence and achievement. Factor analysis produced four behavioral subtypes: (1) a Normal Group (44%) with significant elevations only on subscales relating to intelligence and achievement; (2) an Internalizing Group (26%) with significant elevations on subscales relating to adjustment, achievement, intelligence, depression, psychosis, and social skills; (3) a Somatic Concerns Group (13%) with a significant elevation on the subscale relating to somatic complaints, and (4) an Externalizing Group (17%) with significant elevations on those subscales relating to adjustment, intelligence, development and hyperactivity. It was found that 47% of the subjects had a verbal intelligence score lower than the performance intelligence score, and 9% had a performance intelligence score lower than the verbal intelligence score.

Fuerst, Fisk and Rourke (1989) attempted to replicate the subtypes from the Porter and Rourke (1985) study by analyzing the PIC (Wirt et al, 1977) scores of a new sample of learning disabled children. One hundred thirty-two children, sixty-six males and sixty-six females, from the ages of six through twelve, who were having learning or perceptual problems, were selected from more than two thousand clinic referrals. Six different statistical techniques consistently produced a normal (55%), externalizing (24%), and internalizing (20%) group.

Fuerst, Fisk and Rourke (1990) also performed an empirical analysis of the PIC (Wirt et al, 1977) scores of learning disabled children from the Fuerst et al. (1989) study, employing more sophisticated clustering techniques to obtain a more precise analysis of psychosocial functioning. Six clusters were produced: Normal Group (18%); Mild Anxiety (21%); Mild Hyperactivity (34%); Somatic Concerns (17%); Internalized Psychopathology (26%), and Externalized Psychopathology (16%).

Fuerst and Rourke (in press) attempted to replicate the six subtypes from the Fuerst et al. (1990) study. Five hundred children were randomly selected from five thousand clinic referrals. Subjects were between the ages of six and twelve, had intelligence scores on the WISC between 80 and 120, and had at least one T-score on the PIC (Wirt et al, 1977) that was greater than 70. There were 379 males and 121 females. K-means technique produced five of the subtypes found in the previous study: Normal; Somatic Concerns; Mild Anxious; Externalizing, and Internalizing. No mild hyperactive group was found, but there was a conduct disorder group.

Speece et al. (1985) empirically analyzed learning disabled children's behavior based on teacher responses on the Classroom Behavior Inventory (CBI; Schaefer, Edgerton, & Aronson, 1977). Subjects were sixty-three first and second graders who had been identified as learning disabled according to federal and state guidelines and had a Wechsler Intelligence Test for Children-Revised (WISC-R; Wechsler, 1974) Verbal or Performance IQ score equal to or greater than 85. Cluster analysis produced seven subtypes: (1) Normal group with minor difficulty with task oriented behavior and independence (28.6%); (2) Normal group with a slight tendency toward being more considerate and introverted, with significantly more females than males (25.4%); (3) Poorly socialized group with significant problems with distractibility, hostility and lack of consideration for others, composed of all males (14.3%); (4) Withdrawn group with significant difficulty regarding dependency and introversion (11%); (5) Normal group with a tendency toward being less considerate and more hostile; (6) Undefined (6.3%), and (7) Seriously disturbed group (4.8%).

Fuerst and Rourke (cited in Rourke & Fuerst, 1991) examined the relationship between the age of learning disabled children and psychosocial functioning. PIC (Wirt, Lachar, Klinedinst, & Seat, 1984) scores were evaluated at three ages levels: 7-8 year old, 9-10 year old, and 11-13 year old children. There were over two hundred subjects in each group. At each age level, cluster analysis of the parent report of psychosocial functioning produced three common subtypes: Normal, Internalized and Externalized.

Further support for the stability of psychosocial functioning is found in a three year longitudinal study of learning disabled children by McKinney and Speece (1986), which began when the children were in the first and second grade. It was found that subtype membership was moderately stable over time according to teacher report.

In summary, research utilizing an empirical approach to analyze the psychosocial functioning of the learning disabled has consistently yielded three groups across different samples, measures, and ages. These groups are: (1) a normal group ; (2) an internalizing group; and (3) an externalizing or hyperactive group. These results generated interest in investigating whether there might be a relationship between these psychosocial subtypes and the central processing and academic subtypes which had been identified.

Patterns of Intellectual and Psychosocial Functioning in Learning Disabled Children

Studies of the psychosocial functioning of learning disabled children have included an examination of the relationship between children's performance on intelligence tests and assessments of the children's social/emotional functioning. Based on findings of significant relationships between central processing and academic functioning in learning disabled children, it was predicted that there would also be a significant relationship between the patterns of intellectual and psychosocial functioning.

Landau, Milich, and McFarland (1987) compared third through sixth grade learning disabled boys with nonlearning disabled, male classmates using peer evaluations and teacher report of behavior. Learning disability criteria was based on state guidelines for determining a discrepancy between ability and achievement, with a control for possible regression effects. They found that according to peers, the learning disabled boys, with verbal scores at least fifteen points lower than performance scores, were significantly less popular, more withdrawn and less likeable than controls. According to teachers, they were more inattentive and more overactive than controls. The learning disabled boys with performance scores at least fifteen points lower than verbal scores were reported by peers to be significantly less likeable than controls. The learning disabled boys with verbal and performance scores within eight points of each other were reported by peers to be more rejected, more aggressive, less popular, and less likeable than controls. According to teachers, this group was also more inattentive and overactive than controls.

Fuerst et al. (1990) selected 132 children, ages six to twelve, from two thousand children who were clinic referred because of suspected learning disability. Three groups were formed based on patterns of IQ performance. A difference of at least ten points was required for a Verbal-Performance IQ discrepancy (VIQ<PIQ; PIQ<VIQ). A Verbal equal to Performance IQ pattern (VIQ=PIQ) required scores within nine points of each other. The three groups were found to differ in terms of Full Scale IQ (FSIQ), with the PIQ<VIQ group significantly lower than the VIQ<PIQ group. The mean PIC (Wirt et al, 1977) profiles for the VIQ<PIQ and the VIQ=PIQ were normal. However, the mean PIC scores for the PIQ<VIQ group were significantly elevated on the Adjustment, Delinquency and Psychosis subscales.

An empirical analysis of the PIC scores from the Fuerst et al. (1990) study produced six subtypes: Normal (18%); Somatic Concerns (17%); Mild Anxiety (21%); Mild Hyperactivity (34%); Internalized Psychopathology (26%), and Externalized Psychopathology (16%). The six subtypes were then subdivided based on VIQ-PIQ patterns. The PIQ<VIQ group was found significantly less often in the Normal and Mild Anxious group, representing only about 5% of the subjects in these groups.

The PIQ<VIQ group represented 63% of the Externalized subtype, which was statistically significant, and 46% of the Internalized subtype, which approached significance. The VIQ<PIQ represented 50% of the Normal group and 45% of the Mild Anxious group, both of which were significant. The VIQ<PIQ represented 39% of the Internalized subtype.

Research attempting to relate psychosocial functioning to patterns of performance on intelligence tests has produced somewhat mixed results. The Landau et al. (1987) study found no significant differences between the subtypes of learning disabled children. However, the VIQ<PIQ and the VIQ=PIQ groups exhibited greater psychopathology than controls, with a tendency for the VIQ=PIQ group to be more externalized and the VIQ<PIQ to be more internalized. The Fuerst et al. (1990) study also found a tendency towards internalized behavior in the VIQ<PIQ group. A tendency towards internalization, as well as significant externalizing psychopathology was found in the PIQ<VIQ group. However, there was a significantly lower FSIQ for the PIQ<VIQ than the other two groups.

Patterns of Academic and Psychosocial Functioning in Learning Disabled Children

There have been considerable research efforts directed at attempting to establish a relationship between academic and psychosocial subtypes of learning disabled children. This has focused primarily on the academic areas of reading or reading/spelling and arithmetic.

Ozols and Rourke (1985) investigated the performance of the RSD and AD groups on four tasks of social sensitivity. It was found that social perception and responsiveness varied as a function of the task demands. The children with a relative strength in visual spatial processing (RSD) did better than the children with a relative strength in language-related skills (AD) on tasks which required nonverbal responses. The opposite was true when verbal responses were required. There were also differences noted in the behavior of the two groups of children. The children with language-related deficits initiated very little conversation and were brief and concrete when responding. The children with visual/spatial deficits frequently stared at the examiner and paid very little attention to their surroundings. Little emotion was expressed either on their faces or in their voices. However, they were talkative and frequently expressed verbal resistance to difficult tasks. This latter was in contrast to the RSD children who tended to respond to difficult tasks by simply stating they did not know.

Loveland, Fletcher, & Bailey (1990) compared the performance of a Reading-Arithmetic Disabled group (RAD), an Arithmetic disabled group (AD), and a normal group (ND) on verbal and nonverbal communication in response to videotaped vignettes. Performance varied as a result of task demands. RAD children produced more errors than the AD children when verbal input was provided and verbal output was required. AD children made more errors than the RAD group when nonverbal input was provided and nonverbal output was required.

Fuerst and Rourke (in press) computed WRAT means for the six behavioral subtypes which were produced from the PIC (Wirt et al, 1977): (1) Normal; (2) Somatic Concern; (3) Mild Anxiety; (4) Externalized Psychopathology; (5) Internalized Psychopathology, and (6) Conduct Disorder. Planned comparisons contrasting the reading, spelling, and math scores of the Internalized and Externalized Psychopathology subtypes with the Normal, Conduct Disorder and Somatic subtypes demonstrated that the former group's performance was significantly higher than the latter for reading and spelling, but not math. Also calculated was the difference between the reading and arithmetic means and the difference between the spelling and arithmetic means for each subtype. The greatest difference for both was found in the Internalized Psychopathology subtype. Planned comparisons contrasting the Internalized Psychopathology subtype's performance with all the other subtypes was statistically significant for both of the difference measurements. Thus, it was concluded that the Internalized and Externalized Psychopathology groups had significantly higher Reading and Spelling scores, and that the Internalized Psychopathology group had significantly greater Reading and Spelling than Arithmetic scores.

Nussbaum and Bigler (1986) empirically analyzed the PIC (Wirt et al, 1977) and Child Behavior Checklist (CBC;

Achenbach & Edelbrock, 1983) scores of learning disabled children between the ages of eight and twelve who were referred to a clinic because of academic difficulties in the language arts and/or math. Subjects had a VIQ or PIQ of at least 80, and a discrepancy of at least one and a half standard deviations between ability and achievement. Three behavioral subtypes were derived. Group 1 had severe and generalized deficits in all academic, intellectual, and neuropsychological areas. Group 2 exhibited moderate impairment on all of the measures and was the only group to demonstrate a VIQ-PIQ discrepancy, which was in favor of the latter. This group's description appeared similar to language disabled groups in other studies, but without an arithmetic impairment. Group 3 was superior to the others in functioning but showed poorer visual/constructional functioning than Group 2. Comparisons of the three groups on personality and behavioral measures found that the language group (Group 2) scored significantly higher on the Depression and Internalizing subscales of the CBC. However, it should be noted that there were differences in IQ scores across the three groups (Group 1 Mean: VIQ=116, PIQ=114; Group 2 Mean: VIQ=96; PIQ=102; and Group 3 Mean: VIQ=116, PIQ=114), with Group 2 having the lowest IQ.

The results of these learning disability studies provide some support for a relationship between patterns of academic functioning and psychosocial functioning. The reading disabled children tend to do better on socially sensitive tasks which are visual in nature, and the arithmetic disabled children tend to do better on ones that are auditory. Also, children with better reading and spelling skills tend to have more externalized and internalized pathology. However, a lack of control for IQ across groups has been a problem with some of the research in this area. This, together with variations across studies in the criteria for learning disabilities, makes it difficult to interpret and compare results.

In summary, auditory/linguistic deficits and poorer verbal than performance intelligence scores have been associated with reading problems and verbally-mediated social deficits. Visual/spatial deficits and poorer performance than verbal intelligence scores have been associated with math problems and visually-mediated social deficits. The studies looking at psychopathology in these groups have shown, in general, a tendency for internalizing in the poor reading group, and significant psychopathology in the arithmetic group. Rourke and Fuerst (1991) concluded from their research that the RSD profile was similar to that exhibited by children with no psychopathology, and that the AD profile was similar to that exhibited by children with internalizing psychopathology.

Therefore, the AD group has been the focus of particular attention from neuropsychologists because of the association of central processing deficits not only to academic deficits, but also to significant deficits in psychosocial functioning. Rourke (1989), in particular, has investigated this group of children extensively, and he has identified a particular pattern of strengths and weaknesses which he refers to as the Nonverbal Learning Disability Syndrome.

Nonverbal Learning Disabilities

Rourke's (1989) Nonverbal Learning Disability Syndrome (NLD) is characterized by a profile of specific strengths and weaknesses. The primary central processing deficits are described as difficulties with tactile perception, visual perception, complex psychomotor functioning, and dealing with novel material. The secondary deficits are tactile and visual attention, as well as exploratory behavior. Tertiary processing deficits are tactile and visual memory, concept formation and problem solving. Academic deficits for the NLD syndrome are reportedly reading comprehension, mechanical arithmetic, mathematics, science, as well as early difficulty with graphomotor tasks. Socioemotional/adaptational deficits are described as problems with adapting to novelty, social competence, emotional stability and activity level.

Thus, according to Rourke (1989), the academic and the psychosocial functioning of the NLD children are related to the interaction among and between their neuropsychological strengths and weaknesses. Therefore, the academic and psychosocial factors are viewed as dependent upon the central processing deficits related to visual/perceptual and visual/constructional functioning, adaptation to novel stimuli, as well as the formation of concepts, generation of strategies, and problem solving.

The arithmetic difficulties of NLD children are usually quite significant (Gordon, 1992; Rourke, 1989). The mechanical arithmetic abilities of NLD adolescents reportedly rarely exceed the fifth or sixth grade level. Spatial organizational errors, such as misaligning numbers in columns and becoming confused regarding directionality, are common errors. Problems with visual inattention are often seen, resulting in, for example, misread arithmetic signs and omitted decimals in answers. Procedural errors also occur, such as applying the wrong procedures or omitting or adding steps. NLD children frequently have trouble shifting from one operation to another; they may continue to add when another operation is indicated. Difficulty with graphomotor skills often results in numbers being written poorly, and so large, that written work is crowded and difficult to read, resulting in additional errors. Older children frequently have learned arithmetic rules and operations, primarily by verbal mediation. However, they may exhibit problems in judging when to use a particular stored memory. In addition to problems with the inherent spatial demands of mathematics, broader issues with acquiring number concepts may pose even greater difficulty for these children. This may be reflected in a failure to acquire an overall framework for number concepts, making learning to tell time and count money difficult.

Rourke (1989) attributed the psychosocial functioning of NLD children to their processing deficits. He described the neuropsychological deficits and assets as producing the following psychosocial difficulties:

> 1. Deficits in social judgment as a result of the more basic problems in reasoning and concept formation.
>
> 2. Problems with visual-spatial-organizational skills which result in difficulty with the identification and recognition of faces, expressions of emotion, and other nonverbal dimensions of communication.
>
> 3. Lack of prosody, but a high volume of verbal output, which tends to be boring and produce negative feedback from listeners.
>
> 4. Difficulty with close relationships because of , deficient psychomotor and tactile-perceptual skills which are necessary for appropriate affectionate interactions.
>
> 5. Problems with spontaneous interaction and adaptation because of difficulty with novelty, hypothesis testing and problem solving. (Rourke, 1989, 98-99)

Other researchers have found a profile similar to that depicted by Rourke (1989). Johnson and Myklebust (1967) described similar children. They associated visual/spatial difficulties with arithmetic and social deficits and characterized the children as having "social imperception". Voeller (1986) found a high frequency of attention deficit disorder with and without hyperactivity in these children. Medication tended to improve attention, but not the behavior problems. And, not all of the children had attention difficulties, suggesting the behavior problems were not attributable to the attention deficit.

Thus, there has been a great deal of research focused on studying children who have NLD. Although the detrimental consequences of a reading disability, in terms of academic success, have been well understood for some time, the possibility of an arithmetic disability being associated with significant consequences is a relatively new concept. The profile of strengths and weaknesses developed for arithmetic, as well as reading disabled children, has come to be considered reflective of the integrity of the central nervous system. Therefore, there has been much interest recently in attempting to better understand the relationship between central processing/academic/social deficits and the brain.

Brain Laterality Hypotheses

Verbal and performance intelligence scores are believed to be reflective of the differential integrity of the cerebral hemispheres (Rourke & Telegdy, 1971), with poor verbal scores indicating left hemisphere dysfunction and poor performance scores indicating right hemisphere dysfunction. In a review of the literature, Semrud-Clikeman and Hynd (1990) concluded that because both arithmetic and social-emotional functioning involve the manipulation of visuospatial and perceptual processing, they appear to be related to the right hemisphere. The NLD profile is characterized by lower performance than verbal scores on intelligence tests, poor arithmetic skills, and poor socialization, all of which have been associated with right hemisphere dysfunction.

Support for an association between NLD deficits and right hemisphere dysfunction is found in the literature dealing with populations of medically involved children with learning disorders. Although Rourke (1989) originally described the syndrome as being associated with learning disabled children with no significant medical histories, subsequent research revealed that children with various forms of neurological disorders, diseases, and dysfunctions also manifested the NLD profile. For example, many children with head injuries, hydrocephalus, agenesis of the corpus callosum, removal of significant tissue from the right cerebral hemisphere, as well as children with acute lymphocytic leukemia and other forms of cancer, who received central nervous system irradiation, demonstrated this same pattern of deficits. All of these examples involve significant destruction or disturbance of the axonal matter in the brain. In addition to developmental and medical problems being associated with right hemisphere dysfunction, some researchers have also found a possible genetic tendency toward right hemisphere dysfunction (Voeller, 1986; Weintraub & Mesulam, 1983).

There is some "hard" evidence for associations between central processing and differential hemispheric functioning. Positron emission tomography has shown that Wernicke's area in the left hemisphere is specialized for language, and the homological right hemisphere region for Wernicke's area is specialized for processing visual patterns (Kushner et al, 1988). Mattson, Sheer, and Fletcher (1992) found differences in reading and arithmetic disabled children on electrophysiological measures, which support hemispheric processing differences in learning disabled children. They found less left hemisphere activity in the reading disabled during a verbal task, and less right hemisphere activity in the arithmetic disabled during a nonverbal task.

Theories of structural differences have been offered as explanations for the findings relating to asymmetrical hemispheric functioning (Rourke, 1991). Gur et al (1980) found that the gray to white matter ratio in the brain is greater in the left hemisphere. Goldberg and Costa (1981) proposed that because of these differences the two hemispheres have different processing modes. They suggested that the right hemisphere is important for intermodal integration due to a greater amount of white, axonal, matter. The right hemisphere is, therefore, more adept at dealing with novel information for which there are no preexisting codes. The left hemisphere is viewed as important for intramodal processing due to the greater amount of grey matter. It is believed to be specialized for processing information into existing schemes or codes, such as language.

Affective Processing in Normal and Brain Damaged Patients

Studies of normal and brain injured children provide support for a right hemisphere specialization for the processing of emotional information. There is considerably more support in the adult literature, however, because adults tend to have more focal injuries than children and have been studied more extensively. Although it might be argued that inferences about children should not be based on adults because of developmental issues, Denckla (1973) stated that making such comparisons might be helpful in developing clinical classifications. Thus, an inclusion of adults in a review of the literature pertaining to this area appears justified. Unless otherwise indicated, the following discussion of research pertains to adults.

The right hemisphere has been shown to be superior at processing faces and facial affect (Battista & Whitman, 1992; Benton & Van Allen, 1968; Etcoff, 1984; Ley & Bryden, 1979; Moreno, Borod, Welkowitz, & Alpert, 1990). The processing of facial affect has produced event related potentials over the right centroparietal area (Bader, Lanares, & Oros, 1991).

Voeller, Hanson, & Wendt (1988) found that RHD children performed significantly below controls and LHD children in processing facial affect. A maturational component to facial perception was demonstrated, which has been found in other studies (Carey, Diamond, and Woods, 1980). Five year olds and six year olds performed significantly more poorly than 7 through 9 year olds. Happiness was the easiest, and fear was the most difficult affect to identify. However, RHD children made more errors with happiness, confusing it with anger. Also of note, seven of the eight RHD patients were described as having social difficulties.

Marcel and Rajan (1975) found that both good and poor readers from the ages of 7 to 9 years showed a left visual field (right hemisphere) superiority for facial recognition. However, good readers demonstrated a greater right visual field superiority for recognizing 5 letter words. The extent of the word recognition asymmetry was not related to the facial recognition performance.

The problems that right hemisphere damaged (RHD) patients have in processing faces and facial affect, which left hemisphere damaged (LHD) patients and controls do not have, has been attributed to difficulties with visual perceptual processing, attention, and dealing specifically with emotional information. However, Etcoff (1984) found that the RHD problems in this area could not be attributed to general attentional problems. Attempts to dissociate visual perceptual and emotional components have been more difficult.

The right hemisphere preference for processing facial affect has been attributed to its superiority in dealing with complex visuoperceptual processing and not to a specialization for emotional processing (Bryden & Ley, 1983; Bowers, Bauer, Coslett, & Heilman, 1985). However, Bowers et al. (1985)

found that when RHD and LHD patients were equated statistically on visuoperceptual ability, the RHD group performed significantly poorer than the other two groups on tasks which required categorizing expressions by either naming or pointing. They were not impaired when making associations which involved determining whether two pictures of different people expressing different emotions were the same, when no reference to emotional expression was made in the instructions. These findings suggest a right hemisphere specialization for affective processing.

Blonder, Bowers, and Heilman (1991) used a sophisticated research design to further examine this issue. They had RHD patients, LHD patients, and controls interpret sentences which contained emotional words and references to emotional situations, as well as sentences with verbal descriptors of nonverbal expressions. It was found that the RHD patients not only had difficulty with the perception of facial and prosodic affective information, but also had difficulty understanding the same when they were verbally described. For example, they had no difficulty inferring the meaning of "the house seemed empty without her", but did have difficulty interpreting the meaning of "He spoke quickly and breathlessly". The authors offered this as support for a right hemisphere nonverbal emotional lexicon similar to the left hemisphere's verbal lexicon. Although this finding could result from a problem with visual imaging, Bowers, Blonder, Feinberg, and Heilman

(1991) demonstrated that RHD patients are more impaired with facial imaging than object imaging, which would lend support to the nonverbal emotional lexicon explanation. Additionally, emotional content, but not nonemotional content, pictorially presented, can suppress pragmatic performance in RHD patients, but actively facilitate pragmatic performance in LHD patients (Bloom, Borod, Obler, & Gerstman, 1992).

Tranel, Damasio, and Damasio (1988) found a dissociation between the identification of faces and the categorization of faces based on expression, gender and age. Patients with intact categorization, but an inability to recognize familiar faces (prosopagnosias), were able to recognize voices. The authors proposed that the interpretation of different aspects of facial information draws upon different cognitive processes, which in turn are dependent on different neural mechanisms.

RHD patients, but not LHD patients, have been found to have difficulty producing facial expressions in response to nonverbal emotion. Heilman & Bowers (1990) proposed that a combination of low arousal and difficulty comprehending affect in patients with right hemisphere damage may produce emotional flattening. It has been suggested that this may occur when systems in the right hemisphere which are responsible for interpreting the nonverbal emotional information are disrupted and/or not successful at activating the appropriate motor programs (Richardson, Bowers, Eyeler, & Heilman, 1992). There does appear to be a dissociation between facial expression and representation, however, as RHD patients who could not communicate facial affect in response to nonverbal stimuli were able to do so on command and in response to emotional sentences (Richardson et al. 1992). Work with prosopagnosias has also suggested a dissociation between facial expression and representation, as these patients are able to make faces even though they are not able to recognize them (Etcoff & Magee, 1992).

Dichotic listening paradigms have been employed to study affective processing in normal adults and children. The left ear was found to be somewhat superior when similar affect was presented, but significantly superior when different affect was presented (Bryden & Ley, 1983). Using verbal material, a right ear advantage was shown for content and a left ear advantage for emotional tone (Bryden & Ley, 1983; Safer & Leventhal, 1977). These results were found in children as young as kindergarten (Bryden & Ley, 1983), and although performance improved with age, there was no change in laterality with age. However, there was more laterality shown for girls than boys. In adult testing, no support was found for differential hemispheric processing of positive and negative emotional tone (Ley & Bryden, 1982). Thus, a clear right hemisphere preference has been demonstrated for auditory, emotional information. However, Bryden and Ley (1983) cautioned that these findings could be due to a right hemisphere superiority in the processing of complex patterns as opposed to a specialization for the interpretation of emotion.

In summary, research of normal and brain damaged people has demonstrated a right hemisphere superiority for the processing of nonverbal emotional information. These findings raised questions about a possible association between emotional processing deficits and psychopathology in learning disabled children with deficits suggestive of right hemisphere dysfunction.

Affective Processing in Learning Disabled Children

Lai and Shapiro (1990) investigated the relationship between affective processing, social skills and cognitive functioning in a heterogeneous group of learning disabled children. It was found that children with relatively lower scores on the facial and prosodic affective processing tasks were rated by their teachers as having more social problems.

Purpose and Hypotheses

There is support in the learning disabilities literature for a relationship among patterns of central processing, academic, and psychosocial functioning. Children with arithmetic disabilities, when compared to children with reading disabilities and children with no learning problems, have been found to be at increased risk for psychopathology and to have deficits suggestive of right hemisphere dysfunction. Of interest, there is evidence in the literature that patients with right hemisphere brain damage have difficulty processing affective information. However, to date there has been limited examination of the social functioning of subtypes of learning disabled children, and none specifically investigating affective processing. Therefore, the purpose of this research was to further explore the psychosocial functioning of two academic subtypes of learning disabled children, arithmetic (AD) and reading (RD), utilizing a neuropsychological perspective.

It has been stressed that to assess a child's social functioning, it is necessary to use real-life situations, where the child is dealing with multiple, simultaneous stimuli (Maheady & Maitland, 1982). However, it might also be argued that Luria's (1973) theory of functional systems would make it equally important to study areas of social functioning in isolation, because meaningful information may be obtained to assist with an understanding of overall social functioning.

Rourke & Fuerst's (1991) conceptualization of social competence consists of three areas of functioning. The first area of social competence is perceptual functioning, which is important for understanding verbal, but most importantly nonverbal communication, since over 90 percent of communication in a social transaction has been estimated to be nonverbal (Mehrabian, 1968). The second area is the cognitive skills necessary for problem solving and making decisions about social situations. The third area of functioning relates to the language and motor skills, through which social behavior is expressed. These three areas of functioning interact not only with each other, but with other variables, such as motivation and self-esteem, as well as the specific context of any social situation.

The present research included direct assessment of important functional units at the different levels of social competence as conceptualized by Rourke and Fuerst (1991). Both isolated and simultaneous stimuli were employed. The primary focus was on facial and prosodic affective processing, which would be important functions at the first level of social competence. The second level of social competence was examined by: (1) having the subjects describe how they, as well as child actors, would behave in situations presented on videotape (active versus passive behavior), and (2) having the subjects generate alternative ways of behaving. The third level of social competence was examined by collecting information regarding the type of behavior (verbal versus nonverbal) the subjects described for both themselves and the child actors. Additionally, observational information regarding social skills and adaptive functioning was obtained from parents and teachers to attempt to validate the experimental findings. The following research hypotheses were tested:

Hypothesis 1: There will be a significant difference in facial affective processing across three patterns of academic achievement, with the AD receiving significantly lower scores than the RD or Control groups.

Hypothesis 2: There will be a significant difference in prosodic affective processing across three patterns of academic achievement, with the AD receiving significantly lower scores than the RD or Control groups.

Hypothesis 3: There will be a significant difference in attention to prosody across three patterns of academic achievement when content and prosody are incongruent, with the AD and Control groups attending less to prosody than the RD group.

Hypothesis 4: There will be a significant difference in responses regarding how actors in the video vignettes will behave, with the AD providing more passive responses than the RD or Controls groups.

Hypothesis 5: There will be a significant difference in responses regarding how the subjects report they would personally respond in situations depicted in the video vignettes, with the AD providing more passive responses than the RD or Control groups.

Hypothesis 6: There will be a significant difference in the generation of alternative behaviors, with the AD providing more responses than the RD group.

Hypothesis 7: There will be a significant difference in the number of verbal behavioral choices the subjects make for themselves in response to the video vignettes, with the AD group providing more than the RD group.

Hypothesis 8: There will be a significant difference in the number of nonverbal behavioral choices the subjects make for themselves in response to the video vignettes, with the AD group providing less than the RD group.

Hypothesis 9: There will be a significant difference in parent report of clinically significant internalizing behavior across the three patterns of academic achievement, with the AD group having significantly higher scores.

Hypothesis 10: There will be a significant difference in teacher report of clinically significant internalizing behavior across the three patterns of academic achievement, with the AD group having significantly higher scores.

Hypothesis 11: There will be a significant difference in teacher report of social skill difficulty across three patterns of academic achievement, with the AD group having significantly lower scores.

CHAPTER III

METHODOLOGY

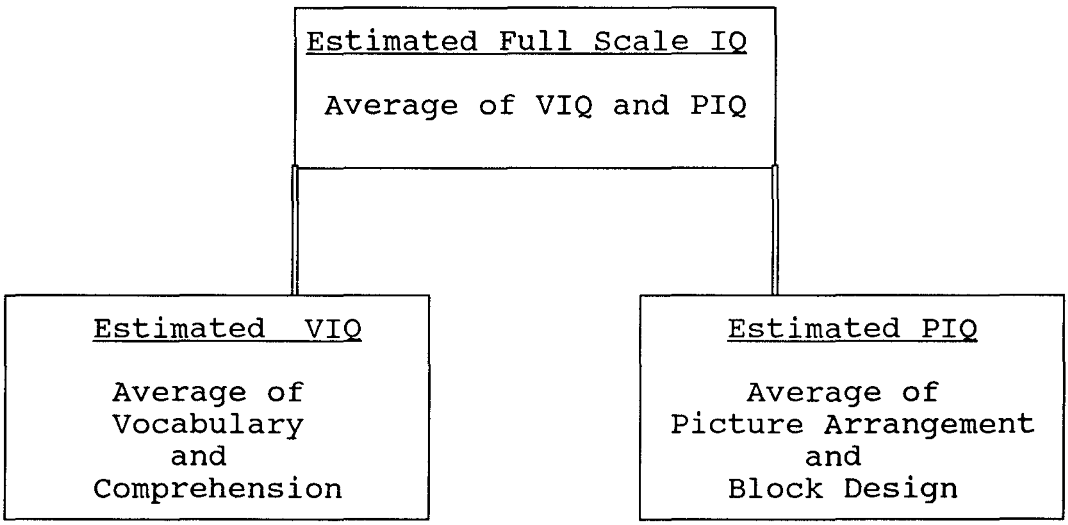
Research Setting

The setting for this research was Loyola University Medical Center, which is a part of Loyola University of Chicago. This study was part of a larger, multi-disciplinary research project designed to evaluate the neuropsychological, neurophysiological and psychosocial functioning of reading and arithmetic disabled children.

Subjects

Children were recruited from area schools for participation in this study. A total of ten reading disabled, ten arithmetic disabled, and ten controls, aged 8 through 10, were included. Any students were excluded who were judged to be educationally or culturally deprived, did not speak English as a primary language in the home, were reported to be suffering from a primary emotional disturbance, had significant primary visual or hearing deficits, had a history of medical problems or had suffered significant head injuries. Only those subjects who met the following criteria were categorized as learning disabled:

(1) were determined to have an Estimated Full Scale IQ of at least 80, and not greater than 120, on a Wechsler intelligence test (WISC-R; or WISC III; Wechsler, 1991), based on an average of an Estimated Verbal IQ (average of the Vocabulary and Comprehension subtests) and an Estimated Performance IQ (average of the Picture Arrangement and Block Design subtests), with at least one of the Estimated Composite IQ Scores equal to or greater than 85 (Figure 1);



Estimated Full Scale IQ ≥= 80

Estimated Verbal and/or Performance IQ ≥= 85

Figure 1. Intelligence Criteria

(2) had at least a 9 point lower score in basic reading skills or math calculation, as measured on the Wechsler Individual Achievement Test (WIAT; The Psychological Corporation, 1992), than predicted achievement, based on the Wechsler intelligence test (in the event both math and reading met this criteria, if one was 9 points lower than the other, it became the primary area of academic deficit);

(3) had at least a seven point discrepancy between math and reading actual scores (Figure 2).

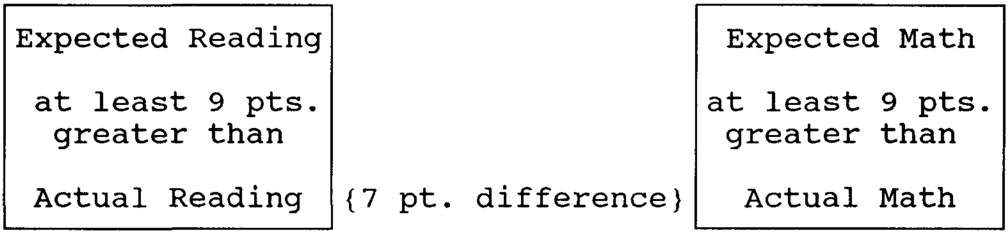


Figure 2. Learning Disability Academic Criteria; pts., points; pt., point.

The control group was composed of students who had average intelligence (Estimated Full Scale IQ of at least 80, and not greater than 120, with at least one of the Estimated Composite IQ scores equal to or greater than 85), determined with the same procedure used for establishing eligibility for inclusion as learning disabled (Figure 1), with the predicted achievement score in reading and math being no more than 5 points greater than the actual score.

Procedures

Each of the subjects volunteered one and a half days to perform research tasks for the total project. Two hours of this time was devoted to the direct assessment of psychosocial functioning to complete the requirements for this part of the project. Parents of the subjects received $50.00 for their child's participation in the entire project. Facial and prosodic affective processing, as well as social decision-making and behavior were directly assessed utilizing computerized and audiotaped tests, as well as video vignettes. The assessments were conducted on a one-to-one basis by specially trained graduate students from the counseling and school psychology programs at Loyola University of Chicago. Parent and teacher inventories and checklists, designed to assess adaptive functioning in the home and school environments, as well as consent forms, were mailed to the parents prior to testing. The consent forms were completed with the parents the first day of testing. The other materials were either hand delivered or mailed to Loyola when completed.

Instrumentation

Direct Assessment

Minnesota Test of Affective Processing

The Minnesota Test of Affective Processing (MN-TAP; Lai, Hughes, & Shapiro, 1991) was developed to assess facial and prosodic affective processing. It is an experimental instrument, with no norms or psychometric data. The current version is presented on a Macintosh II computer, and stimuli consist of black and white photographs of various emotional facial expressions, displayed primarily by children, as well as digitally recorded speech samples. There are a total of twelve subtests, and each subtest has computer-digitized voice instructions. Subjects respond either verbally or by touching areas on the screen, and the examiner enters the responses on the computer, which automatically triggers the presentation of the next item. A brief description of the subtests follows:

1. The Training task. This task familiarizes the subject with the computer and the format of the subtests. It consists of three trials, and the subject responds as to whether two sequentially presented shapes are the same or different.

2. The Inverted Faces task. This task consists of thirty pairs of children's faces presented upside down, with only one face displayed at a time. The subject identifies whether the two faces in a pair are the same or different.

3. The Identity-1 task. This task is the same as the previous task, except the twelve pairs of faces are right-side up. The subject identifies whether the two faces are the same or different.

4. The Identity-Revised task. This task requires the subject to determine if a sequentially presented pair of

photographs with different facial expressions portrays the same child. There are thirty trials.

5. The Affect Discrimination task. The subject is required to determine if the emotional expressions on the next thirty pairs of faces are the same or different, even though the faces may be different.

6. The Faces Teaching task. Four small cartoon faces which are handdrawn and labeled with the emotions "happy", "mad", "sad", and "scared" appear at the bottom of the screen. Illustrations of these emotions are shown, and the subject points to the correct label for each of the eight sample items.

7. The Emotion Matching task. The stimuli are photographs of the faces of children, and the subject touches one of the drawings at the bottom of the screen to correctly label the expression. There are twelve trials.

8. The Affect Choice task. For the next twenty-four trials, five photographs of the same child expressing different emotions are displayed simultaneously on the screen. The subject is instructed to point to the picture which represents the expression named verbally by the computer.

9. The Prosody-1 task. The subject listens to sixteen short sentences, most of which consist of inappropriately paired content and prosody, and judges the affect of each sentence. This task is designed to discriminate whether

prosody or content is preferentially used to interpret meaning.

10. The Prosody-2 task. The subject listens to sixteen sentences with emotional content and neutral prosody, and for each sentence points to one of four written words which describes the emotion.

11. The Prosody-3 task. The subject must determine whether the prosody matches the content of twenty short sentences.

12. The Mixed Mode task. The subject listens to a short sentence with neutral content and emotional prosody. Eight seconds later the face of a person displaying an emotional expression appears on the screen and the subject must determine whether there is a match between the prosody and the face. There are twenty trials.

Florida Affect Battery

The Florida Affect Battery (FAB; Bowers, Blonder, & Heilman, 1991) is an unstandardized instrument which also assesses emotional processing. Four of the prosody tasks are included in this study, but the instructions were shortened and rewritten to reduce the attention and language demands. Instructions and practice items are given verbally by the examiner, then the subject listens to an audiotape and responds verbally. The following subtests were included in the current research protocol:

1. Nonemotional Prosody Discrimination. This subtest evaluates the ability to process propositional prosody and serves as a control for the next two subtests. The subjects listen to sixteen pairs of sentences spoken in either a declarative or interrogative tone of voice, and they must indicate whether the sentences are the same or different.

2. Emotional Prosody Discrimination. This task requires the subjects to judge whether the affective prosody is the same or different in twenty pairs of sentences.

3. Name the Emotional Prosody. This subtest assesses the ability to label verbally the affective prosody of twenty semantically neutral sentences spoken in one of five different tones of voice. The emotions (happy, sad, frightened, angry and neutral) are displayed visually for the children.

4. Conflicting Emotional Prosody. The subjects listen to sixty-four affectively intoned sentences which may or may not differ regarding semantic content. They must judge the affective tone of voice and disregard the content. Again, the children select from a list of emotions.

Video Vignettes

Video vignettes of children engaged in social situations were adapted from research materials developed by the Oregon Research Institute and provided by Larry Irvin for use in this project. Six scenes of child actors engaged in social situations (male and female versions) were shown. Three of the scenes have a child acting mean toward another child, two of the scenes depict "accidents" occurring, and one of the scenes has a child helping another. Subjects responded to open-ended questions for all the scenes, then five of the scenes were repeated, and the subjects responded to multiple-choice questions. The questions were designed to elicit information regarding the subjects' interaction style. Information was obtained regarding how the subjects perceived the actor in the video would respond and how the subjects themselves would respond (active versus passive; verbal versus nonverbal), and how many alternative behavioral responses the subjects could generate. All of the tasks based on the video vignettes were experimental in nature, with no normed data.

Indirect Assessment - Teacher Report

Child Behavior Checklist - Teacher Form

The Child Behavior Checklist-Teacher Form (CBC-T; Achenbach, 1991) is designed to measure the adaptive behavior of children. The teacher completes 113 items by responding that an item is either "Not True", "Somewhat True", or "Very True" of the subject. It consists of eight clinical scales: Withdrawn; Somatic Complaints; Anxious/Depressed; Social Problems; Thought Problems: Attention Problems; Delinquent Behavior and Aggressive Behavior. It yields two composite scores: (1) an Internalizing Scale, which is composed of the Withdrawn, Anxious/Depressed, and Somatic Complaints scales, and (2) an Externalizing Scale, which consists of the

Delinquent and Aggressive scales. There is also a Total Problems score, which is composed of the Internalizing and Externalizing scales, as well as the Social Problems, Thought Problems, and Attention Problems subscales. The test-retest reliability for the CBC-T is reported at .91 for the Internalizing Scale, .92 for the Externalizing Scale, and .92 for the Total Problems score.

Walker-McConnell Scale of Social Competence and School Adjustment: A Social Skills Rating Scale for Teachers

The Walker-McConnell Scale of Social Competence and School Adjustment (Walker-McConnell; Walker & McConnell, 1988) was developed to screen and identify children with social competency deficiencies. It investigates two primary adjustment domains - adaptive classroom behavior and interpersonal social behavior. It consists of 43 items which are positively stated and require a "Never", "Sometimes", or "Frequently" response selection. There are three subscales:

1. Teacher-Preferred Scale. Sixteen items which measure peer-related social skills valued highly by teachers.

2. Peer-Preferred Social Behavior. Seventeen items which measure peer-related social skills valued highly by peers.

3. School Adjustment Behavior. Ten items which measure social skills highly valued by teachers within the context of the classroom.

A total standard score is also provided, based on the three subscales. The internal consistency reliability for the Walker-McConnell is reported at .97. The test-retest reliability for the Total is reported at .87.

Indirect Assessment - Parent Report

Child Behavior Checklist - Parent Form

The Child Behavior Checklist-Parent Form (CBC-P; Achenbach, 1991) measures adaptive functioning and is similar to the Teacher Form. There are 113 items which the parent responds as being "Not True", "Somewhat True", or "Very True" of the subject. The scales of the parent from are the same as those previously discussed for the teacher form. The test-retest reliabilities are reported as .89 for the Internalizing Scale, .93 for the Externalizing Scale, and .89 for the Total Problems score.

CHAPTER IV

RESULTS

Introduction

The specific purpose of this study was to explore possible differences in the psychosocial functioning of two subtypes of learning disabled children. When appropriate, a control group was included for comparison because of the experimental nature of some of the measures. For analytic purposes, the hypotheses were grouped according to one of three areas of cognitive functioning: (1) perception; (2) judgment and problem solving, or (3) expression; or they were included as part of an objective, indirect assessment of behavior, referred to as "external evaluation". Hypotheses 1, 2, and 3 related to Perception. Hypotheses 4, 5, and 6 related to Judgment and Problem Solving. Expression was composed of Hypotheses 7 and 8. Hypotheses 9, 10, and 11 were part of the External Evaluation.

Group Demographics

Thirty children met the stringent criteria for inclusion in this research project, with an equal number in each of the three academic groups. The age and sex composition of the three groups are depicted in Table 1. The average age for all the subjects included in this study was 9.8, with little variability among groups (F=.41; p=.67). Although there was an equal number of males and females in the AD group, there were more males than females in the RD group, and more females than males in the Control group. However, these differences were not significant (Chi Square=5.09; p=.08).

Table 1.--Age and Gender by Group

	Reading	Arithmetic	Control	Total
Males	9.8 (7)	10.7 (5)	10.3 (2)	10.3 (14)
Females	9.1 (3)	9.2 (5)	9.4 (8)	9.2 (16)
Total	9.5 (10)	10.0 (10)	9.9 (10)	9.8 (30)

Note: Figures in parentheses are N's for each group.

The Estimated IQ scores of the three academic groups (Table 2) were all within the Average range, with the exception of the Performance IQ (PIQ) for the RD group, which

Table 2.--Group Means for Estimated IQ

	Reading	Arithmetic	Control	Total
EST. VIQ	98	106	108	104
EST. PIQ	114	100	104	106
EST. FSIQ	106	103	104	105

Note: Est. is the abbreviation for Estimated.

was High Average. The Verbal IQ (VIQ) mean in the RD group was lower than in the AD and Control groups. One-way analysis of variance produced no significant differences among the VIQ means across the groups, although it was near significance, with an F value of 2.70 and a corresponding p value of .09, shown in Table 3. The PIQ mean was lower in the AD group than in the RD and Control groups. One-way analysis of variance obtained a significant difference among the PIQ means (Table 4), with an F value of 4.41 and a p value of .02. A posteriori analysis, employing Fisher's Least-significant

Table 3.--One-Way Analysis of Variance of Estimated VIQ

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	2.4290	1.2145	2.6971	.0855
Within Groups	27	12.1583	.4503		
Total	29	14.5873			

Table 4.--One-Way Analysis of Variance of Estimated PIQ

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	4.0738	2.0369	4.4100	.0220
Within Groups	27	12.4710	.4619		
Total	29	16.5448			

Difference (LSD), revealed the AD group mean was significantly lower than the RD group at the .05 level. The FSIQ means varied little across groups, and a one-way analysis of variance found no significant difference among them (Table 5), with an F value of .40 and a corresponding p value of .68.

Table 5.--One-Way Analysis of Variance of Estimated FSIQ

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	.6036	.3018	.3987	.6751
Within Groups	27	20.4409	.7571		
Total	29	21.0445			

Total achievement was solidly Average for Basic Reading and Numerical Operations (Table 6). As expected, the Basic Reading mean was lowest for the RD group, and a one-way analysis of variance yielded a significant difference, with an F value of 14.20, and a p value of .0001 (Table 7).

Table 6.--Group Means for Achievement

	Reading	Arithmetic	Control	Total
Basic Reading	88	101	110	100
Numerical Operations	105	84	110	100

A posteriori analysis utilizing Fisher's LSD demonstrated a significant difference among all three groups at the .05 level. Also as expected, the lowest mean for Numerical Operations was in the AD group. One-way analysis of variance resulted in a significant difference, with an F value of 15.85 and a p value of .00 (Table 8). A posteriori analysis employing Fisher's LSD demonstrated that the AD group's performance was significantly lower than the performance of both the RD and the Control groups at the .05 level.

Table 7.--One-Way Analysis of Variance of Basic Reading

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	10.4776	5.2388	14.1950	.0001
Within Groups	27	9.9646	.3691		
Total	29	20.4422			

Table 8.--One-Way Analysis of Variance of Numerical Operations

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	16.9130	8.4565	15.8517	.0001
Within Groups	27	14.4039	.5335		
Total	29	31.3170			

In summary, the groups did not differ significantly in age, gender or FSIQ. The RD group had a significantly lower reading score, and the AD group had a significantly poorer math score. VIQ was not significantly lower in the RD group, but it approached significance. The PIQ was significantly lower in the AD group.

Perception

Hypotheses 1, 2, and 3 related to Perception, the first level of cognitive functioning. Facial and prosodic affective processing were specifically examined. Data reduction was utilized on the raw scores from the facial and prosodic affective functioning subtests for Hypotheses 1 and 2.

Hypothesis 1

It was predicted that the AD group would score significantly lower than the RD or Control groups when processing emotional facial information. A Facial Affective Processing score was obtained by combining scores from three facial affective processing subtests of the MN-TAP: (1) Affect Discrimination task; (2) Emotion Matching task, and (3) Affect Choice task. The raw score group means for Facial Affective Processing are displayed in Table 9. The results of a one-way analysis of variance (Table 10) revealed that there were no significant differences among the means. A .05 F value with a corresponding p value of .95 was obtained. Therefore, there were no significant differences in facial affective processing across the academic groups, and Hypothesis 1 was not supported.

Table 9.--Group Means for the Perceptual Processing Tasks

	Reading	Arithmetic	Control
Facial Affective Processing	53.7	53.4	53.1
Prosodic Affective Processing	122.2	125.1	128.2
Prosodic Processing With Conflict	1.9	1.6	1.6

Table 10.--One-Way Analysis of Variance of Facial Affective Processing

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	1.8000	.9000	.0493	.9520
Within Groups	27	493.4000	18.2741		
Total	29	495.2000			

<u>Hypothesis 2</u>

It was predicted that the AD group would perform significantly below the RD and Control groups when processing prosodic information. A Prosodic Affective Processing score was obtained by combining the raw scores of three MN-TAP subtests and three FAB subtests. The MN-TAP subtests were: (1) the prosody score from the Prosody-1 task; (2) Prosody-2 task, and (3) Prosody-3 task. The FAB subtests were: (1) Emotional Prosody Discrimination; (2) Name the Emotional Prosody, and (3) Conflicting Emotional Prosody. The raw score group means for prosodic affective functioning are displayed in Table 9. A one-way analysis of variance found no significant differences among the means (Table 11). An F value of .64, with a corresponding p value of .53 was obtained. Thus, no significant differences in prosodic affective functioning were found across academic groups, and Hypothesis 2 was not supported.

Table 11.--One-Way Analysis of Variance of Prosodic Affective Processing

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	180.0667	90.0333	.6424	.5339
Within Groups	27	3784.1000	140.1519		
Total	29	3964.1667			

<u>Hypotheses 3</u>

The Prosody-1 task from the MN-TAP was analyzed by comparing the groups on the number of responses to prosody when content and prosody were incongruent. It was predicted that the AD and Control groups would respond significantly less to prosodic information than the RD group. Mean raw scores across groups (Table 9) were analyzed using one-way analysis of variance (Table 12). An F value of .34, with a corresponding p value of .71, was obtained. Thus, no significant differences in response to prosody tasks were obtained across academic groups when content and prosody were incongruent. Therefore, Hypothesis 3 was not supported.

Table 12.--One-Way Analysis of Variance of Prosodic Task With Conflict

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	.6000	.3000	.3418	.7135
Within Groups	27	23.7000	.8778		
Total	29	24.3000			

A multivariate analysis of variance, using the Facial Affective Processing and the Prosodic Affective Processing raw scores as the dependent variables, was also completed. The Wilks' Lambda test produced no significant finding, with a Wilks' value of .94, and a p value of .81.

Judgment and Problem Solving

Responses to the video vignettes were scored in terms of "active" versus "passive" behavior. Active was defined as engaging in social interaction, whereas passive was withdrawal from interaction. The video responses were scored by two graduate students. A third scorer was used in the case of disagreement. Hypotheses 4, 5, and 6 related to the judgment and problem solving level of cognitive functioning.

Hypothesis 4

It was predicted that the AD group would attribute more passive behavior to the actors in the video vignettes than would the RD or Control groups. The raw score group means (Table 13) were analyzed using one-way analysis of variance. This produced an F value of .31 with a p value of .73, which is shown in Table 14.

Thus, no significant differences were found across the academic groups in terms of passive behavior attributed to the actors, so Hypothesis 4 was not supported.

Hypothesis 5

It was predicted that the AD group would describe more passive behavior than the RD or Control groups when indicating

Table 13.--Group Means for Judgment and Problem Solving

	Reading	Arithmetic	Control
Actor Passive Responses	1.1	1.0	1.4
Subject Passive Responses	2.1	1.8	2.0
Alternative Responses	3.4	5.9	6.4

Table 14.--One-Way Analysis of Variance of Actor Passive Responses

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	.8667	.4333	.3137	.7334
Within Groups	27	37.3000	1.3815		
Total	29	38.1667			

how they would personally respond to situations presented in the videos. Raw score means for the groups (Table 13) were analyzed using one-way analysis of variance (Table 15). There were no significant differences among the means, with an F value of .13 and a corresponding p value of .88. Thus, the prediction that the AD group, when compared to the RD and Control groups, would indicate a more passive behavior style in responding to social situations depicted in video vignettes was not supported, and Hypothesis 5 was not supported.

Table 15.--One-Way Analysis of Variance of Subject Passive Responses

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	.4667	.2333	.1248	.8832
Within Groups	27	50.5000	1.8704		
Total	29	50.9667			

Hypothesis 6

It was expected that the AD group would be able to produce more alternative ways of behaving than the RD group. The raw score group means for all three groups are presented in Table 13, with the RD group having the lowest score. A T-Test of the RD and AD group means produced a significant difference, with a T-value of 1.86, and a corresponding p value of .04 (Table 16). Further analysis including the Control group was performed because of the experimental nature of this measure. One-way analysis of variance was significant. An F value of 3.49, with a corresponding p value of .05 was obtained (Table 17). A posteriori analysis

Table 16.--T-Test of Alternative Behaviors for the Reading and Arithmetic Groups

	T-Value	D.F.	1-Tail Prob.
Alternatives	1.86	17.44	.04

Table 17.--One-Way Analysis of Variance of Alternative Behaviors

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	51.6667	25.8333	3.4927	.0448
Within Groups	27	199.7000	7.3963		
Total	29	251.3667			

employing Fisher's LSD test demonstrated that there was a significant difference between the means of the RD and AD groups, as well as between the Reading and the Control group at the .05 level. Thus, as predicted, the AD group produced more alternative behaviors than the RD group, so Hypothesis 6 was supported. And, comparison with a Control group also produced a significant difference, suggesting normal performance in the AD group.

A multivariate analysis of variance was performed using the three dependent measures from the judgment and problem solving level of functioning. The variables regarding passive responses for actors, passive responses for the subjects, and alternative behaviors were analyzed. A Wilks' value of .76, with a p value of .29, was found. Thus, this analysis did not produce a significant finding.

Expression

This area of analysis related to whether the subjects described verbal or nonverbal personal responses to the video vignettes. Responses indicating both verbal and nonverbal behavior were excluded. Hypotheses 7 and 8 pertained to expressive functioning.

Hypothesis 7

It was predicted that the AD group would engage in more verbal responses than the RD children. Raw score means for all groups are displayed in Table 18. A T-Test of the AD and

RD group means was not significant, with a T-value of 1.06, and a p value of .15 (Table 19). A one-way analysis of variance of the means of all of the groups was also performed because of the experimental nature of this measure. No significant differences were produced, with an F value of .63, and a p value of .54 (Table 20). Thus, there was no

Table 18.--Group Means for Expression Tasks

	Reading	Arithmetic	Control
Verbal Responses	2.6	3.4	2.9
Nonverbal Responses	3.1	2.5	2.3

Table 19.--T-Test of Verbal Behaviors for the Reading and Arithmetic Groups

	T-Value	D.F.	1-Tail Prob.
Verbal Behaviors	1.06	17.33	.15

Table 20.--One-Way Analysis of Variance of Verbal Responses

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	3.2667	1.6333	.6327	.5388
Within Groups	27	69.7000	2.5815		
Total	29	72.9667			

significant difference between the AD and the RD groups regarding verbal responses to the video vignettes, so Hypothesis 7 was not supported. Additionally, there was not a significant difference between the Control and the learning disabled groups, indicating overall normal performance.

Hypothesis 8

It was hypothesized that the AD group would indicate that they would engage in significantly less nonverbal behavior than the RD group. Raw score group means (Table 18) are shown for all three groups. A T-Test did not demonstrate a significant difference between the AD and RD group means, with a T-value of .83, and a p value of .21 (Table 21). Since this measure was also experimental, a one-way analysis of variance examining all of the group means was performed. This produced no significant differences, with an F value of .79, and a corresponding p value of .47 (Table 22). Thus, Hypothesis 8 was not supported. Since there were also no differences between the two learning disabled groups and the Control group, the learning disabled groups can be assumed to be performing normally on this task.

Table 21.--T-Test of Nonverbal Behaviors for the Reading and Arithmetic Groups

	T-Value	D.F.	1-Tail Prob.
Nonverbal Behaviors	.83	17.17	.21

Table 22.--One-Way Analysis of Variance of Nonverbal Responses

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	3.4667	1.7333	.7866	.4656
Within Groups	27	59.5000	2.2037		
Total	29	62.9667			

External Evaluation

External evaluation related to the information which was obtained from parent and teacher checklists. Hypotheses 9, 10, and 11 pertained to this area of functioning.

Hypothesis 9

It was hypothesized that the Internalizing scale of the parent form of the Child Behavior Checklist would be significantly higher (indicating psychopathology) for the AD group than for the RD or Control groups. The standardized T-score means for all three groups are displayed in Table 23. A one-way analysis of variance demonstrated a significant difference, with an F value of 3.46, and a corresponding p value of .05 (Table 24). A posteriori analysis using Fisher's LSD test showed a significant difference between the RD and the Control groups at the .05 level, with the RD group having greater internalization. Thus, although significant results were obtained, they were not as predicted. There was no significantly greater internalization in the AD group than in the RD and Control groups, so Hypothesis 9 was not supported.

Table 23.--Group Means for External Measures of Behavior

	Reading	Arithmetic	Control
CBC Parent Form - Internalizing	61	50	47
CBC Teacher Form - Internalizing	53	44	44
Walker-McConnell	161.20	166.80	173.90

Table 24.--One-Way Analysis of Variance of CBCP Internalizing Scale

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	9.7260	4.8630	3.4610	.0459
Within Groups	27	37.9370	1.4051		
Total	29	47.6630			

Hypothesis 10

The AD group was expected to achieve a significantly higher score (indicating psychopathology) on the teacher form of the Child Behavior Checklist than the RD or Control groups. Table 23 displays the standardized T-score group means. A one-way analysis of variance produced a significant difference. An F value of 3.41, and a p value of .05 was obtained (Table 25). A posteriori analysis using Fisher's LSD test demonstrated a significant difference between the RD and the Control groups, as well as between the RD and the AD groups, at the .05 level, with the RD group demonstrating greater internalization than both of the other groups. Again, the significant finding was not in the predicted direction. Therefore, the results did not support significantly greater psychopathology in the AD group than in the RD or Control groups, so Hypothesis 10 was not supported.

Table 25.--One-Way Analysis of Variance of CBCT Internalizing Scale

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	5.5820	2.7910	3.4128	.0477
Within Groups	27	22.0810	.8178		
Total	29	27.6630			

<u>Hypothesis 11</u>

The standardized Total Score (Mean=100; Standard Deviation=15) from the Walker-McConnell was analyzed across the three academic groups, with the expectation that the AD group would obtain a significantly lower score (indicating more social difficulties) than the RD or Control groups. Table 23 shows the group means. A one-way analysis of variance (Table 26) was not significant, with an F value of

.40 and a corresponding p value of .68. Thus, the AD group did not score significantly lower than the other groups, so Hypothesis 11 was not supported.

Table 26.--One-Way Analysis of Variance of Walker-McConnell

Source	D.F.	Sum of Squares	Mean Squares	F Ratio	F Prob.
Between Groups	2	810.2000	405.1000	.3967	.6764
Within Groups	27	27574.1000	1021.2630		
Total	29	28384.3000			

The dependent measures from the External Evaluation were analyzed using multivariate analysis of variance. The Internalizing scales from both parent and teacher forms of the CBC, as well as the total score from the Walker-McConnell were analyzed. The Wilks' Lambda test was not significant, with a value of .71 and a corresponding p value of .18.

Additional Analyses

Based on the findings generated by the specific hypotheses of this research project, additional analyses were performed to further evaluate the data.

1. Parent Report of Internalization.

As presented above, with correction for family-wise error rate, a significant difference was found between the RD and

Control groups on the CBCP Internalizing scale. Despite the lack of a statistically significant difference between the RD and AD groups, an investigation was undertaken to further explore the subscales of the Internalizing factor, because of the important conceptual relevance of such a comparison.

Table 27.--T-Test of CBCP Internalizing Subscales

	Means				
	Reading	Arithmetic	T-Value	D.F.	1-Tail Prob.
Withdrawn	58	50	1.37	17.80	.09
Somatic Complaints	63	48	3.39	11.98	.01
Anxious/ Depressed	63	55	1.02	17.32	.16

An analysis was performed to determine if there were significant group differences on the three subscales of the Internalization scale. Since the CBC is normed and the primary groups of interest were the AD and the RD, the Control group was not included in this analysis. T-Tests were performed on the subscale means of the two groups (Table 27).

On the Withdrawn subscale, the difference, with a higher RD score, approached significance, with a T-value of 1.37 and a p value of .09. On the Somatic Complaints subscale, the RD mean score was found to be significantly higher than the AD mean score. A T-value of 3.39 and a corresponding p value of

.01 was obtained. The analysis of the Anxious/Depressed subscale produced a T-value of 1.02 and a p value of .16. Thus, there was no significant difference between the groups in terms of anxiety and depression, although again the RD group's performance was higher than the AD group's performance.

2. Teacher Report - Internalization.

Teacher report on the CBCT revealed a significant difference among all of the groups on the Internalization subscale, as previously discussed. An additional analysis was performed to determine if there were any significant differences on the three subscales. Again, because the CBC is normed and the groups of interest are the RD and the AD, the Control group was not included in this analysis. T-Tests were performed on the means for the two groups (Table 28).

Table 28.--T-Test of CBCT Internalizing Scale

	Means				
	Reading	Arithmetic	T-Value	D.F.	1-Tail Prob.
Internalizing	53	44	2.20	17.98	.02
Withdrawn	48	46	1.04	16.89	.16
Somatic Complaints	50	49	.53	16.02	.30
Anxious/ Depressed	54	46	1.87	17.99	.04

On the Withdrawn subscale of the CBCT, the teacher responses yielded a somewhat higher score (greater psychopathology) for the RD group, but there was not a significant difference between the two groups. A T-value of 1.04, with a p value of .16 was produced. On the Somatic Complaints subscale, there was little difference between the means, resulting in no significance being found. A T-value of .53 and a corresponding p value of .30 was obtained. On the Anxious/Depressed subscale, the RD mean was significantly higher. A T-value of 1.87, with a p value of .04 was obtained.

3. Parent Report - Externalization.

The lack of significant internalized psychopathology in the AD group raised questions about possible externalizing psychopathology. The AD and the RD groups were compared to determine if there were significant differences on the CBC parent form for this scale. The means were analyzed employing a T-Test (Table 29). A T-value of 1.46, with a corresponding p value of .08 was obtained. Thus, the higher RD than AD mean score approached significance for externalization by parent report.

The two subscales of the Externalization scale were also analyzed for the RD and AD groups by performing T-Tests (Table 29). Results from the Delinquent subscale revealed that the RD group mean was significantly higher than the AD group mean, with a T-value of 1.73 and a corresponding p value of .05.

Table 29.--T-Test of the CBCP Externalizing Scale

	Means				
	Reading	Arithmetic	T-Value	D.F.	1-Tail Prob.
Externalizing	57	50	1.46	16.89	.08
Delinquent	57	48	1.73	14.08	.05
Aggressive	57	50	1.40	16.87	.09

The Aggressive subscale analysis produced a T-value of 1.40 with a p value of .09. Thus, the difference between the RD and the AD mean scores approached significance.

5. Teacher Report - Externalization.

Teacher report on the Externalizing subscale of the CBCT was also analyzed in the same manner as the parent form. The means are displayed in Table 30. On the Externalizing scale, there was very little difference between the RD and the AD group means. And, significance was not found, with a T-value of .56 and a corresponding p value of .24 obtained.

Table 30.--T-Test of CBCT Externalizing Scale

	Means				
	Reading	Arithmetic	T-Value	D.F.	1-Tail Prob.
Externalizing	51	49	.56	17.67	.24

6. Visual Perceptual Processing.

Since the AD group was not found to have significantly greater psychosocial difficulties than the RD or Control groups, an additional analysis was performed to evaluate whether the AD children had greater visual perceptual dysfunction. Performance on the two subtests from the WISC III was examined to determine if the AD group had significantly more difficulty than the other two groups. The means for the groups are displayed in Table 31 and show that all are within the Average range, but there is a pattern of lower AD than RD or Control group performance. T-tests of the subtest averages were performed to compare the performance of the two groups of interest, the AD and the RD groups (Table 32). There was a significant difference between the two groups on the Picture Arrangement subtest. A T-value of 2.24, with a corresponding p value of .02 was obtained. However, there was not a significant difference on the Block Design subtest. The T-value for this analysis was .91, with a p value of .19.

Table 31.--Group Means for the WISC III Performance Subtests

	Reading	Arithmetic	Control
Block Design	106	98	102
Picture Arrangement	115	103	106

Table 32.--T-Test for WISC III Performance Subtests for the Reading and Arithmetic Groups

	T-Value	D.F.	1-Tail Prob.
Block Design	.91	17.98	.19
Picture Arrangement	2.24	15.13	.02

A further evaluation of visual perceptual processing was performed by examining the Inverted Faces task of the MN-TAP. This task requires the visual processing of novel stimuli. There was little variability in the means (Table 33), and a T-test was not significant, with a T-value of .05 and a significance level of .48 (Table 34).

Table 33.--Group Means for Select MN-TAP Tasks

	Reading	Arithmetic	Control
Inverted Faces	21.5	21.6	22.2
Affect Choice	20.7	18.3	20.3

Table 34.--T-Test of Select MN-TAP Tasks for the Reading and Arithmetic Groups

	T-Value	D.F.	1-Tail Prob.
Inverted Faces	.05	16.96	.48
Affect Choice	2.35	17.99	.02

The AD group's poorer performance on the Picture Arrangement subtest created interest regarding their general skill with tasks requiring significant visual scanning. This prompted an additional analysis of the Affect Choice task from the MN-TAP, which requires the subject to scan five photos of the same child expressing different emotions. Table 33 displays the group raw score means on the Affect Choice task, with the lowest performance obtained by the AD group. A T-test to examine for possible significant differences between the groups of interest, RD and AD, was performed (Table 34). This analysis produced a significant difference between the two groups. A T-value of 2.35, with a corresponding p value of .02 was yielded.

6. Discriminant Analysis.

A discriminant analysis was performed to determine if select psychosocial variables could predict academic group membership. The variables included were: (1) Prosody (the Prosodic Affective Processing score); Faces (the Facial Affective Processing score); (3) Passive Behavior; (4) Alternative Behaviors; (5) Verbal Behavior; (6) Nonverbal Behavior; (7) CBCP Externalizing; (8) CBCP Internalizing; (9) CBCT Externalizing, and (10) CBCT Internalizing. The first two variables (Prosody and Faces) were the facial and prosodic affective processing tasks from the computer- and audio-based tasks. The third, fourth and fifth variables related to the subjects' decisions regarding how they would respond to the situations depicted in videos (passive versus active and verbal versus nonverbal behavior), as well as their ability to generate alternative behavioral responses. The last four variables were data regarding internalizing and externalizing behavior, which were taken from the scales of the teacher and parent checklists.

Wilks' direct method was performed. Since there were three groups, two discriminant functions were produced. As Table 35 depicts, Function 1 accounted for 70.16% of the total between-groups variability, and Function 2 accounted for the remaining 29.84%. A Wilk's lambda of .2400 with a significance level of .04 was produced, demonstrating that the means of the functions are not equal. The Wilks' lambda associated with Function 2 after Function 1 was removed was .6063, with a significance level of .2585. Thus, Function 2 did not contribute to group differences.

Table 36 presents a summary of the classification results, and shows that 86.7% of the cases were correctly

Table 35.--Canonical Discriminant Functions

Function	Eigenvalue	% Variance	Can. Cor.	After Function	Wilks Lambda	Chi-Square	DF	Significance
				:0	.2400	32.11	20	.0421
1*	1.5267	70.16	.78	:1	.6063	11.26	9	.2585
2*	.6493	29.84	.63					

Note: * Marks the 2 canonical discriminant functions remaining in the analysis; Can. Cor. is the abbreviation for Canonical Correlation.

classified into groups by the functions. No learning disabled cases were wrongly classified into another learning disabled category, but were categorized as not having learning problems.

Table 36.--Classification Results

Actual Group	Number of Cases	Predicted Group Membership RD	AD	C
Reading Disabled (RD)	10	8 (80%)	0 (0%)	2 (20%)
Arithmetic Disabled (AD)	10	0 (0%)	9 (90%)	1 (10%)
Control (C)	10	0 (0%)	1 (10%)	9 (90%)

Percent of "grouped" cases correctly classified: 86.7%

Note: Numbers in parentheses are the percentages of correctly grouped cases.

Table 37 provides the standardized canonical discrimination function coefficients for the variables, which assesses the contribution of each variable to the discrimination between the groups. In terms of relative strength, Nonverbal Behavior is the most weighted in Function 1, followed by CBCP Externalizing, Prosody, Alternative Behaviors, and Passive Behavior. The CBCT Externalizing is the least weighted of the variables. The small values with negative signs are associated with the presence of the variable, whereas the larger values with negative signs indicate the absence of the variable.

Table 37.--Standardized Canonical Discriminant Function Coefficients

	Function 1	Function 2
CBCP Internalizing	.11439	-1.62437
CBCP Externalizing	.64344	1.70956
CBCT Internalizing	.42417	- .33619
CBCT Externalizing	-.01030	- .18597
Passive Behavior	-.50631	- .46572
Nonverbal Behavior	.89360	2.28683
Verbal Behavior	.33395	2.03675
Alternative Behavior	-.59852	.69511
Faces	.22991	.60909
Prosody	-.63494	.03019

The pooled within-groups correlation matrix (Table 38) examines the correlation coefficients between the variables and the functions. CBCP Externalizing has the highest correlation with Function #1, followed by CBCP Internalizing and Alternative Behaviors.

Table 39 contains the group means for the two functions. The RD group has a positive mean for Function 1 and a negative mean for Function 2. The AD group has a negative mean for Function 1 and a positive mean for Function 2. The Control group has negative means for both functions. Thus, based on this analysis, Function 1 discriminates between the RD and the AD group.

Table 38.--Pooled Within-in Correlation Matrix

	Function 1	Function 2
CBCP Externalizing	.47811*	.11906
CBCP Internalizing	.40219*	1.12045
Alternative Behaviors	-.40068*	.14485
CBCT Internalizing	.37816*	-.23043
Nonverbal Behavior	.19330*	-.04333
Prosody	-.17443*	-.04183
CBCT Externalizing	.17304*	.04674
Faces	-.04843*	.01016
Verbal Behavior	.08647	.23367*
Passive Behavior	-.03519	-.10640*

Note: * Variables with large coefficients for a particular function.

Table 39.--Group Centroids

Group	Function 1	Function 2
Reading Disabled	1.53469	- 0.40871
Arithmetic Disabled	-0.22459	1.07109
Control	-1.31011	- 0.66238

CHAPTER V

DISCUSSION

Summary and Conclusions

It was hypothesized that the results of this research project would demonstrate that children with an arithmetic disability have greater difficulty with social and behavioral functioning than children with a reading disability or no learning problems. Data analysis was performed on the results of tasks representative of social functioning at three levels of cognitive functioning, as well as on parent and teacher report of social and behavioral functioning in the school and home environments.

At a perceptual level of cognitive functioning, the three academic groups did not differ on any of the measures employed. The prediction that the AD group, suspected of having right hemisphere dysfunction, would have difficulty with facial and prosodic affective processing, as has been demonstrated with RHD patients (Blonder et al, 1991), was not supported. Further examination of the AD group raised questions regarding the assumption of a right hemisphere, visual perceptual deficit underlying the pure arithmetic disorder. On the Block Design subtest of the WISC III, there were no significant differences among the three groups, although the AD group's performance was the lowest. Additionally, the Inverted Faces task of the MN-TAP, which is considered a novel task and requires significant visual perceptual skill, did not produce significant differences among the groups. However, Picture Arrangement, the other visually-mediated subtest from the WISC III which was used in this research, did produce a significantly lower score in the AD than the RD group. This subtest places considerable demand on visual attention and scanning. Of note, the AD group also performed significantly lower than the RD group on the MN-TAP Affective Choice task, which makes similar high demands on visual attention and scanning. Thus, these findings at least raise the possibility that the AD group in this study did not have an underlying visual perceptual processing deficit significant enough to produce the facial and prosodic deficits which are linked with right hemisphere dysfunction. Another explanation is that there was also adequate functioning in terms of a nonverbal emotional lexicon, which is hypothesized to be independent of visual perceptual processing (Blonder et al, 1990). Therefore, the lack of significant findings in the perceptual area could be attributed to both adequate visual perceptual and nonverbal affective processing.

At the second level of cognitive functioning, making judgments and problem solving, the prediction that the AD group would indicate that they and others would respond passively, in specific situations, to a significantly greater extent than the RD or Control groups, was not supported. Thus, an attempt to link passive behavior with reports from previous literature that the AD group tend to internalize (Rourke & Fuerst, 1991), was not successful. However, it is possible the responses to the videos did not accurately reflect how the subjects would behave in actual situations.

At the second level of cognitive functioning, the AD group generated significantly more alternative behaviors than the RD group, as predicted. Such a finding should be viewed cautiously, however, in terms of being reflective of good problem solving. The responses were evaluated quantitatively not qualitatively, and behaviorally rather than conceptually. Thus, it was possible, for example, for several aggressive, and perhaps poor choices, to increase the number of alternative behaviors. These results may be reflective of a tendency for the AD children to verbalize more than the RD children, which might be expected based on the AD group having greater verbal skills, indicated by higher VIQ.

The third level of functioning related to how the subjects chose to express the behavior they had decided on - whether their active or passive behavior would be performed in a verbal or nonverbal manner. It was predicted that the AD group would indicate more verbal behavior and less nonverbal behavior than the RD group, based conceptually on the verbal/performance discrepancy within each group. Although significant differences were not obtained, the mean scores were in the predicted direction. The RD group had less verbal responses, and the AD group had less nonverbal responses. These findings are consistent with the Loveland et al (1990) study which found that language disabled children had more difficulty with tasks requiring verbal responses, and math disabled children had more difficulty with tasks requiring nonverbal responses.

The prediction that parent and teacher report would be indicative of greater internalizing psychopathology in the AD group than in the RD or Control groups was not supported. To the contrary, the RD group evidenced significantly greater internalization than the Control group by parent report, and significantly greater internalization than the AD and Control groups by teacher report.

Analysis of the three subscales which produced the internalizing score (Withdrawn, Somatic Complaints, and Anxious/Depressed) on the CBCP revealed that the AD means were all lower than the RD means (indicating less psychopathology). Although the Withdrawn and Anxious/Depressed means approached significance, only the Somatic Complaints means were significantly different. It should be noted that none of the means for the groups reached a T-score of 70, which is considered significant for psychopathology. However, there is suggestion of increased risk in the RD group, as the range of the T-scores was from 58 to 63 (79th to 90th percentile).

An analysis of teacher report of the subscales contributing to the internalizing score also showed that all the AD means were lower than the RD means. However, the only significant difference was on the Anxious/Depressed subscale. Again, the T-scores for the group means did not reach a level indicating significant psychopathology, with a range of 48 to 54 (43rd to 66th percentile).

Since the AD group did not evidence greater internalizing behavior as predicted, an additional analysis was performed to determine if the AD and RD groups differed in terms of externalizing behavior. The difference between the groups on the CBCP report approached significance, with a higher (more externalizing) score for the RD group. On the two subscales of the Externalizing scale there was significantly greater delinquency in the RD group than the AD group. The difference between the two groups on the other subscale, Aggressive, was not significant, but approached significance. Again, it should be noted that the overall T-scores were not elevated at a level indicative of significant psychopathology.

Analysis of teacher report of externalizing behavior on the CBCT demonstrated higher RD than AD means. However, there was not a significant difference between the two groups, and the group scores were not significant for maladaptive behavior

Therefore, analysis of tasks reflective of social cognitive functioning produced variable results in terms of predictions. The nonsignificant findings at a social perceptual level may be attributable to adequate visual perceptual functioning in the AD group, with the arithmetic deficits produced as a result of visual scanning and attentional problems. An alternative explanation may be that the somewhat lower visual perceptual performance in the AD group did contribute to the poorer arithmetic than reading performance, but was not significant enough to affect social perception. Additionally, a dissociated, and adequately functioning, nonverbal emotional lexicon may have contributed to the generally normal processing of facial and prosodic affect. At a problem solving level, the AD group's ability to generate significantly more alternative behaviors than the RD group appears reflective of greater verbal skills. And, this was supported at an expressive level, with a tendency for the AD group to provide more verbal responses, and the RD group to provide more nonverbal responses. Such results were expected based on the assumption that language problems produced the lower VIQ and poorer reading performance in the RD group. It was expected that facial and affective prosodic problems in the AD group would result in parents and teachers reporting greater behavioral difficulties in the AD group. A finding of significantly greater psychopathology in the RD group than the AD group, which was consistent across parent and teacher report, was not predicted. But, such a finding is not without some support, and may also be explainable according to Rourke's third hypothesis (Rourke & Fuerst, 1991).

First of all, there has been some evidence to suggest that children with reading deficits, but better math skills, are at risk for psychopathology (Landau, et al, 1987; Nussbaum & Bigler, 1986). Second, there is evidence that differences in asymmetrical hemispheric physiology produce individual differences not only in cognitive processing, but also in mood or affective state. Gainotti (1972) found that while RHD patients often presented as indifferent, with an inappropriate euphoric mood state, LHD patients frequently displayed a very dysphoric mood state, often referred to as a catastrophic reaction. Heilman and Bowers (1990) also discussed catastrophic reaction, stating that patients with damage to the left hemisphere have been found to have a greater arousal response than patients without brain damage. They stated that this cognitive state is compatible with depression, and the two together can produce catastrophic reaction. Less activation of the left hemisphere has been also associated with a state of fear or anxiety (Heller, 1990).

In addition to differences in the emotional functioning of patients with brain damage, there is evidence that in normals there are differences in resting EEG frontal activation asymmetry, which is believed to be related to differences in affective style (Schaffer, Davidson, & Saron, 1983). Even in infants, such differences have been noted, with asymmetrical EEG patterns related to approach and withdrawal reactions (Fox, 1991). This has been interpreted as perhaps indicative of differences in temperament, with lower left hemisphere activation resulting in withdrawal.

In summary, the cognitive measures included in this research project did not demonstrate greater psychosocial difficulties in the AD than the RD group. In fact, the finding of increased risk of psychopathology in the RD group is in direct contrast to much of what has been written about this relatively new area of learning disabilities research. However, there is an extensive literature which describes left brain damaged patients as having difficulty with emotional functioning. This lends support to the current finding of increased psychopathology in the RD group, which is assumed to have left hemisphere dysfunction. Thus, this study has certainly provided information to be considered when developing future research related to psychosocial functioning in subtypes of learning disabled children.

Future Research

Future research, directed at examining the psychosocial functioning of the arithmetic and reading disabled from a neuropsychological perspective, may benefit from addressing some of the issues raised by this project.

1. Although methodology utilized in research of the learning disabled has improved, there are still many differences across studies which make comparison of results difficult. Criteria tend to be well delineated, and a subtyping approach is usually employed, but there is still

much variability in criteria for subject inclusion. Criteria often do not adhere to the formal learning disability definition, which requires a significant discrepancy between ability and achievement. In those studies where a discrepancy is employed, possible regression effects are often not considered. However, this study lends support to the possibility that use of a discrepancy can be important in terms of results. In the few studies with clear discrepancies, the RD group has shown greater psychopathology than the AD group.

2. Questions remain regarding how children with significant visual perceptual deficits would perform on the measures employed in this project. Future research exploring this issue, and research directed at better understanding the relationship between visual perceptual functioning, attentional functioning, and arithmetic disabilities seems important.

3. Although response to static tests of social perception and to video vignettes of social situations is informative, it will be important to study how reflective these are of actual behavior. Ideally, such results need to be compared to observations of children in natural settings, as well as with teacher and parent report of behavior.

4. It may also be important that further research examine not only the relationship between cognitive processing deficits and psychosocial deficits, but also investigate the

possibility that different mood or affective states produce different behavioral functioning. It may be that both the RD and the AD groups have psychosocial difficulties based on Rourke's third hypothesis. In other words, the same brain mechanisms produce both the academic and psychosocial deficits in each group. In the AD group it would be important to further pursue the possibility that cognitive deficits (visual perceptual in nature) associated with right hemisphere dysfunction result in difficulties with the interpretation of nonverbal emotional information. In the RD group it would be important to further explore the possibility of a dysphoric mood or affective state, rather than cognitive processing, producing psychosocial difficulties.

Limitations of the Study

A major limitation of this study is the small sample size, due to the rigid criteria employed for subject inclusion. Since sample size is clearly related to power, the ability to determine significant findings, it is possible that there are, in fact, significant findings which were not detected. Therefore, results should be generalized cautiously, and only to children who meet the same criteria as the subjects included in this study.

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VITA

The author, W. Jean Cronin, was born November 6, 1948, in North Platte, Nebraska. Ms. Cronin received her Bachelor of Science degree in Education from the University of Nebraska in June of 1971. She completed a Master of Education degree in December of 1974 at the University of Nebraska.

Ms. Cronin helped develop a specialized foster care program for the Nebraska Department of Social Services, serving as a program manager, consultant and trainer. She also worked as a school psychologist and an assistant special education director in public schools in Nebraska.

While pursuing a doctorate in school psychology in the Department of Counseling and Educational Psychology at Loyola University of Chicago, Ms. Cronin became interested in neuropsychology. In addition to a neuropsychology practicum at Evanston Hospital in Evanston, Illinois, Ms. Cronin worked as a neuropsychology research assistant, and then as an intern, in the Department of Surgery at Loyola University Medical Center in Maywood, Illinois. Currently, Ms. Cronin is employed full-time in the Department of Surgery at Loyola University Medical Center as a neuropsychology assistant.

APPROVAL SHEET

The dissertation submitted by W. Jean Cronin has been read and approved by the following committee:

Dr. Carol Harding, Director
Professor
Counseling and Educational Psychology
Loyola University of Chicago

Dr. Jack Kavanagh,
Professor and Chair,
Counseling and Educational Psychology
Loyola University of Chicago

Dr. Michael Appleby,
Assistant Professor
Departments of Surgery and Pediatrics
Loyola University Medical Center

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the Committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

8/24/93
Date

Carol Harding
Director's Signature