Nonverbal Learning Disabilities: Models of Proposed Subtypes, Part II

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Part I of this paper presented an overview of the evolution of nonverbal learning disorders (Davis & Broitman, 2006). Part II will review the work of Forrest (2004), Grodzinsky (2003), Mamen (2002), and Palombo (2006), four clinicians who are attempting to broaden our understanding of NLD as a neurobiologically based learning disorder by looking at it through the clinical lens of multiple subtypes.

We shall begin by reviewing the clinician's concept of the child with NLD. Judy Lewis' Web site overview on NLDline.com, which is based on educator Sue Thompson's (1997) groundbreaking work, *The Source for Nonverbal Learning Disorders,* is a useful reference. Lewis lists early speech and vocabulary development, remarkable rote memory, strong auditory retention, attention to detail, at times early reading skills, and excellent spelling skills as among the assets of some children with NLD. Five major categories of deficits and dysfunctions are identified: motor, visual–spatial, organizational, social, and sensory. Motor deficits include poor coordination, severe balance problems, and difficulties with graphomotor skills. Visual–spatial/organizational deficits reflect a lack of image formation, poor visual recall, faulty spatial perceptions, and difficulties with executive functions. These executive functioning difficulties include decision making, planning, initiative, assigning priority, sequencing, motor control, emotional regulation, problem solving, planning, impulse control, establishing goals, monitoring results of action, self-correcting, and problems with spatial relations. Social deficits include difficulties comprehending nonverbal communication, adjusting to transitions and novel situations, along with deficits in social judgment and social interaction. The last category refers to sensitivity in any of the sensory modes: visual, auditory, tactile, taste, or olfactory.

Historically, Rourke and others (Myklebust & Johnson, 1967; Pennington, 1991) spent a significant amount of time clarifying the differences between verbal or phonologically based learning disorders and nonverbal learning disorders. While Rourke's are the most commonly used diagnostic criteria, some clinical opinions are not in complete agreement with his definition.

We will now consider the multiple subtypes of NLD. Our first article focused on the specific diagnostic criteria proposed by Rourke (Rourke, 1985, 1995). His diagnostic model required the presence of six or more of the following characteristics to meet criterion of NLD:

1. Target Test, a test of immediate visual memory from the Reitan–Indiana Neuropsychological Test Battery (Reitan, 1969), at least 1 SD below the mean.
2. None, or minimal, simple tactile perception and suppression versus very poor finger agnosia and/or finger dysgraphesthesia.
3. Highest scores on two subtests of the WISC-III Verbal Scale subtests Vocabulary, Similarities, or Information.
4. Lowest scores on two of the WISC-III Performance Scale subtests Block Design, Object Assembly, or Coding.
5. Wide Range Achievement Test–Revised (WRAT–R), standard score for Reading is at least 8 points higher than Arithmetic.
6. Tactual Performance Test, right, left, and both hand times become progressively worse vis-à-vis the norms.
7. Normal to superior grip strength versus mildly to moderately impaired Grooved Pegboard.
8. WISC-III: VIQ exceeds PIQ by at least 10 points.

Semrud-Clikeman (2001) and others (Forrest, 2004; Myklebust, 1975) have viewed NLD somewhat differently. Without citing specific numbers, Semrud-Clikeman suggests that only some of the strengths and weaknesses proposed by Rourke need to be present for a child to be diagnosed with NLD. Forrest (2004), Grodzinsky (2003), Mamen (2002), and Palombo (2006) suggest that there are specific clinical subtypes of NLD that are important to understand in order to diagnose and treat the child or adult appropriately. A developmental analogy would be similar to the current definition of ADHD, which has evolved to include the inattentive, hyperactive/impulsive, and combined types. Rourke (2006) disagrees, calling it a "confusion of the syndrome of NLD (its neurodevelopmental assets, deficits and dynamics) with its most predominant behavioral (essentially, 'dependent variable') manifestations" (Rourke, http://www.NLD-BPROURKE.CA). According to Rourke, these differences are variations in the expression of NLD. But, since we have no available data documenting that visual–spatial issues alone are responsible for these differences, multiple lines of development, in concordance with theories such as the ones proposed by Anna Freud (1966), Howard Gardner (1999), Daniel Stern (2000) and others could prove to be another valuable model from which to conceptualize the issues of NLD.

We therefore suggest that it is important to expose clinicians who are treating children with NLD to an alternative spectrum of possibilities. We believe this would help ensure that the NLD child is getting appropriate interventions for success in school and in life.

The clinical models presented in this paper consist of a two-subtype model (Forrest, 2004), a three-subtype model (Grodzinsky, 2003), and two four-subtype models (Mamen, 2002; Palombo, 2006) Although some of the models overlap, we will describe the characteristics for each of the most

relevant subtypes and offer an overall integration. We will describe some strengths of these children and review the neuropsychological, social, and academic concerns for each subtype. Although we will be incorporating Palombo's model, its emphasis on social and psychological issues rather than neuropsychological and academic issues renders it less applicable for the purpose of this paper. It is, however, an excellent resource for educational therapists who are interested in knowing more about the social issues related to children with NLD and their treatment.

Two-Subtype Model of NLD

The two-subtype model describes a child who has a visual–spatial or perceptual disorder in addition to a social-skill deficit with or without a math problem (Forrest, 2004; Grodzinsky, 2003). Forrest believes the social skill disorders are caused by the visual–spatial disorders, while Mamen (2002, 2006) argues that the NLD child with a perceptual subtype does not have any significant social skills deficits. These authors do not believe that the NLD child must have significant math problems, as described by Rourke (1995), and Palombo does not incorporate any academic issues into his model.

Forrest suggests that this conceptualization of NLD can confuse the differential diagnosis with Asperger's disorder. Forrest (2004), however, postulates that distinguishing characteristics can aid in the differential diagnosis. For example, she notes that while both the child with NLD and the one with Asperger's are interested in having social relationships, the NLD child tends to be more successful in this respect. NLD children do not have the very narrow, intense, obsessional interests associated with Asperger's. Klin and Rourke (1995), however, presented evidence that Asperger's disorder is a developmental disorder that is comorbid with a neurological profile of nonverbal learning disorders. Their approach integrates the psychiatric or developmental perspective with the neuropsychological one.

Palombo (2006) would agree that visual–spatial problems, which he calls nonlinguistic–perceptual deficits, create social imperception problems. He claims that these nonlinguistic perceptual deficits are the core deficits in all NLD children. He does not link Asperger's disorder with NLD, rather placing Asperger's on the autistic spectrum. He is the only one of the four clinicians we reviewed who hypothesizes that there are subtypes of NLD children who suffer from additional problems of social relatedness and reciprocity that are not related to visual–spatial issues. Palombo calls these social-cognition impairments, which he would include in a separate subtype that also includes reciprocal social relations, verbal and nonverbal language, and affective processing problems.

The two-subtype model is useful in highlighting the math problems, although Forrest (2004) agrees with the work of Keller and Sutton (1991) who suggest that the WRAT measures math calculation only, not broad math skills. Since one cannot determine whether the students performed poorly on the math due to time limits, lining up numbers, or calculation, and so on, it remains unclear what kinds of math problems NLD students' face. In fact, utilizing his data for the most recent criteria of NLD (Rourke, 2000), only 72% of the children he diagnosed with NLD demonstrated poor math skills. Based on these results, one can conclude that math skill deficits are not present in all children with NLD. Therefore the two-subtype model is conceptualized as a visual–spatial processing problem, which creates social skill deficits with the possible comorbidity of a math problem.

Neurological, Social, and Academic Concerns

The NLD child with a visual–spatial or perceptual disorder might have problems in nonverbal reasoning, processing, work production and output, and some aspects of language. The typical nonverbal reasoning difficulties are in the areas of visual constructional reasoning, pattern analysis and synthesis, and nonverbal problem solving, especially with new or novel information. Processing difficulties might include visual and tactile perception, visual and spatial memory, visual attention, and fine and gross motor development (Pennington, 1991; Rourke, 1995). There is research that suggests that there are differences between spatial-simultaneous and spatial-sequential memory (Mammarella et al., 2006). Output difficulties affect handwriting, organizational and executive functions, and production efficiency in general.

NLD children's strengths tend to be language related and include areas such as verbal reasoning, rote verbal learning, simple verbal span memory, oral expression, and phonological processing. However, speech and language pathologists often find that these children have semantic/pragmatic disorders (Volden, 2004). Socially, these children are viewed as naïve, talkative, and have issues involving body or personal space. They may engage in parallel play longer than their peers. They fare better in social relationships, especially in one-to-one situations, than children on the autistic spectrum. Academically, these children tend to be good at decoding, they read fluently with detail-oriented comprehension, and they spell phonetically. Their academic weaknesses tend to be in spatially oriented sciences, geography, and geometry. However, a common confusion that can lead to misdiagnosis stems from the difficulty many NLD children experience with early reading

Three-Subtype Model of NLD

Grodzinsky (2003), Mamen (2002), and Palombo (2006) move beyond a two-subtype model. They agree

with Forrest (2004) regarding the spatial subtype with social problems and define it similarly. They say that these children often have math difficulties related to aspects of visual–spatial processing. However, each proposes a third subtype that significantly overlaps with the others. Although they have chosen different names for this third subtype, the characteristics they describe are almost the same and include visual-processing speed, and the social and attentional domains. The third subtype emphasizes the overlap between attention and executive functioning skills presented by both AD/HD, especially the inattentive type, and NLD. More specifically, this subtype emphasizes how more fragile or inadequate executive functioning skills can be problematic in both academic and social arenas.

Neurological, Social, and Academic Concerns

In this subtype, Grodzinsky, Mamen, and Palombo all focus on social deficits in describing neuropsychological subtypes of NLD. They note a difference between verbal and nonverbal test scores, although all three theorists postulate that aspects of spatial perception seem to be intact. For instance, Mamen (2002) states that on the Object Assembly and Picture Arrangement subtests of the WISC-III relative weaknesses are exhibited. However, she notes that the Block Design task is not usually affected to the same degree; she explains this difference as due to the added pragmatic communication demands inherent in the socially-oriented themes of the Object Assembly and Picture Arrangement subtests.

Social problems for this subtype are thought to be related to expressive body language, pragmatic communication, personal or social space, and difficulties with prosody, humor, metaphor, and analogy. Academically, relative strengths are seen in reading, although some NLD students struggle with advanced reading comprehension. Often math skills are in the average to low average ranges, due to problems with attention to detail and procedural memory. In terms of written language, these children can be good at narrative discourse, but experience difficulty in expository writing where they have trouble anticipating the reader's needs.

All three authors also refer to poor attention span and/or internal and external distractibility, though most often associated with visual processing rather than attention per se. In addition, they note that children in this subtype have executive functioning challenges such as perseveration or cognitive inflexibility, self-regulation, speed, and accuracy. One example presented by Mamen is that the major "nonverbal" deficit on the WISC-III or WISC-IV is that the Processing Speed Index score can be lower than the Perceptual Reasoning Index but, contrary to much of the data on ADHD, both are lower than the Freedom from Distractibility of Working Memory Indices of the WISC-III and IV, respectively. This differs from Rourke's model, which relies on finding a significant discrepancy between verbal and nonverbal reasoning scores. We find that the descriptions above are similar to descriptions of attention deficit/hyperactivity disorder, inattentive subtype. Grodzinsky (2003) states that these children are very often viewed as hypoactive. Another similarity is that children with the inattentive subtype are often described as having issues with executive functioning and slow or "sluggish" cognitive tempos (Teeter & Semrud-Clikeman, 1997), evidenced by their frequently low Processing Speed Index scores. These scores are frequently interpreted as the result of the NLD child's slow graphomotor speed, and/or slow decision making speed (Teeter & Semrud-Clikeman, 1997).

NLD children in this subtype can also be seen as somewhat rigid, though they function reasonably well in familiar settings. They may have a good sense of humor and are comfortable using puns and word play. Basic reading skill development might be slow due to visual-processing inefficiency that impedes learning the orthographic features of letters and words. They may perform poorly on rapid naming tests and/or sound symbol learning tasks (Grodzinsky, 2003). These tests tend to correlate with early alphabet learning, with which these children can have difficulty. However, once they "catch on" or have overlearned the letters, they become fluent readers. Writing is often difficult for these children, and they may be characterized as poor or variable spellers, disorganized in their written language, with trouble monitoring their written production. In math they may have some difficulty retrieving facts, but they generally have average conceptual ability.

Four-Subtype Model of NLD

A fourth neurological subtype is postulated only by Mamen (2002, 2006), a written expressive–nonverbal learning disability subtype that manifests primarily as a handwriting disorder. She believes this subtype should be included within the broader NLD framework, and that it may well be related to a developmental coordination disorder in a subset of these children who also show gross motor difficulties (Mamen, 2006). Mamen identifies the following as characteristics of this subtype:

1. There is an obvious discrepancy between oral skills and written output. Measurable deficits in fine motor, visual memory, and visual–motor integration skills serve to distinguish these children from those who do not like to print or write, who do not practice, and/or who avoid written tasks because they take effort. These children may not show the highly significant discrepancies between their verbal comprehension and perceptual reasoning skills that characterize the other subtypes.

2. On the WISC-III or WISC-IV, while verbal comprehension is usually the strongest of the index scores, the processing speed index may well be significantly lower than all other index scores. Writing fluency, psychomotor speed/accuracy, and fine motor dexterity would also be expected to be deficient.

3. All written work is laborious, with assignments (e.g., essays, journals, projects, written homework, and so on.) messy, minimal, and often unfinished. Genuine fatigue is generally observed in view of the effort expended. These children show a tendency to be extremely slow while copying from the board. They copy letter by letter, even when they can read the words, because they cannot remember what the letters look like. If you make them go fast, they make many errors and become frustrated and often ashamed of their work.

4. These children have few difficulties until the math requires writing. They have difficulty lining up the rows and columns and hence make errors when writing that they do not make when they are manipulating the numbers in their heads.

5. These children tend to dislike or avoid coloring, drawing, and printing readiness activities, although a subset of these children produce detailed drawings when left to be creative. Their difficulties lie in the accurate representation on paper of what their eyes see, either directly (e.g., copying) or indirectly (e.g., from short- or long-term visual memory or from their "mind's eye").

Neurological, Social, and Academic Concerns

The main neuropsychological difficulty noted in the four-subtype model is visual–motor integration, especially in timed situations such as on the WISC-IV Coding subtest. Mamen suggests that the Coding subtests yield lower scores than the Symbol Search subtest in this subtype, and that tests of visual–motor integration tend to be significantly weak in this subtype. She describes the primary academic difficulties as dysgraphia, or difficulty in writing fluently, or copying letters or words rapidly, making it an output disorder. Mamen (2002, 2006) also describes her perception of the social aspects of this disorder, which include low self-esteem, low frustration tolerance, and behavior or anger management issues. She sees these social–emotional issues as secondary rather than primary, and believes they may stem from a temperamental predisposition plus ensuing frustration.

Summary and Conclusions

This article attempts to acquaint clinicians with a range of nonverbal learning difficulties, organized by subtypes. Our review of the existing models, along with our experience, suggests that a four-subtype model is most useful because it highlights what we believe to be the most significant deficits of the NLD child. We also believe that NLD can best be viewed as a "spectrum" disorder. Children can have mild symptoms and behaviors of a disorder without a specific functional impairment. Our observations suggest that the lack of functional impairment is mediated by overall intellectual potential, varying levels of discrepancy between verbal and nonverbal measures, and parenting/intervention strategies that have enhanced compensatory strategies. It is, however, our contention that all children who present with NLD have significant visual–spatial and executive function difficulties. Therefore we consider visual–spatial and executive functioning deficits the primary components of NLD, and they constitute our first and core subtype. By *core,* we mean that any child with NLD would have these issues. However, children in this subtype may also have mild subclinical social and/or academic deficits. Our second subtype would be children with visual-spatial and executive function issues that do significantly affect their social functioning. These children would need formal evaluations and treatment programs, e.g. pragmatic language therapy and social skills training. Our third subtype is children who demonstrate difficulty with visual–spatial and executive functioning, that affect academic performance. Again, the academic issues are primarily math related, but can also emerge in reading comprehension, written expression (especially expository), geography, and the math-related sciences. Our fourth and final subtype is children who demonstrate difficulty with visual–spatial, executive functioning, social issues, and academic performance. We do not believe that these are the only possible subtypes of NLD, and are sure that future research will reveal alternate subtypes. We are currently analyzing data with Dr. Maggie Mamen that she and her colleagues have collected over the last few years. Through factor analysis and/or cluster analysis we hope to see if we can find evidence for any of the subtypes presented in this paper, thereby demonstrating how social and academic functioning are affected.

The evaluation and treatment teams for children with NLD should consist of a psychologist who investigates and diagnoses the intellectual or processing issues; an educational therapist who identifies the academic and organizational issues, providing appropriate intervention; a speech and language pathologist who diagnoses semantic/pragmatic difficulties; and an occupational therapist who identifies and provides assistance with motor difficulties. Other professionals might include a psychotherapist who assists in difficulties with social skills and parenting issues and a developmental pediatrician who can prescribe medication and monitor the behaviors that are appropriate for each stage of development.

The most important concept in this paper is that nonverbal learning issues are more complex than we once thought. A differential diagnosis for NLD must consider these subtypes, dismissing areas where there is no evidence of dysfunction and formulating appropriate treatment plans where difficulties are found.

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