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Verbal Fluency in Children: Developmental Issues and Differential Validity in Distinguishing Children with Attention-Deficit Hyperactivity Disorder and Two Subtypes of Dyslexia

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Previous research studies have shown that in adults, verbal fluency is impaired after lesion to the frontal lobes and left temporal lobe. More recently, there have been a few studies reported which indicated that in children, like adults, left hemisphere and frontal lesions result in pronounced effects on verbal fluency. The present study examined developmental differences in verbal fluency within a sample of 130 normal children, aged 6 to 12 years. Additionally, the same verbal fluency test was administered to two subgroups of children with developmental dyslexia and a group of children with attention-deficit/hyperactivity disorder (ADHD). Analysis of variance (ANOVA) revealed significant between-group differences by age in the normal children. Further, ANOVA demonstrated that the verbal fluency measure was clinically useful in differentiating the Language Disorder/Dysphonetic Dyslexic subgroup from the Visual-Spatial/Dyseidetic Dyslexic subgroup and the ADHD group, with the latter two groups performing within the average range © 1999 National Academy of Neuropsychology. Published by Elsevier Science Ltd

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INTRODUCTION

Previous research with adult populations has shown measures of verbal fluency (rapid verbal naming) to be sensitive to brain integrity, particularly in the left frontal lobe. For example, several studies have reported differential effects on verbal fluency depending on the laterality of the lesion. Research has indicated that subjects with left hemisphere lesions, primarily frontal, have significantly lower verbal fluency scores than those with right hemisphere lesions (Benton, 1968; Borkowski, Benton, & Spreen, 1967; Miller, 1984; Milner, 1964; Newcombe, 1969; Pendleton, Heaton, Lehman, & Hulihan, 1982; Perret, 1974).

Other studies have found lateralization effects after temporal lobectomies, with left temporal patients having significantly lower verbal fluency scores both preoperatively as well as 1 week postoperatively (Martin, Loring, Meador, & Lee, 1990), with greater improvement in verbal fluency found at 6 months (Hermann & Wyler, 1988) and 1 year (Loring, Meador, & Lee, 1994) following surgery. However, Loring et al. (1994) reported that both right and left temporal lobectomy patients had decreases in verbal fluency immediately after surgery and that the patterns in performance were similar for patients regardless of which temporal lobe had been resectioned.

Studies have also examined the differential effects of anterior and posterior lesions on verbal fluency. Within the left hemisphere, subjects with prefrontal lesions have been found to have greater impairments in verbal fluency than subjects with temporal lesions (Crowe, 1992; Milner, 1964). Similarly, results in a study by Ramier and Hécaen (1970) indicated that while subjects with left frontal impairments had the greatest deficits in verbal fluency, individuals with right frontal lesions had significantly lower verbal fluency than those with other right-sided lesions. Further, research suggests that individuals with frontal lesions are more impaired in verbal fluency, as compared with controls with extracranial nervous system pathology or no neurological impairment (Miller, 1984), and controls with psychiatric disorders even when covarying for intelligence quotient (IQ), age, and education (Crockett, Bilsker, Hurwitz, & Kozak, 1986). Thus, while there appears to be strong evidence in adults that left hemisphere lesions impair verbal fluency performance to a greater degree than right hemisphere lesions, and that anterior lesions are more damaging than posterior lesions, measures of verbal fluency cannot be used in isolation to localize brain lesions.

VERBAL FLUENCY IN CHILDREN

Similar to the adult literature, brain lesions appear to negatively impact verbal fluency in children/adolescents; however, a direct relationship between lesion site and verbal fluency has not been established. For example, Levin et al. (1993), investigated various cognitive impairments in head-injured children and adolescents and found that severely head-injured subjects (Glasgow Coma Scale ≤ 8) (GCS; Teasdale & Jennett, 1974), but not those with less severe injuries (GCS >8), produced fewer correct words than normals on a verbal fluency measure. Frontal, but not extrafrontal, lesion size was found to significantly increase the GCS scores' accuracy at predicting verbal fluency. In addition, the prediction accuracy of verbal fluency performance was significantly improved based on the size of orbital-frontal lesions. Using the Rapid Automatized Naming Test (RAN; Denckla & Rudel, 1976), a related fluency measure requiring the rapid naming of digits, colors, letters, and objects, children with left hemisphere lesions have been found to respond at a significantly slower rate than matched normal controls

(Aram, Ekelman, & Whitaker, 1987) and children with unilateral right hemisphere lesions, perhaps reflecting slower lexical retrieval (Aram, Meyers, & Ekelman, 1990).

Given that the vast majority (approximately 90%) of children with developmental dyslexia exhibit deficits in phonological processing and language development (see Hynd & Cohen, 1983; Lombardino, Riccio, Hynd, & Pinheiro, 1997 for review), research studies have investigated the rapid verbal naming performance of children with neurodevelopmental disabilities on measures of verbal fluency. For example, studies have shown that children with developmental dyslexia are characterized by deficits in verbal fluency and rapid automatized naming (Denckla & Rudel, 1976; Felton & Wood, 1989; Felton, Wood, Brown, Campbell, & Harter, 1987; Korhonen, 1991, 1995; Levin, 1990; Rudel, 1985; Wolf, 1986; Wolf & Obregon, 1992). Korhonen (1995) also reported that although initially, 9-year-old children with dyslexia and deficits in rapid naming did not differ significantly from controls on a verbal fluency measure (Korhonen, 1991), they did differ significantly at age 18, with the dyslexic children being less productive.

In addition, there is now a growing body of research that suggests that children with attention-deficit/hyperactivity disorder (ADHD) may be experiencing higher cortical dysfunction involving the frontal cortex, limbic system and the brainstem reticular activating system (Hynd et al, 1993; Lou, Henriksen, Bruhn, Borner, & Nielsen, 1989; Riccio, Hynd, Cohen, & Gonzalez, 1993; Voeller, 1991; Zametkin et al., 1990). Given this literature, it is reasonable to speculate that children with ADHD would do poorly on executive function tasks thought to be mediated by the frontal lobes. However, while some studies have reported that children with ADHD exhibit poor performance on measures of verbal fluency (Felton et al., 1987; Grodzinsky & Diamond, 1992; Kozoil & Stout, 1992), other studies have failed to confirm this relationship (Fischer, Barkley, Edelbrock, & Smallish, 1990; Frost, Moffitt, & McGee, 1989; McGee, Williams, Moffitt, & Anderson, 1989; Reader, Harris, Schuerholz & Denckla, 1994).

DEVELOPMENTAL ISSUES

One issue to consider in using measures of verbal fluency with younger populations is the relationship with development. The literature suggests that verbal fluency is not significantly associated with age in early through middle adulthood (Cauthen, 1978; Miller, 1984), but does decline with advancing age (Schaie & Strother, 1968). In children, however, verbal fluency development has been found to be positively related to age. Some researchers have found that verbal fluency increases with age and approaches adult levels by age 10 (e.g., Regard, Strauss, & Knapp, 1982) whereas others (Welsh, Pennington, & Groisser, 1991) have found that children as old as 12 were significantly less fluent than an adult group, suggesting that verbal fluency continues to develop into adolescence. This is consistent with research that has shown that frontal lobe functioning develops in multiple stages throughout childhood, with full mastery of all frontal lobe skills not present at 12 years of age (Becker, Isaac, & Hynd, 1987; Passler, Isaac, & Hynd, 1985). Thus, verbal fluency measures may be sensitive to neurodevelopment, but it is not yet clear at what age performance on these instruments reaches adult levels.

While verbal fluency measures have been fairly well researched with adult populations, research on these measures with children is less exhaustive. The present study was undertaken to examine developmental trends in verbal fluency (rapid verbal naming) within a group of normal functioning children as well as to examine the clinical utility of this verbal fluency measure with subtypes of children diagnosed with developmental dyslexia and with children diagnosed with ADHD.

METHODS

Subjects

Normal sample. This study included a sample of 130 (64 male, 66 female) regular education children ranging in age from 6 through 12 years. The seven age groups ranged in size from 17 to 19 children with a fairly equal distribution of males (49%) and females (51%); 84.6% were Caucasian and 15.4% were African American. To be included, each child had to be of normal intelligence (standard score ≥ 85) as measured by the Otis-Lennon Mental Ability Test (Otis & Lennon, 1988), reading on grade level (as reported by their teacher), without behavior problems, as assessed by the 39-item Conners Teacher Rating Scale (Cohen, DuRant, & Cook, 1988; Cohen & Hynd, 1986; Conners, 1969), and without academic retention. The mean IQ for the normative sample was 106.28 ± 10.92. ANOVA revealed no significant ($p > .05$) IQ differences across the age groups.

Clinical samples. In order to assess the performance of children with various neurodevelopmental disabilities, the verbal fluency test was administered to two subgroups of children with developmental dyslexia (language disorder/dysphonetic, $n = 35$; visual-spatial/dyseidetic, $n = 7$) and a group of children with ADHD ($n = 23$). It should be noted that the sample size of the Visual-Spatial/Dyseidetic Dyslexic subgroup is consistent with incidence figures reported by Boder (1971, 1973), who has long maintained that this subgroup is considerably less frequent than the Language Disorder/Dysphonetic subgroup.

Clinical subjects were selected consecutively over a 2-year time period from referrals to the Child Neuropsychology Service at the Medical College of Georgia. This sample ranged in age from 6.75 to 15.8 years (mean age = 8.7 years); 73% were male, 89% were Caucasian, and 92% were right-handed. The mean reported family income ranged from $30,000 to $40,000. ANOVA and chi-square analyses revealed that the clinical groups did not differ significantly ($p > .05$) on gender, race, handedness, age, or family income, as reported by the parents. ANOVA indicated that the clinical groups did not differ significantly ($p > .05$) on mean Full Scale IQ as measured by Wechsler Intelligence Scale for Children-III (WISC-III; Wechsler, 1991) with means well within the average range (Language Disorder/Dysphonetic = 92.5 ± 11.7; Visual-Spatial/Dyseidetic = 99.1 ± 12.43; ADHD = 97.0 ± 12.91). No child had a positive history of autism, cerebral palsy, epilepsy, stroke, closed-head injury, or other neurological/psychiatric disorder.

Children with developmental dyslexia met learning disability criteria according to the Georgia State Department of Special Education regulations (i.e., exhibited normal intelligence and an IQ/achievement discrepancy ≥ 20 standard score points in reading recognition and/or reading comprehension). Further, these children were clinically subtyped based upon their neuropsychological test profiles (Boder, 1971, 1973; Cohen, Krawiecki, & DuRant, 1987; Mattis, French, & Rapin, 1975; Pirozzolo, 1979). Table 1 provides means and standard deviations on the various neuropsychological test variables administered to the three clinical groups for subtyping purposes.

Specifically, on neuropsychological evaluation the Language Disorder/Dysphonetic group exhibited a mean verbal-performance discrepancy of 10.7 on intelligence testing in favor of performance IQ (PIQ). As compared with PIQ, this group revealed relative areas of deficit in expressive and receptive language, auditory discrimination, and immediate auditory/verbal memory. In contrast, this group demonstrated intact visual discrimination, constructional praxis, and immediate visual/nonverbal memory. Analysis of reading and spelling errors revealed difficulty in phonetic word attack and sound blending.

In contrast, the Visual-Spatial/Dyseidetic group exhibited a mean verbal-performance discrepancy of 18 points in favor of verbal IQ (VIQ). As compared with VIQ, this group exhibited relative areas of dysfunction in constructional praxis and immediate visual/nonverbal memory. Further, this group demonstrated intact expressive and receptive language, auditory discrimination, and immediate auditory/verbal memory. Analysis of reading and spelling errors revealed that this group frequently confused visually similar letters and words as well as displaying letter reversals and left-right confusion.

Children in the ADHD group met criteria for this disorder according to the *Diagnostic and Statistical Manual of Mental Disorders* (3rd ed., revised; *DSM-III-R*, American Psychiatric Association, 1987) based upon clinical interview with the parents. In addition, each child received ratings on the ADHD factor of the 39-item Conners Teacher Rating Scale (Cohen et al., 1988; Cohen & Hynd, 1986), and the 48-item Revised Conners Parent Rating Scale (Cohen, 1988) that were ≥ 1.5 *SD* above the mean with no other significant comorbid psychopathology noted. In general, children in the ADHD group did not exhibit a significant verbal-performance discrepancy or evidence of a co-occurring learning disability on neuropsychological evaluation.

TABLE 1
Mean Standard Score Test Profiles for the Clinically Derived Dyslexic Subtypes and Attention-Deficit Hyperactivity (ADHD) Group

	Dyslexic Subtype								
	Language		Visual		ADHD				
Test Variables	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	Tukey-HSD
WISC-III									
VIQ	88.1	13.6	107.8	12.6	98.8	14.2	17.78	.000	1 < 2, 3
PIQ	98.8	10.4	89.8	12.2	95.3	13.5	4.60	.012	2 < 1
FSIQ	92.5	11.7	99.1	12.4	97.0	12.9	2.99	.054	
Langauge									
Receptive Vocabulary (PPVT-R)	86.1	14.5	105.8	12.2	98.1	13.6	18.07	.000	1 < 2, 3
Auditory Discrimination (Wepman)	77.6	21.0	103.1	17.7	97.1	14.1	15.34	.000	1 < 2, 3
Expressive Vocabulary (WISC-III)	90.9	14.3	104.7	14.3	100.7	12.2	10.38	.000	1 < 2, 3
Picture Naming (BNT)	75.6	19.7	112.2	14.9	99.8	15.1	30.24	.000	1 < 2, 3
Visual-Spatial									
Visual Motor (DTVMI)	90.3	11.2	82.8	10.8	94.1	11.3	1.95	.15	
Visual Discrimination (TVPS)	113.4	15.3	101.0	20.5	112.8	19.7	.20	.82	
Immediate Auditory Memory									
Number Recall (KABC)	91.3	16.5	108.8	18.5	100.6	12.7	7.69	.000	1 < 2, 3
Sentence Imitation (DTLA-2)	82.7	16.9	106.5	14.5	97.4	11.4	18.83	.000	1 < 2, 3
Immediate Visual Memory									
Visual Memory (TVPS)	100.8	12.5	90.7	10.7	99.3	15.0	3.56	.03	2 < 1
Hand Movements (KABC)	95.1	12.8	87.5	7.1	98.8	13.9	3.01	.05	2 < 3
WRAT-3									
Reading	73.2	13.1	83.6	11.2	97.4	14.0	39.19	.000	1 < 2 < 3
Spelling	74.8	12.3	84.5	12.3	95.2	13.0	30.29	.000	1 < 2 < 3
Math	84.1	11.5	96.3	16.1	97.5	13.7	15.58	.000	1 < 2, 3
GORT-3									
Passage Reading	70.9	12.3	79.8	12.5	94.0	18.7	22.01	.000	1 < 2, 3
Reading Comprehension	80.2	12.1	90.7	12.8	94.0	13.0	12.41	.000	1 < 2, 3

ADHD = Attention-Deficit/Hyperactivity Disorder; BNT = Boston Naming Test; DTLA-2 = Detroit Test of Learning Aptitude-2; DTVMI = Developmental Test of Visual Motor Integration; GORT-3 = Gray Oral Reading Test-3; KABC = Kaufman Assessment Battery for Children; Language = Language Disorder/Dysphonetic; *M* = mean; PPVT-R = Peabody Picture Vocabulary Test-Revised; *SD* = Standard Deviation; TVPS = Test of Visual Perceptual Skills; Visual = Visual-Spatial/Dyseidetic; Wepman = Wepman Auditory Discrimination Test; WISC-III = Wechsler Intelligence Scale for Childred-Third Edition; WRAT-3 = Wide Range Achievement Test-3.

Procedure

Each child was administered the verbal fluency task in a quiet room in their school (regular education subjects) or as part of a comprehensive neuropsychological test battery administered in the Child Neuropsychology Laboratory at the Medical College of Georgia (clinical subjects). For this task, the child was asked to verbalize as many words as possible, beginning with a particular letter of the alphabet (C,P,B,R), within a 30-second time interval. No proper names or plural forms of previously verbalized responses were allowed. Raw scores (number of correct words) were summed for each of the four trials yielding a total score that was used for data analysis. Cronbach's alpha reliability coefficient was computed for the fluency scale as a whole and yielded an alpha of .80, with all four items (letters) contributing positively to the alpha. In the case of the clinical groups, raw scores were transformed to standard scores ($M = 100$; $SD = 15$) based on the mean and standard deviations by age level of the regular education sample.

RESULTS

Table 2 presents the mean raw scores and standard deviations on the verbal fluency task for the seven age groups of regular education children. ANOVA across the seven age groups of normal children revealed a significant ($F = 17.39$; $p < .001$) age effect. Pairwise comparisons using the Tukey-HSD procedure indicated that the 6-year-old group performance was significantly ($p < .05$) different from that of the 8- through 12-year-old groups. However, their performance did not differ significantly from the 7-year-old group. The 7-year-old group performance was significantly ($p < .05$) different from that of the 10- through 12-year-old groups, but did not differ significantly from that of the 8- and 9-year-old groups. Finally, the 8- and 9-year-old group performances were significantly ($p < .05$) different from that of the 12-year-old group, but not from that of the 10- and 11-year-old groups or each other.

ANOVA across the two Dyslexic subgroups and the ADHD group revealed a significant ($F = 9.38$; $p < .001$) performance effect. Tukey-HSD pairwise comparisons showed that the performance of the Language Disorder/Dysphonetic Dyslexic subgroup ($M = 75.86 \pm 23.93$) was significantly ($p < .05$) lower than that of the Visual-Spatial/Dyseidetic Dyslexic subgroup ($M = 99.86 \pm 10.29$) and the ADHD group ($M = 97.13 \pm$

TABLE 2
Mean Verbal Fluency Raw Scores for Nomal 6- to 12-Year-Old Children

Age (Years, Months)	*n*	*M*	*SD*
6, 0 to 6, 11	19	15.53	4.99
7, 0 to 7, 11	19	19.47	5.61
8, 0 to 8, 11	18	23.67	6.82
9, 0 to 9, 11	17	23.76	3.58
10, 0 to 10, 11	19	26.63	4.81
11, 0 to 11, 11	19	28.32	5.43
12, 0 to 12, 11	19	30.42	5.81

M = mean; SD = standard deviations.

16.04). The Visual-Spatial/Dyseidetic Dyslexic subgroup and the ADHD group did not differ significantly ($p > .05$).

Finally, scattergrams of the distribution of individual standard scores for each child, within each clinical group, were created. This was done in order to determine how many children within each clinical group actually performed in a manner consistent with what the group mean scores would suggest. Figure 1 shows that the majority of children comprising each group tended to perform in a manner consistent with what would be expected, based upon the mean standard score for each group. For example, 71.43% (n = 25) of the Language Disorder/Dysphonetic group obtained scores <85, while 85.71% (n = 6) of the Visual-Spatial/Dyseidetic group, and 86.96% (n = 20) of the ADHD group obtained scores ≥85.

DISCUSSION

The results of this study indicate that in normal children verbal fluency (rapid verbal naming) does improve significantly between 6 and 12 years of age. Thus, the verbal fluency task demonstrates age differentiation and meets one component in the validation of a test (Anastasi, 1988). This finding is also consistent with studies that have examined frontal lobe development in children. Specifically, previous studies have shown that the development of frontal lobe functions continues at least through the age of 12, if not beyond (Becker et al., 1987; Passler et al., 1985; Welsh et al., 1991). However, the extent to which the presumed frontal lobe functions (focused/directed attention, immediate working memory, and word retrieval from long-term memory), measured by this verbal flu-

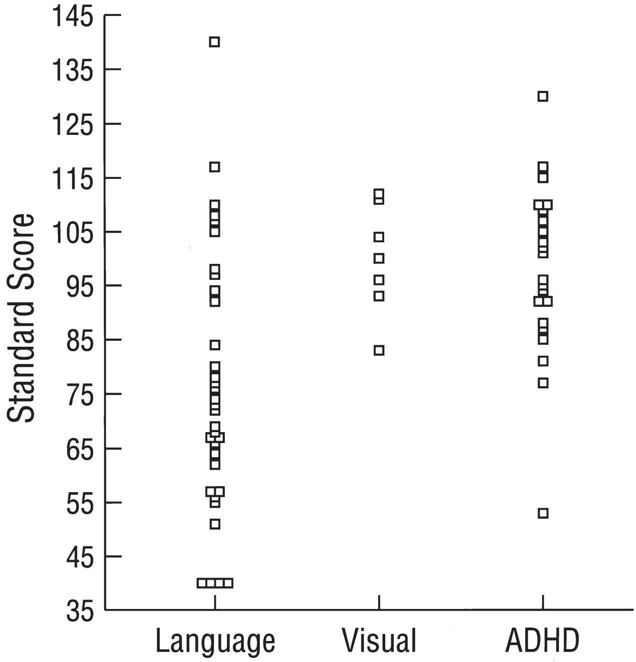

FIGURE 1. Distribution of individual performances across clinical groups. Language = Language disorder/dysphonetic; Visual = visual-spatial/dyseidetic; ADHD = attention-deficit/hyperactivity disorder.

ency task at age 12 are comparable to that of young adults needs to be examined in future research.

Regarding differential diagnosis, while it appears that this verbal fluency task cannot be used in isolation to subtype children with developmental dyslexia, these results do suggest that not all children with dyslexia exhibit problems with verbal fluency (rapid verbal naming). Specifically, the Visual-Spatial/Dyseidetic subgroup demonstrated average verbal fluency ability (6 of 7 children) while the Auditory Linguistic/Dysphonetic subgroup exhibited significantly impaired performance, as might be expected, given the nature of their neuropsychological deficits. Thus, these results lend support for the contention that the dyslexic population is heterogeneous in nature with each subgroup exhibiting a distinctive pattern of higher cortical and/or subcortical dysfunction (Hynd & Cohen, 1983).

TABLE 3
Mean Standard Score Test Profiles for the Children with the Language Disorder/Dysphonetic Subtype of Dyslexia: High Fluency Scorers (>85) Versus Low Fluency Scorers (<85)

	Auditory Linguistic/ Dysphonetic Subtype				
	High Fluency		Low Fluency		
Test Variables	*M*	*SD*	*M*	*SD*	*p*
WISC-III					
VIQ	93.9	13.5	84.4	13.1	.04
PIQ	104.5	11.7	97.5	11.8	.06
FSIQ	98.5	12.9	89.6	12.2	.04
Language					
Receptive Vocabulary (PPVT-R)	95.7	16.8	84.8	16.0	.05
Auditory Discrimination(Wepman)	79.4	20.5	73.2	22.3	.24
Express. Vocabulary (WISC-III)	94.5	14.4	85.8	13.8	.06
Picture Naming (BNT)	87.5	12.6	76.2	21.5	.04
Visual-Spatial					
Visual Motor (DTVMI)	97.1	11.6	92.5	10.0	.15
Visual Discrimination (TVPS)	113.3	15.4	112.6	16.4	.45
Immediate Auditory Memory					
Number Recall (KABC)	98.1	11.6	90.5	19.0	.10
Sentence Imitation (DTLA-2)	88.8	7.9	80.4	17.5	.10
Immediate Visual Memory					
Visual Memory (TVPS)	93.3	7.1	102.4	11.7	.006
Hand Movmements (KABC)	98.8	11.9	93.3	12.9	.15
WRAT-3					
Reading	75.8	10.8	68.8	14.2	.07
Spelling	83.3	8.8	72.2	14.5	.005
Math	85.5	7.4	84.3	10.0	.35
GORT-3					
Passage Reading	82.5	12.5	77.2	12.3	.16
Reading Comprehension	80.1	10.7	66.5	11.1	.005

BNT = Boston Naming Test; DTLA-2 =Detroit Test of Learning Aptitude-2; DTVMI = Developmental Test of Visual Motor Integration; GORT-3 = Gray Oral Reading Test-3; KABC = Kaufman Assessment Battery for Children; M = mean; SD = standard deviation; PPVT-R = Peabody Picture Vocabulary Test-Revised; TVPS = Test of Visual Perceptual Skills; Wepman = Wepman Auditory Discrimination Test; WISC-III = Weschsler Intelligence Scale for Children-Third Edition; WRAT-3 = Wide Range Achievement Test-3.

Figure 1, however, reveals that there is a subset of children within the Language Disorder/Dysphonetic subtype (28.57%; $n = 10$) that demonstrate average performance. In an attempt to explain the cause for this disparity in performance within this subtype, one-tailed t-testing was carried out across the remaining neuropsychological variables, comparing the 10 children with high fluency scores (>85) to the 25 children with low fluency scores (<85). Analysis of Table 3 reveals that the high fluency group demonstrated mild deficits in word retrieval, Boston Naming Test (BNT) and sentence imitation, Detroit Test of Learning Aptitude-2 (DTLA-2) in conjunction with a mild reading disability. In contrast, the low fluency group demonstrated mild to moderate deficits across all linguistic measures, in conjunction with faulty sentence imitation skills. Further, this group exhibited lower VIQs in general, as well as poorer performance on tests of reading.

These findings could be interpreted in one of two ways. One hypothesis appears to be that these groups simply differ on the basis of severity of their language disorder. A second hypothesis suggests that it may be possible to further subdivide the Language Disorder/Dysphonetic subgroup into a more anterior and a more globally impaired grouping, depending upon the location of the dysfunction within the left perisylvian language area. Specifically, it is proposed that the anterior group may exhibit deficits involving articulation and/or oral-motor planning/sequencing in conjunction with mild deficits in word retrieval and immediate auditory/verbal memory. In addition, these children may exhibit attentional deficits. In contrast, the globally impaired group would be expected to exhibit deficits in expressive and receptive language, auditory discrimination and/or rapid phonological processing, and deficits in immediate auditory/verbal memory with and without attentional deficits. Support for this speculation can be derived from results of previous studies (Cohen, Hynd, & Hugdahl, 1992; Cohen, Riccio, & Hynd, 1998; Levin, 1990; Torgeson, 1977; Torgeson & Goldman, 1977). Further research regarding this speculation is certainly warranted.

Given the body of research that has postulated frontal lobe involvement in ADHD (Hynd et al, 1993; Lou et al, 1989; Riccio et al., 1993; Voeller, 1991; Zametkin et al., 1990), it is interesting to note that the performance of the ADHD group was generally not found to be impaired. While this finding supports the results of several studies (Fischer et al., 1990; Frost et al., 1989; McGee et al., 1989; Reader et al., 1994), it is not consistent with the results of other studies (Felton et al., 1987; Grodzinsky & Diamond, 1992; Kozoil & Stout, 1992). These differences may be explained by the fact that some researchers examined children with ADHD who also had developmental dyslexia (presumably of the Language Disorder/Dysphonetic subtype), while others were careful to exclude children with dyslexia. Further, these studies differ with regard to the criteria used for diagnosis of ADHD (e.g., significant inattention/hyperactivity scores on parent/teacher rating scales in isolation vs. in combination), mean level of intelligence, and mean age at time of assessment. Finally, this finding may indicate that in children, like adults, not every task that is thought to assess frontal lobe integrity will be clinically sensitive in every child with presumed frontal lobe dysfunction.

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