1990

Identification of dyspraxic characteristics in children with moderate and severe articulation disorders

Gail Woodward
Portland State University

AN ABSTRACT OF THE THESIS OF Gail Woodward for the Master of Science in Speech Communication: Emphasis in Speech-Language Pathology presented July 10, 1990.

Title: Identification of Dyspraxic Characteristics in Children with Moderate and Severe Articulation Disorders

APPROVED BY MEMBERS OF THE THESIS COMMITTEE:

[redacted]

Mary E. Gordon, Co-Chair

[redacted]

C. Donald Nelson, Co-Chair

[redacted]

Robert L. Casteel

[redacted]

David H. Martinez

The purpose of this investigation was to determine if public school children with moderate and severe articulation disorders exhibit dyspraxic characteristics on a standardized developmental dyspraxia screening test.

Identification of dyspraxic characteristics in children may be essential for planning an effective treatment program. The treatment approach for children with developmental apraxia of speech (DAS) is a non-traditional, complex approach, involving long-term commitment to individualized communication treatment which focuses on improved intelligibility (Blakeley, 1983). It is this researcher's inference that public school children who demonstrate moderate and severe articulation disorders may be dyspraxic, and would benefit from a non-traditional speech treatment approach.

Nineteen children, with articulation disorders, between the ages of 5 and 12 were selected from the Portland metropolitan area public elementary schools. Of the 19 subjects who were referred with multiple articulation errors, 14 were labeled severe and 5 were labeled moderate using the Arizona Articulation Proficiency Scale-Revised (AAPS-R). The TOLD-P or TOLD-I and the PPVT-R were administered to determine expressive and receptive language ages, respectively. The resultant language ages were entered in Subtest I of the Screening Test for Developmental Apraxia of Speech (STDAS) and the remaining seven subtests were administered to all subjects.

The results of this study revealed that 71 percent of the 14 children with severe articulation disorders

demonstrated a high probability (97 percent or greater) of being included in a dyspraxic group according to the STDAS. Results also showed that the five moderately disordered children demonstrated little or no probability (2 percent or less) of being dyspraxic.

Characteristics most often demonstrated by the dyspraxic subjects included the following: (a) expressive language discrepancy, (b) verbal sequencing errors, (c) multiple two- and three-feature articulation errors, (d) transpositions, (e) prosody deviations, (f) concomitant language disorder, and (g) spontaneous speech more unintelligible than single words.

These results suggest that children with severe articulation disorders who demonstrate the characteristics outlined above are likely to be dyspraxic and would benefit from a more intensive assessment and, if appropriate, initiation of a non-traditional treatment approach. Although the moderately disordered children in this study showed little or no signs of dyspraxia, children with moderate articulation disorders who demonstrate dyspraxic characteristics would also benefit from further evaluation and, if appropriate, a DAS treatment approach.

IDENTIFICATION OF DYSPRAXIC CHARACTERISTICS IN CHILDREN WITH MODERATE AND SEVERE ARTICULATION DISORDERS

by

GAIL WOODWARD

A thesis submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE
in
SPEECH COMMUNICATION
with emphasis in
SPEECH-LANGUAGE PATHOLOGY

Portland State University
1990

TO THE OFFICE OF GRADUATE STUDIES:

The members of the Committee approve the thesis of Gail Woodward presented July 10, 1990.

[redacted]

Mary E. Gordon, Co-Chair

[redacted]

C. Donald Nelson, Co-Chair

[redacted]

Robert L. Casteel

[redacted]

David H. Martinez

APPROVED:

[redacted]

Theodore G. Grove, Head, Department of Speech Communication

[redacted]

C. William Savery, Interim Vice Provost for Graduate Studies and Research

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION AND PURPOSE

INTRODUCTION

The term "developmental apraxia of speech" (DAS) was first applied to the articulatory patterns of a specific group of children in 1954 (Morley, Court, & Miller). Since that time, confusion and controversy over the etiology and, according to Guyette and Deidrich (1981), existence of the disorder has complicated identification and treatment of DAS. For this reason, children with DAS may not be identified by the SLP and therefore, are administered a treatment program designed for children with functional articulation disorders (FAD) (Mitcham, 1975). Differentiation of dyspraxic characteristics from the characteristics exhibited by children with FAD seems to be essential for planning an effective treatment program.

The recommended treatment approach for children with apraxia of speech is a non-traditional, complex approach, involving long-term commitment to individualized communication intervention which focuses on improved intelligibility (Blakeley, 1983). Traditional forms of speech

intervention, such as the phonological and motor learning approaches, are often ineffective in the remediation of DAS (Jaffe, 1984). The phonological approach assumes a language-based impairment rather than a motor disorder (Weiner, 1984). In a motor learning approach, treatment is directed toward individual target sound production in a variety of contexts that include levels ranging from isolated sound practice to spontaneous speech (Ruscello, 1984). Additionally, traditional treatment programs rarely include daily sessions which may be imperative in the remediation of DAS (Blakeley, 1983; Ferry, Hall, & Hicks, 1974). It is this researcher's hypothesis that school age children who demonstrate moderate to severe articulation disorders may be dyspraxic, and therefore would likely benefit from a non-traditional approach.

In previous studies that have examined characteristics and identification of DAS in so-called FAD children, standardized screening instruments were not applied; rather, an evaluation battery was constructed and administered by the researchers (Mitcham, 1975; Rosenbek & Wertz, 1972; Williams, Ingham, & Rosenthal, 1981; Yoss & Darley, 1974a). These studies attempted to establish differential diagnosis of DAS from FAD by identifying a specific group of speech and non-speech behaviors that characterize children with DAS. Subjects included

children with moderate and severe articulation disorders (Rosenbek & Wertz, 1972; Williams et al., 1981; Yoss & Darley, 1974a). Results of these studies were inconclusive. In the current study, the performances of moderate and severe articulation disordered subjects were described using a standardized screening instrument for DAS, i.e., the Screening Test for Developmental Apraxia of Speech (STDAS) (Blakeley, 1980). The STDAS was used with the intention of reducing assessment variability which often occurs in the diagnosis of DAS when diagnostic "structure" is absent (Haroun, Gordon, & Blakeley, 1988).

STATEMENT OF PURPOSE

The purpose of this research was to determine if children diagnosed as having moderate and severe articulation disorders exhibit dyspraxic tendencies as measured by the STDAS (Blakeley, 1980). The following research question was posed: Do children diagnosed as having moderate and severe articulation disorders exhibit dyspraxic tendencies on a standardized developmental dyspraxia screening test?

DEFINITIONS

The following are descriptions of terms used throughout this study:

Acquired Apraxia of Speech: A disturbance in the ability to program the speech musculature to produce the sequenced movements of speech, in the absence of weakness, paralysis, or incoordination. Onset occurs after normal articulatory development is complete (Love & Webb, 1986).

Apraxia of Speech: ". . . an impaired capacity to form vocal tract configurations and to make transitions between vocal configurations for volitional speech production in the absence of motor impairments for other actions using the same musculature" (Rosenbek, Kent, & LaPointe, 1984, p. 12).

Developmental Apraxia of Speech (DAS): A disturbance in the ability to program the speech musculature in order to produce the sequenced movements of speech, in the absence of weakness, paralysis, or incoordination. Onset occurs prior to normal articulatory development (Love & Webb, 1986).

Functional Articulation Disorder (FAD): ". . . an inability to produce correctly all of the standard speech sounds of the language for which there is no appreciable structural, physiological or neurological basis in the speech mechanism or its supporting structures, but which can be accounted for by normal variations in the organism or by environmental or psychological factors" (Powers, 1971, p. 708).

Oral Apraxia: Impaired ability to program the articulators for nonspeech oral movements (Weiss, Gordon, & Lillywhite, 1987).

Soft Neurological Signs: " . . . inconsistent and isolated indications of neurological disturbance, rarely clustering together to present a classic neurologic syndrome allowing reliable lateralization and location of lesion" (Love & Webb, 1986, p. 227).

CHAPTER II

REVIEW OF THE LITERATURE

The term "developmental apraxia of speech" was first used by Morley, Court, & Miller in 1954 to describe the articulatory patterns of a specific group of children. Since then, a limited amount of well-defined research has emerged, and consequently, confusion and controversy over the existence of the disorder has developed (Guyette & Deidrich, 1981; Haynes, 1985). To add to the confusion, a wide variety of terms which are used in reference to the disorder have emerged, including developmental verbal dyspraxia, articulatory dyspraxia, congenital dyspraxia, dilapidated speech, and motor aphasia (Eisenson, 1986; Haynes, 1985; Nelson, 1988). This last term is probably least accepted because it implies a central language impairment, and dyspraxia is considered to be a motor planning disorder (Eisenson, 1986).

A review of the literature reveals that research conducted in the last ten years has focused less on identification and existence of DAS and more on treatment and language skills associated with the disorder. This change of focus may reflect growing support among researchers for

the existence of the disorder and an interest in the development of appropriate and effective treatment programs for these children.

Although many studies of apraxia of speech have focused on the disorder in adults, the majority of research presented in this paper will pertain to children. Research involving the adult disorder of apraxia of speech will only be introduced where it helps to facilitate or further the understanding of DAS.

INCIDENCE AND ETIOLOGY OF DAS

Incidence of DAS seems impossible to estimate due to lack of agreement among researchers on the specific diagnostic indicators which characterize the disorder, and the controversy over the existence of the disorder. However, a typical public school caseload consists of approximately 80 percent articulation disorders, and of these children, Ferry et al. (1974) suggested that 10 percent may demonstrate DAS. This figure may seem high because many of these children may not be identified (Ferry et al., 1974). Although Mitcham (1975) did not indicate specific percentages in her study, she identified public school children who demonstrated dyspraxic tendencies and who had been diagnosed as FAD and subsequently treated using an FAD approach.

In adults, apraxia of speech is usually caused by damage to the motor speech and adjacent brain area of the left hemisphere (Kornse, Manni, Rubenstein, & Graziani, 1981). However, in their study of manual dexterity of children with DAS, Kornse et al. (1981) found that DAS is probably not due to congenital or acquired defects to the areas of the brain which are usually impaired in acquired apraxia of speech. Nonetheless, there is general agreement among researchers that DAS is caused by neurological impairment (Blakeley, 1980; Crary, 1984; Edwards, 1973; Prichard, Tekieli, & Kozup, 1979; Rosenbek & Wertz, 1972), although specific proof of pathological causation has not been established (Horwitz, 1984). Nelson (1988) described the impairment as being "associated with neurophysiological dysfunction rather than anomalies of neuroanatomical structure" (p. 1). The cause of such prebirth neurological damage is speculative, but may include both genetically based disorders and metabolic disorders (Nelson, 1988).

Edwards (1973) and Ferry et al. (1974) agreed that DAS may be the result of neural dysfunction rather than a focal or diffuse anatomical impairment. Further, Edwards (1973) indicated that the impairment may be of the sensory or motor pathways of speech or the interconnections between the neurological processes. Horwitz (1984) did

not necessarily agree with the neurological findings in some of these studies and supports his opinion by pointing out limitations in studies conducted by Rosenbek and Wertz (1972), Yoss and Darley (1974a), and Ferry et al. (1975); however, he added that the EEG and neurological abnormalities discovered in such studies suggest that "concomitant neurological symptomatology may be diverse" (p. 113). In his well-designed neurological study, Horwitz (1984) used computed tomography to scan the anatomical integrity of the brain. Additionally, DAS subjects were assessed for clinical neurological deviations or EEG patterns. Findings failed to delineate consistent neurological findings or specific localization of anatomical abnormalities. A convincing family background of language disorders was discovered, but conclusions regarding the inheritance of DAS were not established.

A summary of the neurological studies of children with DAS reveals that neurological abnormalities are diverse with no consistent patterns of symptomatology among studies.

CHARACTERISTICS OF DAS

In an attempt to identify and describe DAS, speech-language pathologists, neurologists, pediatricians, and others have studied children described as DAS and FAD.

From these studies, a wide variety of characteristics related to DAS have emerged. DAS is best identified by a cluster of symptoms; not all characteristics are observed and no one characteristic must be present. To add to the confusion, the typical cluster of symptoms observed are not limited to DAS and may vary as children mature (Hall & Penelope, 1986; Jaffe, 1984). This section describes characteristics of DAS most commonly found in the literature.

Eisenson (1984) described the general early communicative development of children with DAS from birth. According to this author, because their auditory discrimination and auditory perception are not affected by the DAS, as babies, they respond to environmental sounds much like normal children do. Around one year of age, the children with DAS play baby interactive games and babble, but may not imitate adult verbalizations. This lack of verbal behavior may be subtle and probably goes unnoticed by the parents. Around 18 months, however, the lack of verbal behaviors often become a concern to the parents and by 2.5 to 3 years of age most parents are worried or anxious about their child's lack of speech. Additionally, feeding problems may develop, and children with DAS may prefer liquids over solid foods that require chewing.

Eisenson (1984) stated that the primary difficulty involves the impairment of volitional production of the sequence of movements for speech. Although the children produce a number of isolated sounds, they often have difficulty executing a series of such sounds. According to Eisenson (1984), as rate of production and length of utterance increase, performance often becomes worse. Edwards (1973) stated that production of single words and short serial phrases may be nearly normal. Additionally, speech may not be the only behavior affected by DAS. Some children may exhibit an overall dyspraxia characterized by slowness or awkwardness in all forms of motor abilities (Eisenson, 1984).

Yoss and Darley (1974a) conducted a study with the intention of determining specific characteristics which might differentiate children with DAS from those with FAD. The speech characteristics they found to be statistically significant in the differentiation are: (a) slower and incorrectly sequenced diadochokinetic rates, (b) difficulty with polysyllabic words, (c) two- and three-feature errors, (d) difficulty with volitional movements of oral musculature, and (e) altered prosody. They also reported a high incidence of soft neurological signs in the DAS group.

Williams et al. (1981) attempted to replicate the Yoss and Darley (1974a) study using the same variables and

a different group of subjects. Their results did not agree with the previous study since the only characteristics they found to be statistically significant in differential diagnosis were difficulty with volitional movements of oral musculature and slower diadochokinetic rates. Williams et al. (1981) reasoned that the subjects used in the previous study may have been articulation-disordered children who also demonstrated soft neurological signs, while the subjects used in the latter study did not demonstrate the same neurological symptoms. Therefore, the subjects in the two studies were not well matched, and probably because of this, findings from these studies did not agree.

Characteristics found by Rosenbek and Wertz (1972) in their study of 50 children diagnosed with DAS, include the following: (a) delayed and deviant speech development, (b) receptive language superior to expressive, (c) may or may not exhibit oral apraxia, (d) phonemic errors with omissions occurring most often, (e) metathetic errors (e.g., ɛfəlʌnt for "elephant"), (f) increased errors with increased word length, (g) spontaneous speech more unintelligible than single word articulation tests indicate, (h) vowel misarticulations, (i) inconsistent errors, (j) prosodic disturbances, and (k) groping trial-and-error behavior in an attempt to position the articulators as well as silent posturing.

Additionally, results from this study suggest that DAS may occur as a part of a generalized neurological dysfunction or it may occur alone. When it occurs alone, it may be more likely to attract the label "functional." According to Bernthal and Bankson (1981), the term "functional" has become an all-encompassing term that includes all children with articulatory deficits of unknown causes. They contended that articulation disorders of unknown etiology may be caused by subtle organic factors. Diagnosis of DAS may be confounded by lack of symptoms of cerebral dysfunction, and in some cases, the apraxia of speech may be the only neurological sign (Johnson, 1980; Rosenbek & Wertz, 1972).

Additional characteristics outlined by Hall and Penelope (1986) include (a) severe articulation/ pohonological disorder; (b) decreased intelligibility in conversational speech; (c) resistance to traditional articulation remediation techniques; (d) slow response to remediation; (e) presence of learning disabilities, and reading and academic problems; and (f) family history of speech problems. Additionally, in their research, they found DAS children to be at high risk to exhibit highly variable word-retrieval difficulties.

Research concerning the language abilities of children with DAS is another area of controversy. Many researchers agree that receptive language abilities of

children with DAS are nearly normal while expressive language is usually delayed (Blakeley, 1980; Nelson, 1988; Rosenbek & Wertz, 1972). Controversy exists over whether the expressive language delay is a characteristic of DAS caused by the articulation deficit or a separate concomitant communication disorder associated with DAS (Edwards, 1973; Ekelman & Aram, 1983, 1984; Guyette & Diedrich, 1983; Yoss & Darley, 1974a). Many of the DAS studies do not describe the language abilities of their subjects. Yoss and Darley (1974a) excluded children with expressive language delay from their study, Eisenson (1984) claimed that the language delay is caused by the articulation difficulty, and Edwards (1973) pointed out that it is necessary for a speech-language pathologist to be aware of both articulation and expressive language disorders in order to provide an appropriate treatment program. Aram (1979) proposed that in DAS, the difficulty may be in the selecting and sequencing of the syntactic, lexical, and phonological components of language.

Recently, two studies performed by Ekelman and Aram (1983, 1984) have attempted to describe the language difficulties observed in children with DAS. The authors uncovered syntactic deficits in children with DAS that could not be attributed to the motor-speech and/or phonological impairments alone, but instead suggested a

concomitant syntactic component. Their findings revealed the following syntactic deficits: (a) Developmental Sentence Analysis (DSS) (Lee, 1974) score below chronolgoical age; (b) difficulty in the DSS grammatical categories of main verb, personal pronoun, and indefinite pronoun; (c) grammatical marker errors including third person singular, regular past tense, irregular past tense, auxiliaries, copula, modal, and past participle; and (d) reliance on simple sentence constructions, with most complex sentences produced in error.

Further, Ekelman and Aram (1983, 1984) presented the following evidence, based on the data above, to support a syntactic rather than motor-speech explanation for the syntactic errors revealed in their study. Although most of the subjects' Mean Length of Utterances (MLU) (Chapman, 1981) were above the ages associated with the normal development of grammatical markers, the following grammatical markers were in error: (a) many pronoun selection errors which cannot be attributed to motor-speech and/or phonological impairments; (b) errors in both regular and irregular past tense forms, and although plural and possessive forms were nearly error free, they produced a high percentage of errors for the third-person singular forms; (c) in question transformations, the subjects often failed to invert the copula, auxiliary, and "do" forms;

and (d) DAS children produced few complex sentences, and a high percentage of those produced were in error. These results support the theory that expressive language deficits found in children with DAS are "co-existing," separate from, and not caused by, the motor-speech impairment.

Recently, Byrd and Cooper (1989), in an attempt to determine the similarities between the speech of developmentally apraxic, stuttering, and normal speaking children, administered the STDAS to all subjects in the three groups and compared their performances. They concluded that because no differences were found between the apraxic and stutterer responses on seven of the eight subtests, neurological processing deficits may be an etiological factor in both disorders. Further, they inferred that in the future, tests for DAS may help to differentiate between developmental and chronic stutters.

DIAGNOSIS OF DAS

As indicated earlier, differential diagnosis of DAS as compared to FAD is difficult. The only standardized instrument available to facilitate the identification of DAS in children is the STDAS (Blakeley, 1980). Clinicians who have a working knowledge of DAS often use their own unpublished protocol for assessment (Haroun et al., 1988; Nelson, 1988). The drawbacks of using a personally

designed test battery are (a) public school speech-language pathologists (SLP) may not be familiar with DAS and therefore are unprepared to design such an instrument, and (b) identification of DAS has been found to be highly variable among clinicians (Haroun et al., 1988; Thorsen, 1984).

In the study by Haroun et al. (1988), clinicians with a "current working knowledge" (p. 8) of DAS administered a personal unpublished assessment battery and the investigator administered the STDAS to children with articulation disorders. Results indicated a "slight to high" correlative relationship between the evaluators and the STDAS and a "low" relationship among the evaluators. The authors suggested that these results indicate the "STDAS tapped more of the components of DAS in the sense of comprehensiveness than any single evaluator measure" (p. 2).

However, the standardization of the STDAS has been heavily criticized by Guyette and Diedrich (1983) relative to validity, reliability, and subject selection procedures. This criticism has been partially met by validation studies and reviews which indicate that the STDAS samples a range of speech behaviors that characterize DAS and overall, it may be useful for screening purposes (Blakeley, 1983; Meline & Howard, 1981; Thorsen, 1984; Weeks, 1984). Reliability was not reported in the STDAS

manual. Nonetheless, in consideration of all these factors, the STDAS may be the best instrument for identification of DAS in public schools.

TREATMENT OF DAS

The importance of differentiation between DAS and FAD is emphasized when various treatment programs for children with severe articulation disorders are examined. Identification of dyspraxic tendencies in children may be essential for planning an effective treatment program. The treatment approach for children with apraxia of speech is a non-traditional, complex approach, involving long-term commitment to individualized communication remediation which focuses on improved intelligibility (Blakeley, 1983; Haynes, 1985; Johnson, 1980). Many researchers agree that special treatment programs are needed for children with DAS and recently, DAS treatment programs have received increased attention in the literature. The next section is a presentation of some of the treatment approaches described in the literature.

Haynes (1985) offers some suggestions for remediation of DAS which she has drawn from a review of the literature on acquired apraxia of speech and general principles used in articulation treatment: (a) concentrated drill on performance, both in imitation and on command, of tongue and

lip movements; (b) imitation of sustained vowels and consonants followed by production of simple syllable shapes; (c) use of movement patterns and sequences of sounds; (d) avoidance of auditory discrimination drills; (e) use of slow rate and self-monitoring skills; (f) use of a core vocabulary; (g) use of carrier phrases; (h) rhythm, intonation, and stress paired with motor involvement; (i) frequent, intensive, and systematic drill; (j) increase orosensory perceptual awareness; and (k) physical therapy (Blakeley, 1983; Edwards, 1973; Rosenbek, Hansen, Baughman, & Lemme, 1974; Yoss & Darley, 1974b).

Recently, studies have emerged which evaluate some of the treatment approaches designed for children demonstrating DAS. Chumpelik (1984) described a treatment approach that focuses on the programming components of motor control. This approach is called Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT), and it has been successfully applied to children with DAS and other speech-disordered persons. This system is intended to "help provide the lacking and essential kinesthetic feedback (closed-loop) while providing the feed-forward or sequential information (open-loop) that the system needs for transforming conscious motor control into automatic sequences" (p. 152). The PROMPT approach includes the use of tactile cues for each phoneme, given externally to the

face and structures involved in voicing and nasality. Duration of the cues and amount of pressure placed on the different muscle groups is important for the development of appropriate programming. The intent is to provide feed-forward information about the preselected phoneme sequences. PROMPT is unique because it combines principles from a neurological or sensory feedback model with a motor-learning approach.

In a case study reported by Shelton and Garves (1985), the treatment program enhanced verbal stimuli through the pairing of visual and auditory input called Signed Target Phoneme (STP) Therapy. The visual cues used where hand shapes from the American Manual Alphabet. Results indicated that STP facilitated the production of volitional sequences of speech sounds in the single subject studied. Further research into STP therapy is necessary before a positive relationship can be established, but this study suggested possible benefits of visual techniques in DAS therapy.

Another recent study which utilized visual cues was conducted by Klick (1985). In this study, an Adapted Cuing Technique (ACT) which utilizes manual cues was administered. The changes in hand configurations prepare the speaker for speech sound change acting as a guide to articulatory placement and movement. Results following

three months of treatment indicated improved oral communication skills. As in the STP study, a single subject design was used, making it impossible to substantiate a positive relationship between the treatment approach used and improved articulation.

The research studies presented in this literature review point to the existence of DAS. As for the controversy over etiology, treatment, incidence, and language versus motor programming impairments, it becomes obvious that further research is warranted. One might expect the most revealing research on this topic to occur in the near future.

CHAPTER III

METHODS

SUBJECTS

Nineteen children, 5 females and 14 males, from the Portland metropolitan area public elementary schools, served as subjects for this study. Subjects ranged in age from 5-10 to 11-11 years with a mean of 7-1. Each potential subject was diagnosed as moderate to severe articulation disordered with multiple articulation errors by the public school speech-language pathologist (SLP), and was receiving treatment provided by the SLP. Criteria for selection of subjects included: (a) signed release forms (Appendix A); (b) between the ages of 5 and 12 years; (c) normal hearing the day of testing; (d) labeled moderate to severe with multiple articulation errors by the SLP; (e) labeled moderate or severe as determined by the Arizona Articulation Proficiency Scale-Revised (AAPS-R); and (f) not identified as having mental retardation, orthopedic impairment, visual impairment, social-emotional impairment, or any other health impairment by the school SLP.

INSTRUMENTATION

The instruments used for screening criteria in this investigation are described below.

Beltone Portable Audiometer. All potential subjects received a bilateral audiometric screening test at 20 dB for the frequencies of 500, 1000, 2000, and 4000 Hz. The audiometer used for the screening was recently calibrated according to ANSI standards. ASHA standards were used to determine pass/fail criteria; those who failed any frequency were not considered for this study.

Arizona Articulation Proficiency Scale-Revised (AAPS-R) (Fudala, 1982). The AAPS-R was administered according to manual instructions. It is a test of articulation that yields scores which convert to severity ratings based on frequency of occurrence of misarticulated sounds.

The instruments described below were used for the experimental procedure.

Screening Test for Developmental Apraxia of Speech (STDAS) (Blakeley, 1980). The STDAS was administered according to manual instructions to subjects who met the criteria for participation in the study. The STDAS is a screening instrument used to determine if further evaluation for characteristics of developmental dyspraxia is indicated. The STDAS is comprised of eight subtests:

Expressive Language Discrepancy, Vowels and Diphthongs, Oral-Motor Movement, Verbal Sequencing, Articulation, Motorically Complex Words, Transpositions, and Prosody. A raw score is obtained and converted to a weighted score. Next, the weighted score is applied to a probability graph which determines the percentage probability of that child's performance being included in an apraxic group (Appendix B).

Peabody Picture Vocabulary Test-Revised (PPVT-R) (Dunn & Dunn, 1981). The PPVT-R was administered according to manual instructions. The PPVT-R is a test of language comprehension that yields a language comprehension age which was used for Subtest I of the STDAS to determine the expressive language discrepancy. The percentile ranking on the PPVT-R was used to ensure that the child's receptive language skills exceeded that recommended by Blakeley (1980) (above the 8th percentile) for administration of the STDAS.

Test of Language Development-Primary (TOLD-P) and Test of Language Development-Intermediate (TOLD-I). The TOLD-P and TOLD-I include subtests that evaluate both language comprehension and language expression. The mean age equivalency scores of the three expressive subtests (Oral Vocabulary, Sentence Imitation, and Grammatical Completion) were used for Subtest I of the STDAS to

determine if an expressive language discrepancy existed. The TOLD-P was used with children 6 to 8-11 years of age and the TOLD-I was used with children more than 9 years of age. Subtests were administered according to manual instructions.

PROCEDURES

Criteria Screening Procedures

All testing was conducted in quiet, well-lit rooms at the subjects' schools. The subjects were examined, one at a time, and all sessions excluding the hearing screening were recorded on audio tape.

Testing of subjects began with a pure tone hearing screening test followed by administration of the AAPS-R. Two subjects received a less than moderate rating on the AAPS-R, and because of this, were excluded from this study.

STDAS Testing Procedures

The PPVT-R, the TOLD-P or TOLD-I, and the STDAS were administered to subjects who met the screening criteria delineated above. According to the STDAS manual instructions, it should not be administered to children falling below the 9th percentile on the PPVT-R. This occurred with one potential subject who was excluded from the study.

Reliability

Reliability for the AAPS-R, TOLD-P, TOLD-I, and STDAS was determined for intrajudge and interjudge reliability. For intrajudge reliability, 1 to 2 weeks after test completion, 4 of the 19 subjects were randomly selected and the examiner retranscribed their audio taped sessions and compared those results with the original transcription. For interjudge reliability, this investigator and another examiner recorded and transcribed responses from audio tape for 4 of the 19 subjects. Scores on each subtest of the STDAS, TOLD-P, and TOLD-I were compared, and the AAPS-R total scores were analyzed for reliability.

The mean reliability scores were: (a) on the TOLD-P, 93 percent for intrajudge and 94 percent for interjudge, (b) on the AAPS-R, 87 percent for intrajudge and 90 percent for interjudge, and (c) on the STDAS, 97 percent for intrajudge and 95 percent for interjudge.

DATA SCORING AND ANALYSIS

All standardized testing instruments were scored according to manual instructions. The mean and standard deviation of the raw scores for each subtest of the STDAS were computed. The raw scores were converted to weighted scores according to manual instructions, and these scores were applied to a graph which indicates the percentage of

probability that the score belongs to a dyspraxic group (Appendix B). If the total weighted score is less than -60, then the probability that the subject belongs to a dyspraxic group is greater than 99 percent. If the total weighted score is greater than +60, then the probability is less than 1 percent that the subject is dyspraxic. If the total weighted score is 0, then the subject has a 50-50 chance of belonging to either the dyspraxic or not dyspraxic group. When analyzing subtest scores, the investigator searched for clusters of behavior, which might identify specific tasks that appeared to be especially difficult for the dyspraxic subjects.

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS

The purpose of this study was to determine if children with moderate and severe articulation disorders exhibit dyspraxic tendencies as measured by the STDAS. Nineteen subjects, 5 females and 14 males, ranging in age from 5-10 to 11-11 years participated in this study. Fourteen were identified as severe and five as moderate as established by the AAPS-R. The STDAS was administered to determine the percentage probability that each subject belongs to a dyspraxic group.

The research question investigated in this study was: Do children diagnosed as having moderate and severe articulation disorders exhibit dyspraxic tendencies on a standardized developmental dyspraxia screen test? Table I shows that while most of the subjects participating in this study exhibited some of the dyspraxic characteristics analyzed by the STDAS, not all demonstrated the combination of characteristics necessary to give them a raw score that corresponds with a high probability of being included in a dyspraxic group. The probability percentages

TABLE I

SUMMARY OF RAW SCORES, SEVERITY RATINGS, AND PERCENTAGE PROBABILITY RATINGS ON THE STDAS FOR ALL SUBJECTS

Subject Severity	Subtest I Ex. Lang. Discrepancy	Subtest II Vowels & Diphthongs	Subtest III Oral-Motor Movement	Subtest IV Verbal Sequencing	Subtest V Articulation	Subtest VI Motorically Complex Words	Subtest VII Transpositions	Subtest VIII Prosody	Total Weighted Score	% Probability Score
#1 S	5	1	4	6	18.0	1	0	1	-229	>99
#2 S	0	0	0	0	3.5	1	1	3	+ 58	< 1
#3 S	3	1	1	3	33.0	0	0	3	-306	>99
#4 S	5	0	1	0	22.0	0	0	0	- 38	97
#7 S	5	0	1	0	16.5	0	2	0	- 38	97
#8 S	0	0	3	0	2.5	0	0	0	+126	< 1
#9 S	5	0	1	3	2.5	0	0	1	+ 6	35
#11 S	5	0	5	3	23.0	1	1	0	-119	>99
#14 S	5	2	0	6	23.0	0	2	1	-283	>99
#15 S	5	0	6	6	33.0	0	2	3	-488	>99
#16 S	5	1	1	6	2.5	1	3	3	-147	>99
#17 S	5	0	1	6	25.5	0	2	3	-347	>99
#18 S	1	0	0	0	5.5	0	2	0	+115	< 1
#19 S	5	0	0	3	3.0	3	1	3	- 59	>99
#5 M	1	1	1	0	0.0	0	1	0	+160	< 1
#6 M	5	1	0	3	3.5	0	0	0	+ 66	< 1
#10 M	0	0	1	0	0.0	0	0	0	+173	< 1
#12 M	5	0	0	0	5.0	0	0	1	+ 91	< 1
#13 M	5	1	2	0	8.5	0	0	0	+ 48	2

M = Moderate
S = Severe

reveal that all moderate subjects showed a less than 3 percent chance of belonging to a dyspraxic group. Of the 14 severe subjects, 3 showed less than 1 percent

chance of belonging to a dyspraxic group, 10 showed 97 percent or greater chance of belonging to a dyspraxic group, and 1 showed a 35 percent chance of being dyspraxic. Figure I shows a graph of the total raw weighted scores on the STDAS for all subjects. Of the group as a whole, it appears that 53 percent demonstrated dyspraxic characteristics and 47 percent did not. Of the 14 severe subjects, 71 percent exhibited dyspraxic tendencies and 29 percent did not.

In Table II, the subjects are grouped by severity level and means and standard deviations are given for the subtest raw scores and total weighted scores. The standard deviations show that there was a high amount of variability among the subjects' performances on the subtests.

TABLE II

MEANS AND STANDARD DEVIATIONS FOR SUBTESTS AND TOTAL WEIGHTED SCORES ON THE STDAS GROUPED BY SEVERITY

		Subtest								Weighted
		I	II	III	IV	V	VI	VII	VIII	Score
MOD	Mean	3.2	.6	.8	.6	3.4	0	0.2	0.2	+107.6
	S.D.	2.5	.6	.8	1.3	3.6	0	0.5	0.5	56.1
SEV	Mean	3.9	.4	1.7	3.0	15.3	.5	1.1	1.5	-125.0
	S.D.	2.0	.6	2.0	2.6	11.7	.9	1.0	1.4	184.2

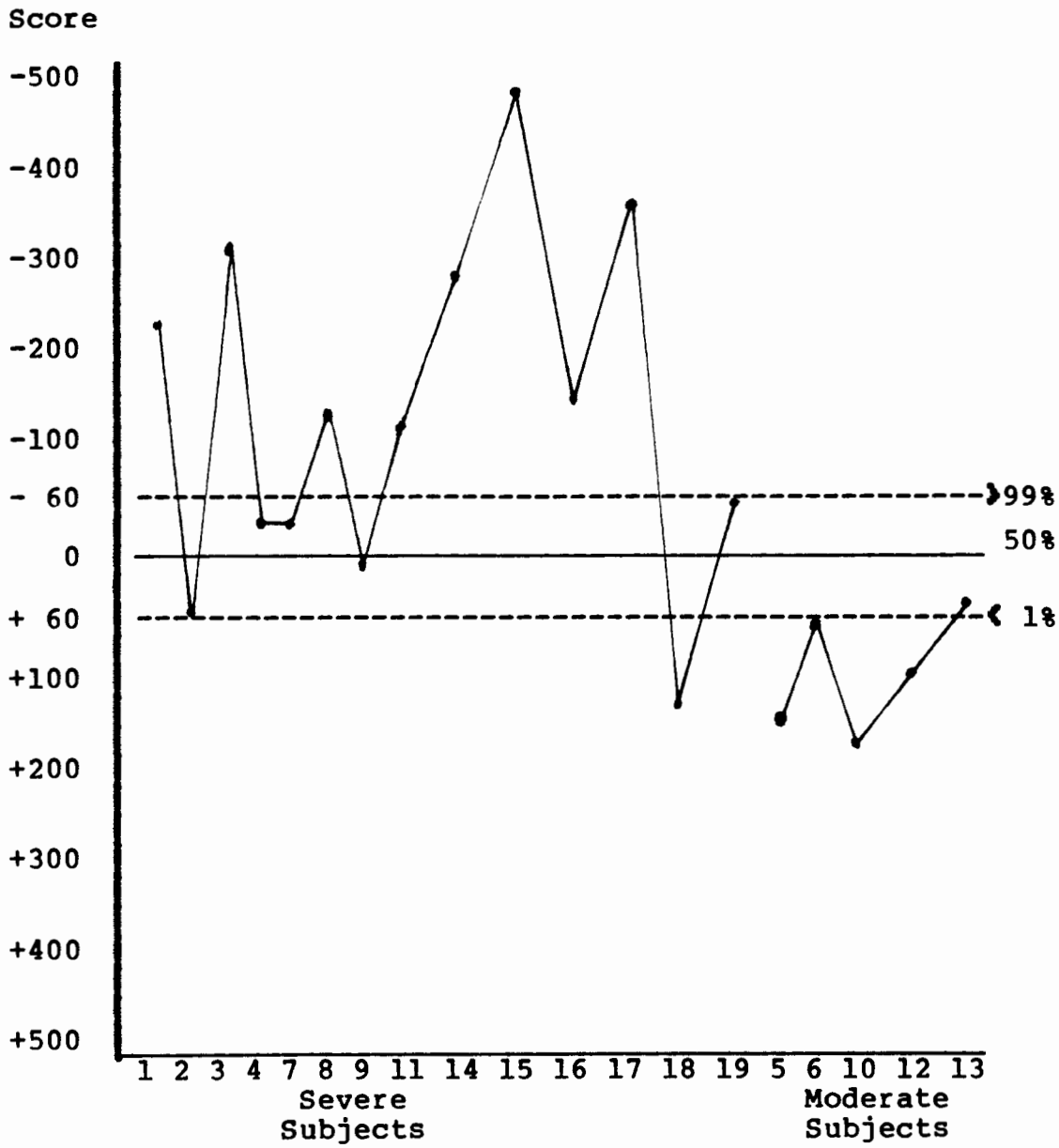


Figure 1. STDAS weighted raw scores for moderate and severe subjects.

DISCUSSION

All the articulation disordered children in this study demonstrated at least one characteristic of DAS as elicited by the STDAS. However, seven of these children received scores indicating a less than 2 percent probability of being dyspraxic. Those children who received a score suggesting a high probability of being dyspraxic exhibited not one or two, but a cluster of, symptoms. These results support the prevailing consensus in the literature that DAS is best identified by a cluster of symptoms; not all characteristics are observed and no one characteristic must be present. Nonetheless, certain subtests appeared to be more difficult for the majority of the subjects who received scores indicating a 97 percent or greater probability of belonging to a dyspraxic group. These subjects (#1, 3, 4, 7, 11, 14, 15, 16, 17, and 19) will be referred to as "dyspraxic" throughout this section.

On the first subtest of the STDAS all of the dyspraxic subjects demonstrated an expressive language discrepancy with only one subject receiving a less than maximum penalty score. In this subtest increasing penalty points are given as the proportion of expressive language delay increases. Seven of the ten dyspraxic subjects had great difficulty with the verbal sequencing portion of the STDAS. The verbal sequencing subtest increases in

difficulty from imitation of a single sequence of three nonsense syllables (e.g., pʌtʌkʌ) to triple sequencing of the same nonsense syllables (e.g., pʌtʌkʌ, pʌtʌkʌ, pʌtʌkʌ). Seven of the 10 dyspraxic subjects received a penalty of 15 or more on the articulation subtest. In the articulation subtest, penalty points are given when a child makes two- to three-feature articulation errors in two or more positions and/or when sounds are omitted in the presence of at least one other position error. Seven of the ten dyspraxic subjects used at least one transposition in Subtest VII. In this subtest, subjects are required to imitate words that tend to elicit transpositions and are penalized for reversals and redundancies of sounds and/or syllables. In Subtest VIII, seven of the ten dyspraxic subjects demonstrated deviations in prosody including disfluencies, silent groping, and "tip toeing" through speech. Overall, the areas found to be most difficult for the dyspraxic subjects, and possibly indicative of DAS, include expressive language discrepancy, verbal sequencing errors, multiple two- and three-feature articulation errors, transpositions, and prosody deviations. These results agree with most studies of DAS characteristics found in the literature, but that is not surprising because Blakeley (1980) based his screening test on the characteristics "essentially agreed upon" in the literature.

Several studies have found an impaired ability to perform volitional oral movements in children with DAS. In this study, of the ten subjects identified as dyspraxic, only three demonstrated a great deal of difficulty with the oral movement tasks. These results support the conclusion of the Rosenbek and Wertz (1972) study that DAS subjects may or may not exhibit oral apraxia.

In the area of language, the results of this study point to expressive language delay as a characteristic of DAS. If this is true, then the study by Yoss and Darley (1974a) may be criticized for excluding children with language delays of more than six months. Williams et al. (1981) also excluded language delayed children as they were attempting to replicate the Yoss and Darley (1974a) study. In neither of these studies were language skills of the subjects examined or discussed. In the present study, 16 of the 19 subjects demonstrated receptive language skills essentially within normal limits and expressive language delays more than 6 months below their chronological ages, and so would have been excluded from both studies noted above. In the Yoss and Darley (1974a) and Williams et al. (1981) studies, exclusion of children with expressive language delays may have resulted in exclusion of children with DAS, thus making it difficult to identify a group of behaviors typical of children with DAS.

While some of the language errors were obviously caused by articulation difficulties (e.g., omission of plural /s/), other errors were indicative of a separate concomitant language disorder (e.g., difficulty with verbal definitions, and pronoun and article errors). Eisenson (1984) maintained that the expressive language delay associated with DAS is caused by the articulation disorder, while Ekelman and Aram (1983, 1984) suggested that the delay is a "co-existing" disorder. The results of this study support Eisenson in that some of the language errors may be due to articulation problems, but at the same time, the results allow this researcher to agree with Ekelman and Aram that a co-existing language disorder may be characteristic of DAS.

Rosenbek and Wertz (1972) found children with DAS to be more unintelligible in spontaneous speech than single word articulation tests indicate. This was found to be true in this study. Interestingly, many children made more errors on the STDAS articulation subtest where they were asked to repeat three words sequentially than they did on the AAPS-R where one word is said at a time.

Figure 1 (p. 30) shows the total weighted score for each severe and moderate subject. All the moderate subjects performed at a level indicating a less than 2 percent probability of being in a dyspraxic group. The range of the severe subjects' scores is much wider than the

range of the moderate subjects' scores. Although the moderate subjects' performances were widely distributed over a large range, their scores clustered closer to the mean than did the severe scores. It may be that the children who are truly dyspraxic differed more in their performances than did the FAD children. It is easy to understand the confusion surrounding symptoms associated with DAS when one examines the wide range of scores and standard deviations revealed in this study.

After reviewing the positive and negative literature directed to the STDAS, and administering the test to several children, it seems appropriate to make some observations from this researcher's point of view. One might say "A test is only as good as the person who is using it." In the STDAS testing manual, Blakeley (1980) emphasized the use of the STDAS only for what it was intended, screening. It is not a diagnostic tool designed to label children dyspraxic. Instead, as Thorsen (1984) and Weeks (1984) have revealed, the STDAS is a useful tool as a part of a differential diagnostic battery for DAS. It may be especially helpful for public school SLPs who are unfamiliar with and/or have had limited experience with the disorder. In his study, Weeks (1984) found the scoring system a little confusing. This may be true. The scoring system may need some clarification in order to ensure that

the STDAS is administered and scored identically by everyone who uses it. This investigator recommends the use of the STDAS to screen children with moderate to severe articulation disorders suspected of DAS.

Because this is a descriptive study, it is impossible to make absolute statements based on the results. However, the following inferences were developed based on the collected data. Results revealed that while some children with severe articulation disorders are likely to be dyspraxic, others are not. Additionally, children with moderate articulation disorders seem to be less likely to be dyspraxic than those with severe articulation disorders.

CHAPTER V

SUMMARY AND IMPLICATIONS

SUMMARY

The purpose of this investigation was to determine if public school children with moderate and severe articulation disorders exhibit dyspraxic characteristics on a standardized developmental dyspraxia screening test.

Identification of dyspraxic characteristics in children may be essential for planning an effective treatment program. The treatment approach for children with developmental apraxia of speech (DAS) is a non-traditional, complex approach, involving long-term commitment to individualized communication treatment which focuses on improved intelligibility (Blakeley, 1983). It is this researcher's inference that public school children who demonstrate moderate and severe articulation disorders may be dyspraxic and would benefit from a non-traditional speech treatment approach.

Nineteen children, with articulation disorders, between the ages of 5 and 12 were selected from the Portland metropolitan area public elementary schools. Of the 19 subjects who were referred with multiple articulation

errors, 14 were labeled severe and 5 were labeled moderate using the Arizona Articulation Proficiency Scale-Revised (AAPS-R). The TOLD-P or TOLD-I and the PPVT-R were administered to determine expressive and receptive language ages, respectively. The resultant language ages were entered in Subtest I of the Screening Test for Developmental Apraxia of Speech (STDAS) and the remaining seven subtests were administered to all subjects. The results of this study revealed that 71 percent of the children with severe articulation disorders demonstrated a high probability (97 percent or greater) of being included in a dyspraxic group according to the STDAS. Results also showed that the five moderately disordered children demonstrated little or no probability (2 percent or less) of being dyspraxic.

Characteristics most often demonstrated by the dyspraxic subjects included the following: (a) expressive language discrepancy, (b) verbal sequencing errors, (c) multiple two- and three-feature articulation errors, (d) transpositions, (e) prosody deviations, (f) concomitant language disorder, and (g) spontaneous speech more unintelligible than single words.

These results suggest that children with severe articulation disorders who demonstrate the characteristics outlined above are likely to be dyspraxic and would

benefit from a more intensive assessment and, if appropriate, initiation of a non-traditional treatment approach. Although the moderately disordered children in this study showed little or no signs of dyspraxia, children with moderate articulation disorders who demonstrate dyspraxic characteristics would also benefit from further evaluation and, if appropriate, a DAS treatment approach.

RESEARCH IMPLICATIONS

This investigator suggests a replication of the Yoss and Darley (1974a) study with the following alterations: (a) only examine children with severe articulation disorders, (b) administer a standardized instrument for DAS, and (c) include children with expressive language disorders.

It is also suggested that this study be replicated with the addition of a case history for each subject. This investigator felt as if a "piece" was missing because no background information was collected. This information could be gathered through conversations with the parent and the child's SLP. Case history information that may assist in the diagnosis of DAS may include (a) delayed onset of speech, (b) family history of speech problems, (c) feeding problems, (d) if school-age, learning

disabilities, and (e) results of neurological evaluation, if available (Aram, 1979; Eisenson, 1984; Ferry et al., 1974; Nelson, 1988; Rosenbek & Wertz, 1972; Yoss & Darley, 1974a).

In this study, articulation errors and severity varied greatly depending on the task the subject was required to perform. Most of the subjects exhibited fewer errors on the AAPS-R than they did on the articulation subtest of the STDAS probably because the former required a one-word response and the latter required the child to sequence three words. It is suggested that instead of a one-word articulation test to establish a severity rating, a sentence test or language sample be used.

DAS treatment studies employing a large group of subjects are needed. Most research in this area has been single subject design, making it difficult to establish a positive relationship between improved articulation and the treatment technique used. It may be interesting and pertinent to apply one DAS treatment program to both children with DAS and children with FAD as it may be that both would benefit from such an approach.

CLINICAL IMPLICATIONS

The results of this study appeared to indicate that many children in public schools with severe articulation

disorders may also be dyspraxic and therefore, would benefit from a treatment approach designed for children with DAS. It would benefit the child and SLP to identify these children so that an effective treatment approach may be utilized. The only standardized instrument available to help with this task, although it is a screening, is the STDAS. This investigator supports the use of the STDAS over "clinical judgment" alone to determine if further evaluation by an expert in DAS is merited.

REFERENCES

Aram, D.M. (1979). Developmental apraxia of speech. Paper presented at the annual convention of the American Speech-Language-Hearing Association, Atlanta, Georgia.

Bernthal, J., and Bankson, N. (1981). Articulation disorders. Englewood Cliffs, NJ: Prentice-Hall.

Blakeley, R. (1980). Screening test for developmental apraxia of speech. Tigard, OR: C.C. Publications.

Blakeley, R. (1983). Treatment of developmental apraxia of speech. In W.H. Perkins (Ed.), Dysarthria and apraxia. New York: Thieme-Stratton.

Byrd, K., and Cooper, E. (1989). Apraxic speech characteristics in stuttering, developmentally apraxic, and normal speaking children. Journal of Fluency Disorders, 13 (3), 215-229.

Chapman, R.S. (1981). Computing mean length of utterance in morphemes. In J.F. Miller (Ed.), Assessing language production in children. Baltimore: University Park Press.

Chumpelik, D. (1984). The PROMPT system of therapy: Theoretical framework and applications for developmental apraxia of speech. Seminars in Speech and Language, 5, 139-155.

Crary, M.A. (1984). Phonological characteristics of developmental verbal dyspraxia. Seminars in Speech and Language, 5, 71-83.

Darley, R. (1964). Diagnosis and appraisal of communication disorders. Englewood Cliffs, NJ: Prentice-Hall.

Dunn, L., and Dunn, L. (1981). Peabody picture vocabulary test-revised. Circle Pines, MN: American Guide Service.

Edwards, M. (1973). Developmental verbal dyspraxia. British Journal of Disorders of Communication, 8, 64-70.

Eisenson, J. (1984). Aphasia and related disorders in children. New York: Harper & Row.

Eisenson, J. (1986). Language and speech disorders in children. New York: Pergamon Press.

Ekelman, B., and Aram, D. (1983). Syntactic findings in developmental verbal apraxia. Journal of Communication Disorders, 16, 237-250.

Ekelman, B., and Aram, D. (1984). Spoken syntax in children with developmental verbal apraxia. Seminars in Speech and Language, 5, 97-110.

Ferry, P., Hall, S., and Hicks, J. (1974). Verbal dyspraxia in children: A neurological cause of "poor speech." Journal of Oregon Speech and Hearing Association, 13, 14-19.

Fudala, J. (1982). Arizona articulation proficiency scale: Revised. Los Angeles: Western Psychological Services (9th ed.).

Guyette, T., and Diedrich, W. (1981). A critical review of developmental apraxia of speech. In N. Lass (Ed.), Speech and language: Advances in basic research and practice (vol. 5), New York: Academic Press.

Guyette, T., and Diedrich, W. (1983). A review of the screening test for developmental apraxia of speech. Language, Speech, and Hearing Services in Schools, 5(1), 23-31.

Hall, P.K., and Penelope, K. (1986). The presence of word-retrieval deficits in developmental verbal apraxia. Paper presented at the annual convention of the American Speech-Language-Hearing Association, Detroit, Michigan.

Haroun, D., Gordon, M., and Blakeley, R. (1988). A validation study of the STDAS. Unpublished manuscript.

Haynes, S. (1985). Developmental apraxia of speech: Symptoms and treatment. In D. Johns (Ed.), Clinical management of neurogenic communicative disorders (2nd ed.). Boston: Little, Brown, and Company.

Horwitz, S.J. (1984). Neurological findings in developmental verbal apraxia. Seminars in Speech and Language, 5, 111-118.

Jaffe, M.B. (1984). Nuerological impairment of speech production: Assessment and treatment. In J.M. Costello (Ed.), Speech disorders in children: Recent advances. San Diego: College-Hill Press.

Johnson, J. (1980). Nature and treatment of articulation disorders. Springfield, IL: Charles C. Thomas.

Klick, S. (1985). Adapted cueing techniques for use in treatment of dyspraxia. Language, Speech, and Hearing Services in Schools, 16, 256-259.

Kornse, D., Manni, J., Rubenstein, H., and Graziani, L. (1981). Developmental apraxia of speech and manual dexterity. Journal of Communication Disorders, 14, 321-330.

Lee, L.L. (1974). Developmental sentence analysis. Evanston, IL: Northwestern University Press.

Love, R., and Webb, W. (1986). Neurology for the speech-language pathologist. Boston: Butterworth Publishers.

Meline, T., and Howard, M.R. (1981). Screening test for developmental apraxia of speech. ASHA, 23, 451-452.

Mitcham, S. (1975). Location of dyspraxic characteristics in children with severe "functional" articulation disorders. Unpublished master's thesis, Portland State University, Portland, OR.

Morley, M., Court, D., and Miller, H. (1954). Developmental dysarthria. British Medical Journal, 1, 8-10.

Nelson, D. (1988). Developmental articulatory dyspraxia. Unpublished manuscript.

Powers, M. (1971). Functional disorders of articulation-symptomatology and etiology. In L.E. Travis (Ed.), Handbook of speech pathology and audiology. New York: Appleton-Century-Crofts, 837-875.

Prichard, D., Tekieli, M.E., and Kozup, J. (1979). Developmental apraxia: Diagnostic considerations. Journal of Communication Disorders, 12, 337-348.

Rosenbek, J., and Wertz, R. (1972). A review of 50 cases of developmental apraxia of speech. Language, Speech, and Hearing Services in Schools, 3, 23-33.

Rosenbek, J.C., Hansen, R., Baughman, C.H., and Lemme, M. (1974). Treatment of developmental apraxia of speech: A case study. Language, Speech, and Hearing Services in Schools, 5, 13-22.

Rosenbek, J.C., Kent, R.D., and LaPointe, L.L. (1984). Apraxia of speech: An overview and some perspectives. In Rosenbek, J.C., McNeil, M.R., and Aronson, A.E. (Eds.), Apraxia of Speech: Physiology, Acoustics, Linguistics Management. San Diego, CA: College-Hill Press.

Ruscello, D. (1984). Motor learning as a model for articulation instruction. In J.M. Costello (Ed.), Speech disorders in children: Recent advances. San Diego: College-Hill Press.

Shelton, I.S., and Garves, M.M. (1985). Use of visual techniques in therapy for developmental apraxia of speech. Language, Speech, and Hearing Services in Schools, 16, 124-128.

Thorsen, D.L. (1984). A validation study of the screening test for developmental apraxia of speech. Unpublished master's thesis, Portland State University, Portland, OR.

Weeks, R.A. (1984). Differential diagnosis of developmental apraxia with the screening test for developmental apraxia of speech. Unpublished master's thesis, Washington State University, Pullman, WA.

Weiner, F. (1984). A phonologic approach to assessment and treatment. In J.M. Costello (Ed.), Speech disorders in children: Recent advances. San Diego: College-Hill Press.

Wiess, C., Gordon, M., and Lillywhite, H. (1987). Clinical management of articulatory and phonologic disorders (2nd ed.). Baltimore: Williams & Wilkins.

Williams, R., Ingham, R., and Rosenthal, J. (1981). A further analysis of developmental apraxia of speech in children with defective articulation. Journal of Speech and Hearing Research, 24, 496-505.

Yoss, K.A., and Darley, F.L. (1974a). Developmental apraxia of speech in children with defective articulation. Journal of Speech and Hearing Research, 17, 399-416.

Yoss, K.A., and Darley, F. (1974b). Therapy in developmental apraxia of speech. Language, Speech, and Hearing Services in Schools, 5(1), 23-31.

APPENDIX A

CONSENT FORM

CONSENT FORM

Dear Parent:

We are presently graduate students in the Speech and Hearing Program at Portland State University. We are investigating how children in public schools who have problems saying certain sounds perform on the Screening Test for Developmental Apraxia of Speech and The Assessment of Phonological Processes. We would appreciate your permission to include your child in this project.

The testing will involve the instruments mentioned above, a hearing screening, administration of articulation tests, and expressive and receptive langauge tests. Your child will be identifying pictures and objects, repeating words, and imitating oral movements. The testing procedures will be carried out in one session taking approximately one hour of your child's time to complete.

Your child's participation in this study will present no physical or psychological risks. All data obtained during the course of study will remain confidential. Published data will not reveal the name of your child.

If you decide to allow your child to participate in this study, please fill out the appropriate portion of this form. Please return your reply to your child's classroom teacher as soon as possible. If you choose to allow your child to participate, you are free to withdraw him/her from the study at any time without affecting services provided at his/her school or from Portland State University. This study will benefit children with severe articulation disorers by providing new information to the speech-language pathologists working with them.

I have read and understand the above statements and I agree to let my child_____ participate in this study.

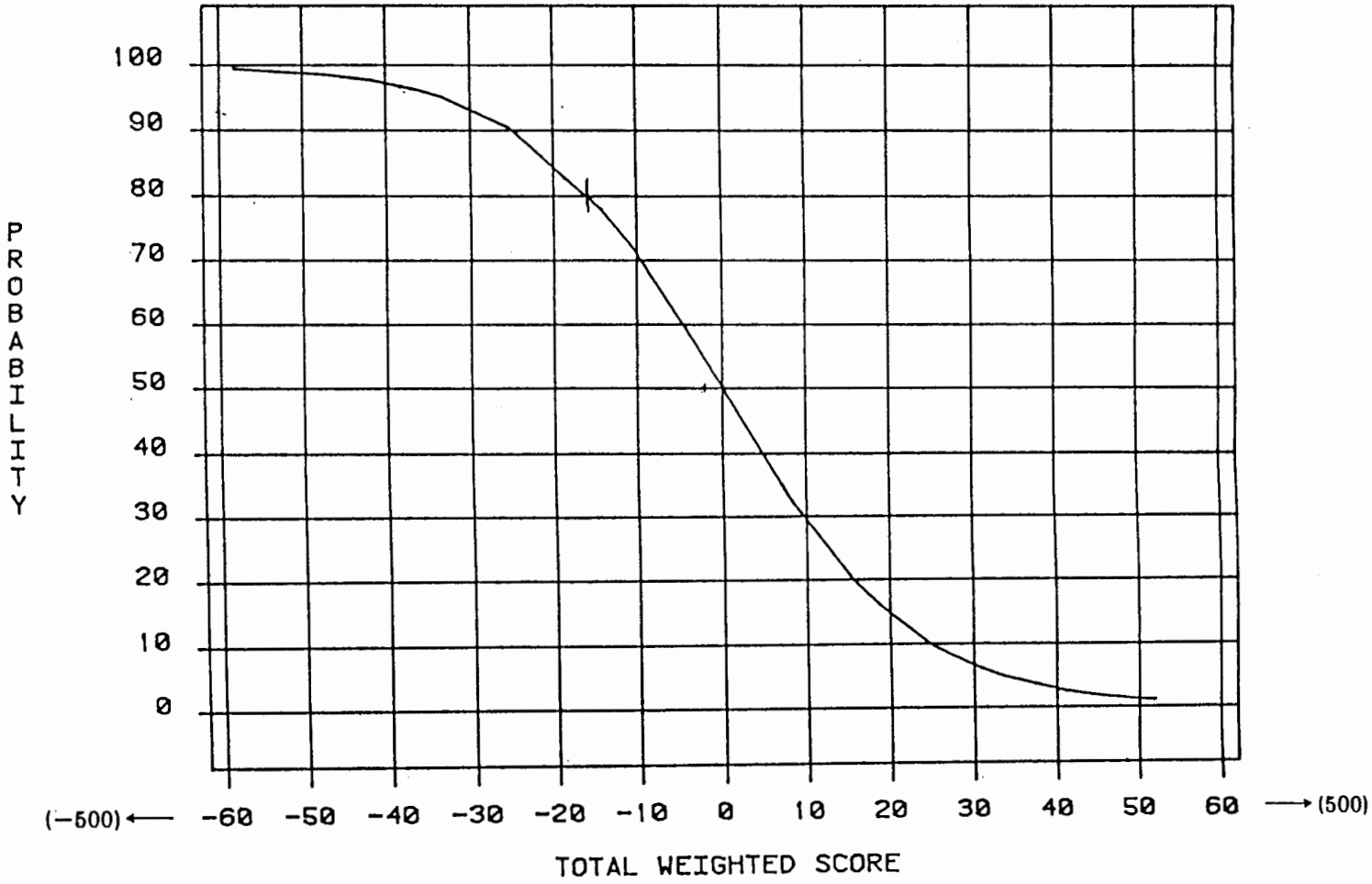
_____ _____ _____

DATE PARENT PHONE #

If you experience problems that are the result of your participation in this study, please contact the secretary of the Human Subjects Research Review Committee, Office of Grants and Contracts, 303 Cramer Hall, Portland State University, 725-3417.

APPENDIX B

PROBABILITY GRAPH AND SCREENING TEST SUMMARY SCORESHEET



Graph used for determining the probability of belonging to the apraxic group. (Blakeley, 1980)

SCREENING TEST SUMMARY SCORESHEET

Raw Score Summary		Calculation of Weighting Factors	
	Raw Score	Weighting Factor	Weighted Score
1. SUBTEST VI: Motorically Complex Words	____	x 12 =	____
2.		(Female) Add 23 points	____
3.		Constant term	+ 261
4. Total of lines 1,2, and 3			
5. Age to nearest year	____	x 11 =	____
6. SUBTEST I: Expressive Language Discrepancy	____	x 5 =	____
7. SUBTEST II: Vowels and Diphthongs	____	x 15 =	____
8. SUBTEST III: Oral-Motor Movement	____	x 11 =	____
9. SUBTEST IV: Verbal Sequencing	____	x 22 =	____
10. SUBTEST V: Articulation	____	x 10 =	____
11. SUBTEST VII: Transpositions	____	x 16 =	____
12. SUBTEST VIII: Prosody	____	x 29 =	+ ____
13. Total of lines 5 through 12			
14. Enter total on line 4 here			____
15. Enter total on line 13 here and subtract from line 14			− ____
TOTAL WEIGHTED SCORE			( )

Place a + in the parenthesis if line 13 is less than line 4.
Place a − in the parenthesis if line 13 is greater than line 4.

(Blakeley, 1980)