Receptive Language in Children with Developmental Apraxia of Speech

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ABSTRACT

The purpose of this study was to determine whether different subgroups of children with developmental apraxia of speech (DAS), with and without receptive language impairment, were evident and to provide descriptive data on the degree of receptive language delays. Four subjects were first tested to determine the presence of DAS, and then used to examine receptive language skills. Three of the four subjects demonstrated significant receptive language deficits. This suggests that there are, in fact, subgroups within DAS. However, due to the small number of subjects tested further research is recommended.

LITERATURE REVIEW

Despite the recent surge of interest in developmental apraxia of speech (DAS), researchers have not yet succeeded in identifying any single distinctive feature of this disorder. There is then, little consensus among researchers and clinicians regarding the definition, etiology, and behavioral characterization of DAS (Davis, et al. 1998). However, the literature has yielded a base line of commonly occurring behavioral characteristics of DAS which appear useful for diagnosis. Nevertheless, though there is a discrepancy between receptive and expressive language, clinical experience has shown that some children with DAS are, in fact, deficient in both receptive *and* expressive language. This then, both raises questions and generates controversy.

Developmental apraxia of speech (DAS) is "a neurologically based disorder in the ability to program movements for speech volitionally in the absence of impaired neuromuscular function" (Smith, et al. 1994, p. 82). A number of interchangeable terms have been used to describe children with characteristics of DAS. Theses include: apraxia, developmental articulatory dyspraxia, childhood verbal apraxia, developmental apraxia of speech, and developmental verbal dyspraxia. These terms reflect differing ideas regarding the cause of the disorder, rather than the defining characteristics. According to Jakielski, et al. (1998, p. 3): "Currently, those who view the disorder as motor-based use the term DAS, while those who view the disorder as language-based advocate for the term 'developmental verbal dyspraxia."

Children with DAS are typically unintelligible. According to Davis, et al. (1998), their speech is comprised of a limited phonemic repertoire, frequent omission errors, a high incidence of vowel errors, inconsistent articulation errors, altered prosody, and increased errors on longer units of speech output. They also exhibit significant difficulty imitating words and phrases, and a predominant use of simple syllable shapes.

The characterization of developmental apraxia was originally derived from apraxia of speech in adults. This disorder category is based on acquired brain damage resulting in difficulty programming speech movements (Broca, 1861). Morley, Court, and Miller (1954) first applied "dyspraxia" to children based on similarity of symptoms seen in adult apraxics (Davis, 1998). While apraxia of speech in adults is acquired, or "associated with cerebral lesions caused by degeneration or trauma, which occur after speech has developed" (Steinburg, 1980, pp. 8), the cause of developmental apraxia of speech in children is unknown. Gubbay, et al. (1965) suggested inadequate cerebral dominance, delayed maturation, and structural lesions as causal factors associated with this disorder. Rosenbek and Wertz (1972) and Yoss and Darley (1974) also report neurological abnormalities in children with DAS.

Several theories have been developed to explain DAS, but none have proven sufficient to account for the variety of characteristics present in children exhibiting the disorder. For example, one criteria commonly used to diagnose children with DAS is the discrepancy between the child's expressive (production) and receptive (comprehension) language. However, as mentioned previously, clinical experience has shown that this is not always accurate. To explain this inconsistency, Crary (1993) recently theorized that there are two subgroups of DAS depending upon location of involvement in the brain. Crary proposed a model for developmental motor speech disorders in which "overlapping motor and speech-language functions exist within the left-hemisphere 'language areas'" (Crary, 1993).

The implication of this theory is that "although motor and speech dysfunctions may occur independently, there are cases in which dysfunctions in both may occur" (Crary, 1993, p. 59). Abnormalities located more posteriorly, in the area that controls receptive language, would result in receptive language delays along with DAS, whereas abnormalities located anterior to this area, would produce DAS characteristics only. This study will attempt to provide data on the possible extent of receptive language deficits in children with developmental apraxia of speech by asking the question: "Are there subgroups of children with DAS who do and do not evidence receptive language delays?"

METHOD

Subjects

Subjects included one boy and one girl. These two were tested by the examiner. Data for two additional female subjects were obtained from previously administered test protocols provided by other examiners. All four children had hearing within normal limits and were previously diagnosed with DAS.

Procedure

The Screening Test for Developmental Apraxia of Speech (Blakeley, 1980) was used to determine subjects' performance on speech and non-speech motor tasks. Because the psychometric properties of this test have not been examined, the reliability and validity of the test are unknown. Further, the scoring of this test relies partially on expressive language discrepancy, which is the variable at question in this research. Therefore, the results were not scored, but rather presented as a description of subjects' behaviors on the tasks described below:

Vowels and Diphthongs: The first subtest examined the subjects' ability to produce vowels and diphthongs. Each subject was asked to repeat words read by the examiner. There were two or three words for each vowel or diphthong target. *Oral-Motor Movement*: For this subtest, subjects were asked to perform movements with his/her tongue and lips following the examiner's model.

Verbal Sequencing: Subjects were asked to imitate five sets of trisyllables (/ p^t^k^ /) and then to repeat each of the set of trisyllables three times (/ p^t^k^-p^t^k^-p^t^k^ /).

Articulation: Subjects were asked to repeat words modeled by the examiner. Each word contained a target phoneme in each of three word positions (initial, medial, and final).

Motorically Complex Words: Subjects were asked to imitate the correct production of long, difficult words three times. The words tested were "aluminum, linoleum and statistics."

Transpositions: Subjects were again asked to repeat words modeled by the examiner. Transpositions or reversals and redundancies of sounds and syllables (metathetic errors) represent another aspect of difficulty in speech articulation said to be frequently present in the child with developmental apraxia of speech (see Rosenbe and Wertz, 1972). The words included in this subtest are designed to provoke transpositions (Blakeley, 1980).

Prosody: Connected speech was analyzed for deviations in rate, phonemic spacing, inflection, and stress.

Listening Comprehension: The listening comprehension portion of the Oral and Written Language Scales (OWES) (Carrow-Woolfolk, 1995) was administered to test subjects' receptive language skills. The reliability and validity of this test have been thoroughly examined and prior data demonstrate the internal consistency of the scores, the stability of the standard scores, interrater agreement, and the validity of the test. The examiner provided a verbal stimulus, and the subjects responded either by pointing to one of four pictures or by identifying the number of the picture (1, 2, 3, or 4) which matched the stimulus.

Finally, letters requesting copies of test protocols of children who had taken the Blakeley and either or both of the OWLS and the Peabody Picture Vocabulary Test (PPVT) (Dunn and Dunn, 1997) were sent to other clinics to obtain additional data. The PPVT also tests receptive language and is commonly administered as a subtest of the Screening Test for Develomental Apraxia of Speech. Because administration of the Blakeley and the PPVT is more common than the Blakeley in combination with the OWLS, results of the PPVT were also taken as an acceptable measurement of receptive language. In some cases, results of additional language tests were available and the scores were also noted. The receptive language skills of Subjects 1 and 2 were tested directly by the examiner, while information for Subjects 3 and 4 was provided by other sources. All data were analyzed descriptively.

RESULTS

Evaluations of the subjects revealed that three of the four children showed significant receptive language delays. Results for the four subjects are described according to DAS characteristics and receptive language skills. Table 1 summarizes the subjects' receptive language scores.

Table 1. Subjects' Receptive Language and Age Equivalency and Percentile

SUBJECT	GENDER	AGE[1]	PPVT		OWLS		OTHER
			AE	Percentile	AE	Percentile	Percentile
1	M	11-01	7-07	5th	6-09	<1st	
2	F	6-06	8-06	9th	7-10	79th	
3	F	15-0	4-01	<1st			93rd
4	F	6-10	3-07	1st			<1st

[1] Age scores are presented as "years -months".

SUBJECT 1

Screening Test for Developmental Apraxia of Speech

Vowels and Diphthongs: Subject 1 was able to correctly produce 12 of 14 different vowels in words. One of the missed sequences was the / au / sequence. He was asked to say "now, out, cow," and said / aut, mal, kau /. This response suggests that he was able to correctly produce the / au /, but had difficulty with sequencing. The other missed sound was / ^ /. When asked to say "mud, hut," he said / m^d, hEt /. This inconsistency is typical of DAS.

Oral-Motor Movement: Subject 1 was able to produce all movements of the tongue with relative ease with the exception of placement of the tongue behind the upper teeth. On this task, he eventually achieved correct placement of the tongue, but showed significant difficulty. He was unable to produce sequences of lip protrusion-retraction.

Verbal Sequencing: Subject 1 was able to correctly produce each set of trisyllables on either the first or second trial. However, when asked to repeat each set of trisyllables three times, he was unable to do so correctly for any set on any of the three trials.

Articulation: Errors were as follows for each position in words:

Phoneme	Initial	Medial	Final
/ j /		distortion	
/ s /		z / s	omission
/ r /	w / r		
/ /	s /	f /	omission
/ t /		d / t	
/ v /			omission
th (voiced)			omission
3		v / 3	

It should also be noted that on first attempt at a series of words, Subject 1 made frequent sequencing errors. For example, when presented with "Santa-bicycle- miss," he said "Santa-miss-bicycle."

Although the subject's speech revealed many inconsistencies, as is characteristic of developmental apraxia of speech, a few error patterns were noted. For example, final consonant omission was observed several times, especially when the final consonant was a fricative. Also, labiodental sounds were substituted for linguapalatal sounds.
Motorically Complex Words: Subject 1 was able to correctly produce "aluminum" on his first try. However, he was unable to produce the other words on any of the trials.

Transpositions: Errors are as follows:

Target Word	**Subject 1's Production**
package	/ paesIdI /
difficult	/ dIvIdo /
horrible	/ hrbIl /
plastic	/ plaezI /
accident	/ aez dI /

For the majority of the words, he was able to correctly produce the initial consonant, but deleted the final consonant.

Prosody: Rate and spacing were affected by the subject's difficulty in pronouncing various words, but inflection and stress were relatively normal.

Oral and Written Language Scales

Subject 1 (11 years 1 month) scored at an age equivalency level of 6 years 9 months (see Table 2). This placed him below the first percentile for his age group. These results indicate extremely poor receptive language. Examination of the subject's incorrect responses indicate difficulty with sentences including negation and prepositions. In addition, sentences or descriptions with several parts or complex wording were frequently missed. The subject may not have used contextual cues or may have had limited meanings for words, which was noted on one particular question where the subject confused the word "cap" as in hat for "cap" as in lid.

Peabody Picture Vocabulary Test-III

The PPVT-III placed Subject 1 in the 7 year 7 month age range. This is in the fifth percentile, which is clearly a low score.

SUBJECT 2

Screening Test for Developmental Apraxia of Speech

Vowels and Diphthongs: Subject 2 correctly produced all vowels and diphthongs.

Oral-Motor Movement: Although she was able to perform multidimensional movements of the tongue, Subject 2 showed significant difficulty with sequences of lip protrusion- retraction.

Verbal Sequencing: Subject 2 was able to imitate each set of trisyllables as well as repeat each set three times within at least three trials.

Articulation: Errors were as follows:

Phoneme	Initial	Medial	Final
/ r /	w / r	w / r	w / r
/ /			s /
th (unvoiced)		f / th	
3			z / 3

Motorically Complex Words: The subject was unable to correctly produce these words.

Transpositions: Errors are as follows:

Target Word	Subject 1's Production
hamburger	/ haemb go /

Prosody: Prosody was normal.

Oral and Written Language Scales

Subject 2 (age 6 years and 6 months) scored at the 7 year 10 month age range. This placed her in the 79th percentile, indicating normal to above average receptive language skills.

Peabody Picture Vocabulary Test-III

The PPVT-III was also administered and indicated above average receptive language skills. Subject 2 placed in the 90th percentile, or 8 year 6 month age range.

SUBJECT 3

Screening Test for Developmental Apraxia of Speech

Vowels and Diphthongs: Subject 3 was able to produce 12 of 14 different vowels in the words. One of the missed sounds was / au /. She was asked to say "now, out, cow," and said / maIn, aut, kau /. The other target sound was / ou /. She was asked to repeat "hoe, no, go," and said / hi, gou /. Her production indicated that she was sometimes able to produce the sound, but was unable to repeat the sequence. This is typical of DAS.

Oral-Motor Movement: Although she was able to perform multidimensional movements of the tongue, Subject 3 was unable to produce sequences of lip protrusion-retraction.

Verbal Sequencing: Subject 3 was unable to produce / p^t^k^ /, / k^t^p^ /, / t^t^p^ /, or / k^k^t^ / on any trial. However, she did produce / p^p^t^ / on four trials. When asked to repeat each set of trisyllables three times, she was unable to produce the / t^t^p^ / sequence or the / p^p^t^ / sequence on any of the three trials.

Although Subject 3's speech was appropriately inconsistent for her diagnosis as apraxic, a few error patterns were noted. For example, on two occasions, she shortened three syllable words to two syllables. In addition, Subject 3 either omitted the linguadentals "th" (voiced) and "fu" (unvoiced) or substituted labiodentals (/ f / and / v /). Finally, substitutions or omissions were noted for the liquids / r / and / l /.

Articulation: Errors were as follows:

Phoneme	**Initial**	**Medial**	**Final**
/ n /		m / n (/name^ / for banana)	
/ t /	k / t	k / t (/ keo/ for potato)	
/ w /		omission	
/ b /			omission
/ g /	d / g	d / g	omission
/ j /			omission (/ ^n^ / for onion)
/ s /	t / s	t / s	
/ l /	w / l	omission	omission
/ r /	w / r	w / r (kowIt / for carrot)	^ / r (/ ka^ /)
/ t /		/t	
/ d3 /		d / d3 (t oldi / for sodier)	3 / d3
th (unvoiced)	f / th	omission (/ t^v / for bathtub)	f / th
/ z /		d / z (/ tId z / for sissors)	s / z
/ v /			omission
th (voiced)	v / th	omission (/ fE / for feather)	sun / smooth
3		omission (/ tE / for treasure)	

Motorically Complex Words: The subject was unable to produce any of the words on any of the trials.

Transpositions: Errors are as follows:

Target Word	**Subject 3's Production**
basket	/ baesIt /
hamburger	/ haembo /
music	/ muzI /
package	/ paetI /
elephant	/ Ef n /
girl	/ d^ /
hockey	/ hakI /
difficult	/ dIt^l /
horrible	/ hab^ /
plastic	/ paetI /
accident	/ aesI /

Subject 3 reduced all of the three syllable words in the section into two syllables. For the majority of the words, she was able to correctly produce the initial consonant correctly, but deleted the final consonant.

Prosody: Subject 3's rate was increased intermittently resulting in the alteration and/or deletion of sounds and syllables which reduced intelligibility. However, both the inflection and stress in her voice were appropriate.

Peabody Picture Vocabulary Test-III

The PPVT-III was administered by a professional speech-language pathologist and placed Subject 3 (age 15 years) in the 4 year 1 month age range for vocabulary. This indicated a severe deficit in receptive language skills.

Test of Adolescent Language-2

The following are the results of the TOAL-2:

Subtest	**Percentile Rank**
Listening/Vocabulary	<1
Listening/Grammar	<1

The percentile rank of less than 1% reveals that Subject 3's performance is greater than three standard deviations from the norm. This confirms a serious deficit in receptive language skills.

SUBJECT 4

Screening Test for Developmental Apraxia of Speech

Vowels and Diphthongs: Subject 4 correctly produced all vowels and diphthongs in the stimulus words.

Oral-Motor Movement: Subject 4 performed all oral-motor movements successfully.

Verbal Sequencing: Subject 4 she was unable to imitate any set of trisyllables, as well as repetition of trisyllable sets, on any trial.

Articulation: Errors were as follows:

Phoneme	**Initial**	**Medial**	**Final**
/ f /	p / f	p / f	
/ ng /			n / ng
/ g /		k / g	k / g
/ d /			omission
/ j /	l / j	omission	
/ s /	t / s	k / s	
/ l /			omission
/ r /	w / r	omission	omission
/ /	d /	s /	
/ t /	t / t	d / t	/t
/ d3 /	d / d3	d / d3	s / d3
th (unvoiced)	d / th	f / th	s / th
3		k / 3	/3

Motorically Complex Words: Subject 4 was unable to produce any of the words on any of the trials.

Subject 4 reduced all three-syllable words into two syllables and deleted some fricatives.

Prosody: Prosody was rated according to the test protocol as readily apparent and adding a distinct characteristic to the subject's speech.

Transpositions: Errors are as follows:

Target Word	**Subject 4's Production**
basket	/ baekEt /
hamburger	/ haemb /
music	/ mju k /
package	/ paekEts /
elephant	/ EpEnt /
difficult	/ dIk t /
horrible	/ h^pl /
plastic	/ paek t /
accident	/ aekEnt /
nose	/ nos /

Peabody Picture Vocabulary Test-Revised

The PPVT-R placed Subject 4 (age 6 years 10 months) in the 3 year 7 month age range and the first percentile, indicating very poor receptive vocabulary.

DISCUSSION

To date, research has not determined the existence of subgroups of children with developmental apraxia of speech who do and do not evidence receptive language delays. In fact, it was not until recently that the possibility of such subgroups was even examined. Crary (1993) hypothesized that overlapping motor and speech-language functions in the left hemisphere will create situations in which motor and speech-language dysfunctions occur simultaneously. Testing the receptive language skills of children with developmental apraxia of speech, Crary also hypothesized that subgroups of children with and without receptive language deficits would emerge. The findings of this study supported the hypothesis, and provide initial evidence of receptive language deficits in children with DAS.

The children tested in this study were all previously diagnosed by a professional speech-language pathologist as having DAS, but were retested using the *Screening Test for Developmental Apraxia of Speech*. This allowed current examination of their speech and motor skills. Performances of all subjects were in agreement with previous diagnoses.

Results of the language portion of this study indicated that three of the four children tested showed significant receptive language delays. The only inferences that can be safely taken from this study are that there are DAS children with receptive language deficits and there may be children without these deficits. Due to the small number of subjects additional research is needed to examine the receptive language skills of children with DAS.

The receptive language scores of Subjects 1, 3, and 4 are inconsistent with the current diagnostic criteria that receptive language is innate. Subject 2's scores also stand out as not only equivalent or above her expressive language skills, but above most children her age. Because current diagnostic tests and treatment approaches for this disorder were developed under the assumption that children with DAS possessed normal language skills, revision of these tests and techniques is critical to accommodate the specific needs of children who are delayed in this area. For example, diagnostic tests with complicated or lengthy verbal instructions may not be understood by a child with receptive language delay, thus compromising the validity of that test.

Finally, these findings suggest that a child with receptive language delay will likely benefit from instructions involving imitation of the tasks to be performed to ensure that the directions are understood and that the test is examining DAS, not the child's receptive language. Clearly, research is also needed to provide a more reliable set of data on the prevalence of receptive language delay in children with DAS. Additional research on the cause of these receptive language delays is recommended.

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