CHAPTER

27

A Perceptual Comparison of Prosodic Features in Apraxia of Speech and Conduction Aphasia

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Disruption of normal speech prosody is included among the characteristics of the verbal output of individuals with apraxia of speech (AOS) (Kent and Rosenbek, 1982), as well as those with conduction aphasia (Benson, 1979; Yorkston and Beukelman, 1979). The commonly accepted descriptor for the prosodic component of apraxic speech is "equal and even stress" with frequent repeated audible attempts to initiate word production (Darley, Aronson, and Brown, 1975). In conduction aphasia, fluently produced speech is intermittently interrupted by repetitions of whole words and word fragments, presumably associated with attempts to correct literal paraphasic errors (Benson, 1979); Yorkston and Beukelman, 1979). Clinical investigators admit to occasional difficulty in distinguishing these disorders, especially if the level of impairment is mild or the speech sample is limited. However, analysis of either the type or frequency of occurrence of prosodic abnormalities in these two groups is rare. This study provides a detailed perceptual analysis and comparison of selected aspects of speech prosody in subjects with apraxia of speech without concomitant aphasia and those with conduction aphasia without apraxia of speech. By studying subjects carefully selected as representative of apraxia of speech or conduction aphasia, a more firm differentiation of the two groups was anticipated.

Perceptual analysis of the nonsegmental properties of speech production that contribute to the perception of prosody at the single-word level, and presumably to the prosodic disturbances in apraxia of speech and conduction aphasia, has been accomplished by attention to several characteristics: syllable stress, timing parameters such as juncture (Hyman, 1975; Lehiste, 1970), and word and sound repetition. Failure to maintain smooth transitions between sounds or between syllables in words is also considered an interruption in the continuous flow of normally produced words (Bergmann, 1986; Wingate, 1969) and may contribute to the overall perception of disturbed prosody in neurogenic populations.

METHODS

SUBJECTS

Subjects were four adult males with apraxia of speech and four with conduction aphasia. All were native speakers of English and had speech discrimination scores of 70 percent or better at 40 dB HL in at least one ear. Selection of all subjects was made by consensus between two certified speech-language pathologists (McNeil and Rosenbeck) with exten-

sive experience in the detection of apraxia of speech and conduction aphasia and their differentiation from other neurogenic speech disorders. Judgments of the presence of apraxia of speech or conduction aphasia were made perceptually on the basis of live as well as audiotaped and videotaped speech performances on the Apraxia Battery for Adults (ABA) (Dabul, 1979), conversational speech, the "Cookie Thief" and its repetition from the Boston Diagnostic Aphasic Examination (BDAE) (Goodglass and Kaplan, 1983), and the verbal subtests of the Porch Index of Communicative Ability (PICA) (Porch, 1967).

Apraxic subjects were selected on the basis of the presence of apraxia of speech and the absence of aphasia and dysarthria. Darley's (1982) definition was used as the conceptual determination of aphasia. Evidence of apraxia of speech was effortful groping on the initiation of speech, sound substitutions, imitative speech that was superior or equal to spontaneous speech on selected tasks, and articulatory agility, phrase length, and melodic line ratings between 1 and 4 on the BDAE (Goodglass and Kaplan, 1983) ratings of speech characteristics. The absence of aphasia was determined by performance at or above the 1st percentile for normal subjects on the average of subtests II, III, V, VI, VII, X, and XI of the PICA (Porch, 1967). The verbal and graphic subtests were removed from the overall score because of probable misinterpretation of scores on these subtests in subjects who may have oral and limb deficits accompanying language deficits. The absence of dysarthria was determined perceptually using the features of dysarthric speech described by Darley, Aronson, and Brown (1975). Judgments were made from performance on a structural-functional (S-F) speech examination (Veterans Administration Hospital Examination, Madison, Wisconsin) and from the ABA (Dabul, 1979).

Conduction aphasic subjects were selected on the basis of frequent sound substitutions in the presence of "fluent" speech and ratings between 4 and 7 on the articulatory agility, phrase length, and melodic line rating scale on the BDAE (Goodglass and Kaplan, 1983). Imitative speech evidenced more segmental and suprasegmental errors than elicited or spontaneous speech. Relevant subject biographic and testing data are shown in Table 27-1.

PROCEDURES

Stimuli for this study were the 30 mono-, di-, and trisyllabic words from part II (Words of Increasing Length) of the ABA (Dabul, 1979). This subtest includes such familiar words as "thick," "thicken," and "thickening" and "please," "pleasing," and "pleasingly." As required by this test

TABLE 27-1. SUMMARY OF BIOGRAPHIC AND DESCRIPTIVE DATA FOR THE SUBJECTS WITH APRAXIA OF SPEECH AND CONDUCTION APHASIA

	Subjects							
Measure	A1	A2	A3	A4	C1	C2	C3	C4
Gender	M	M	M	M	M	M	M	M
Age	59	62	54	72	48	66	60	62
Time after onset (mos)	62	64	39	48	60	2	4	62
S-F exam.	WNL*	WNL	WNL	WNL*	WNL	WNL	WNL†	WNL†
Total RCPM	27	28	30	28	33	26	32	27
Total WFM	13	4	11	31	7	9	16	11
O.A. PICA	14.66	14.33	14.53	14.96	13.94	14.39	14.13	14.87
O.A. RTT	13.94	12.08	12.23	14.07	10.80	12.08	13.04	13.94
BDAE aud. comp.	116	113	118	116	110	115	117	114
BDAE speech ratings:								
1. Artic. agility	2	4	3	1	6	5	5	5
2. Phrase length	7	4	4	4	7	5	5	5
3. Melodic line	3	4	4	2	7	5	7	5
BDAE total sent. rep. w/o errors	8	7	1	1	1	1	1	3
Apraxia bat. for adults:								
1. Total limb	47	50	48	45	40	45	50	50
2. Total oral	43	37	49	43	48	49	49	49

*There was a questionable right-sided lingual weakness on clinical examination that was not confirmed with additional testing for this subject.
†There was a question of oral sensory diminution on clinical examination in this subject.

administration, subjects repeated each word once after the examiner's live voice model.

Prosodic judgments and narrow phonetic transcription were performed by two experienced transcribers using principles of the International Phonetic Association (IPA) (1949) and diacritics detailed by Shriberg and Kent (1982). Only final productions of words were transcribed. In cases where subjects repeated words or audibly groped to find the appropriate articulatory position or sound in initial or noninitial word position, these attempts were counted as events but not transcribed phonetically.

For this study, three general categories of word-level prosodic deviations were identified and evaluated. These were (1) deviations from the expected syllabic stress (either equal or abnormal stress), (2) abnormalities in intraword timing parameters, which included open juncture and long stop closure, and (3) repeated production attempts.

Syllabic stress judgments were based on production of the two- and three-syllable words. The code *equal stress* refers to the perception of equivalent syllabic emphasis on both or all three syllables when the normal production of the word required a variation in stress across the syllable chain. *Abnormal stress* refers to the perception of misplaced syllables stress, such as syllabic prominence occurring on the second syllable in the word "thickening." In some cases, the second syllable of a two-syllable word such as "thicken" received more stress than it normally would. However, if the relative weights of stress were maintained, that is, primary stress on the first syllable and secondary stress on the second syllable, syllabic stress was coded as correct.

Assessment of intraword timing parameters and repeated production attempts was made on all word productions. The term *open juncture* refers to the silent interval, or pause, between the sound boundaries of adjacent syllables. One example occurs in the transcription differentiating the two phrases "ice cream" and "I scream." In the current data, open juncture was identified in cases such as [ɵI + kan + Iŋ]. This term appears to be synonymous with that of *syllable segregation* or *syllabification* used by other investigators. The term *long stop closure* refers to inappropriately lengthened closure on nonfinal stop sounds in cases where a full silent gap was not perceived. This had the perceptual effect of a bumpy transition from the stop to the fricative.

Three types of repeated production attempts were coded. An *initial struggle* was defined as an audible search for an articulatory position or sound at the beginning of a word. A *noninitial struggle* was defined as an audible search for an articulatory position or sound occurring after the initial sound cluster or syllable. A *repetition* referred to the iteration of an entire word or syllable.

Transcription reliability for these prosodic features was computed by

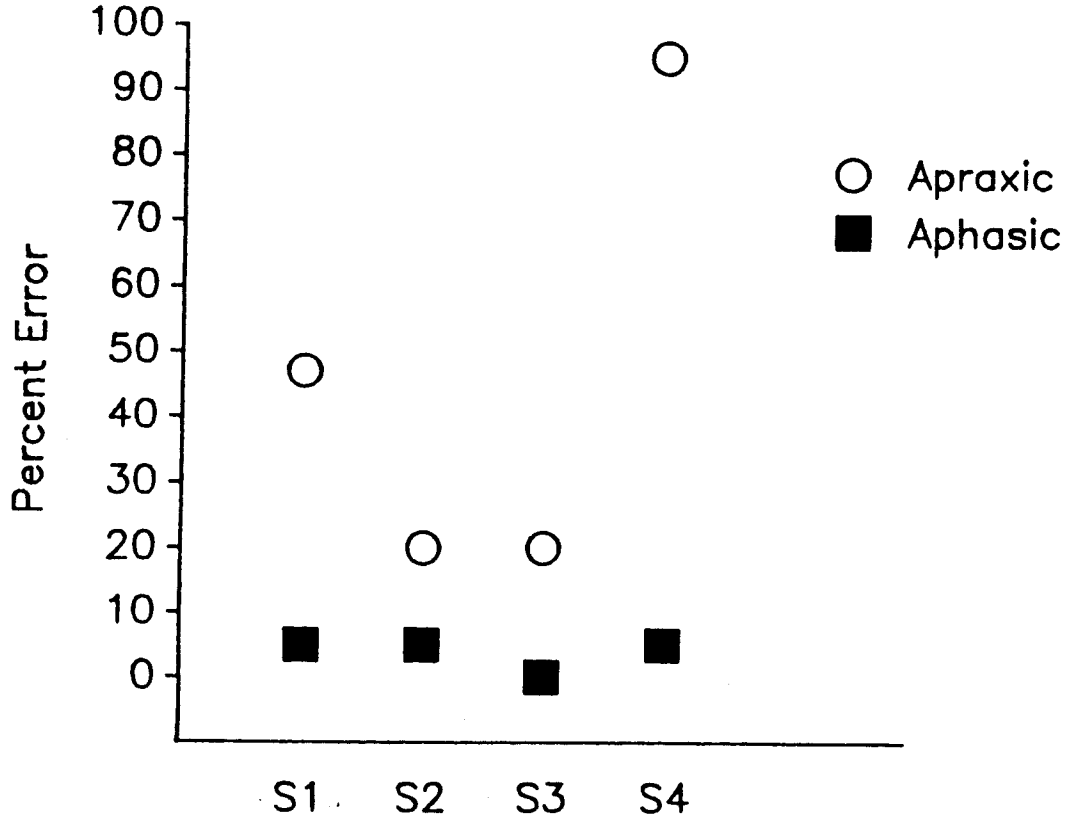
retranscribing all productions by each subject more than 1 year after the initial transcription. Overall reliability was calculated at 65 percent; that is, 65 percent of the time the transcribers agreed on time 1 and time 2 that an error had occurred and on the nature of the error.

RESULTS

SYLLABIC STRESS

The AOS group produced syllabic stress deviations on almost half the polysyllabic productions. Errors were coded on 43 percent of the disyllabic and 46 percent of the trisyllabic words. This error rate is substantially higher than that for the conduction aphasic group, which erred on 3 and 5 percent on di- and trisyllabic words, respectively. Stress errors occurred at a slightly higher rate in three- than in two-syllable words in

Fig. 27-1. Syllabic stress error rate for each of the four subjects (S1, S2, S3, and S4) in the AOS and conduction aphasic groups. The error rate represents both equal and abnormal stress deviations.



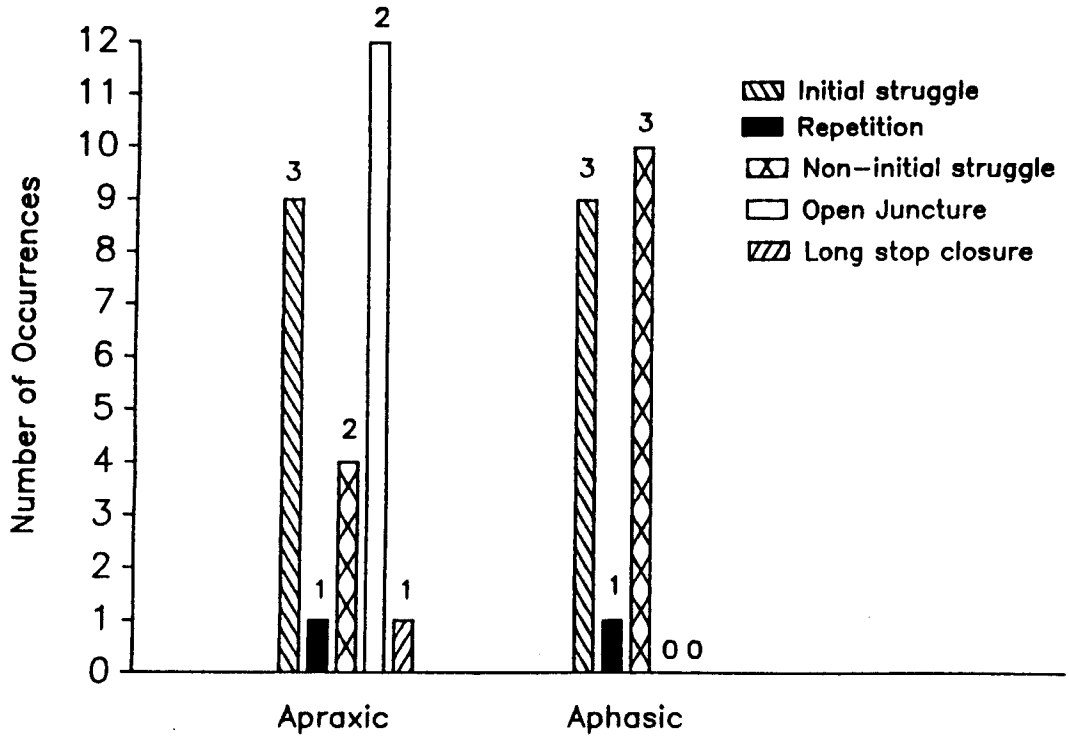
both groups. Equal stress was perceived far more often than misplaced stress for both groups.

In the AOS group, there was considerable intersubject variability in rate of syllabic stress error. As illustrated in Figure 27-1, although all apraxic subjects produced stress errors, error rate ranged from 20 to 95 percent. In the aphasic group, one subject made no stress errors. The other three subjects each produced only one stress error.

OTHER PROSODIC FEATURES

Nonstress prosodic features were initial struggle, noninitial struggle, repetition, open juncture, and long stop closure. The frequency of occurrence of these features of speech coded in each group is shown in Figure 27-2. The digits above the bars represent the numbers of subjects who demonstrated errors of that type. The numbers of initial struggles and repetitions were equal in each group. Differences between the groups centered on the features of noninitial struggles and sound or syllable transitions (open juncture and long stop closure). The aphasic group produced a higher number of noninitial struggles than the apraxic

Fig. 27-2. Frequency of occurrence of nonstress prosodic features of speech produced in the AOS and conduction aphasic groups. The digits above the bars represent the number of subjects who produced errors of that type.

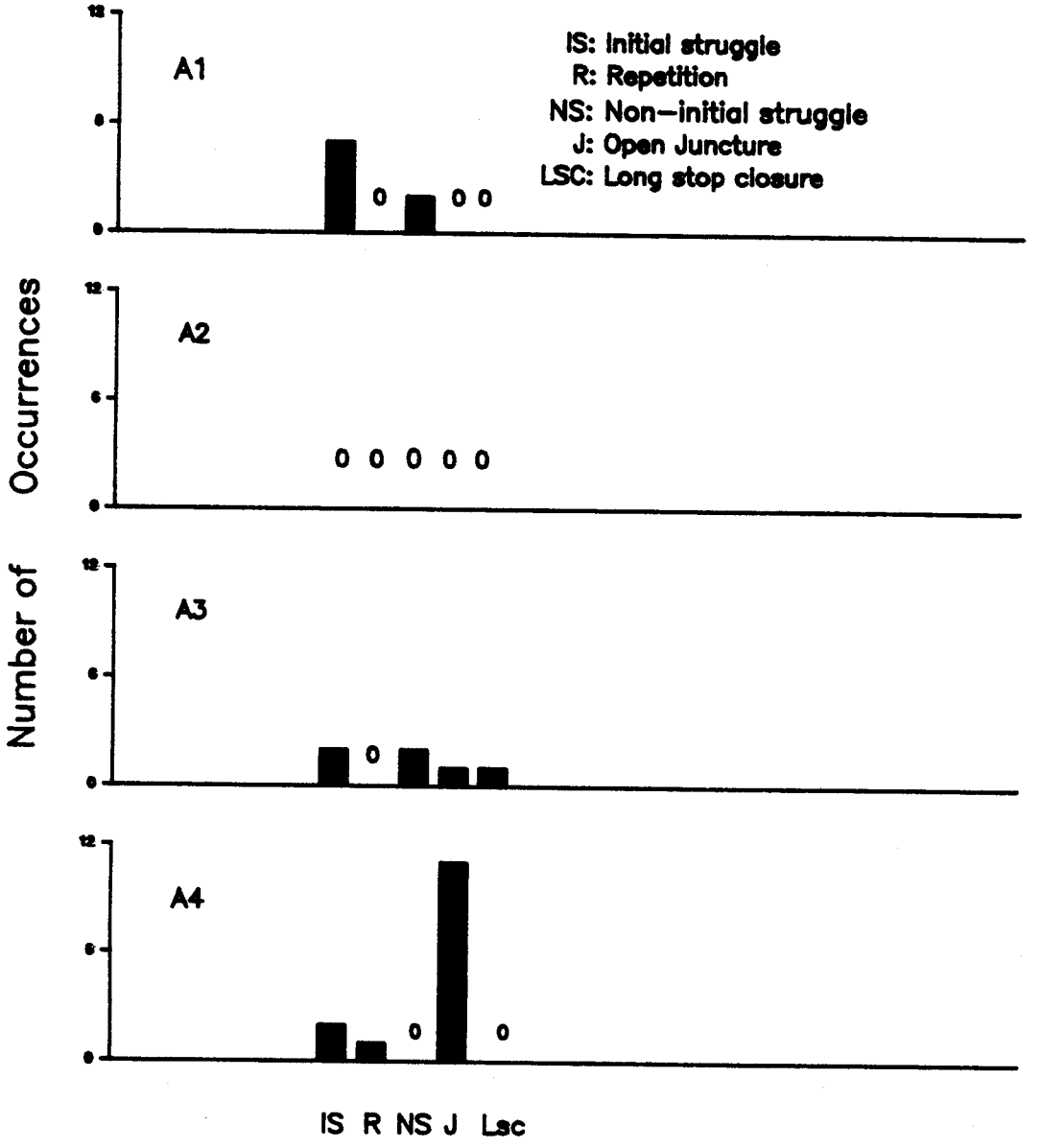


group. The aphasic group demonstrated no instances of open juncture or long stop closure, in contrast to the AOS group.

There was considerable intersubject variability in the AOS group, as shown in Figure 27-3. For example, one subject (A2) produced none of these prosodic deviations. Subject A4 was essentially the sole contributor to the high incidence of open juncture.

Although small in number, there was a somewhat more even distribution of errors across categories in the conduction aphasic group, as

Fig. 27-3. Frequency of occurrence (0 to 12 instances) of nonstress prosodic features of speech produced by individual AOS subjects.



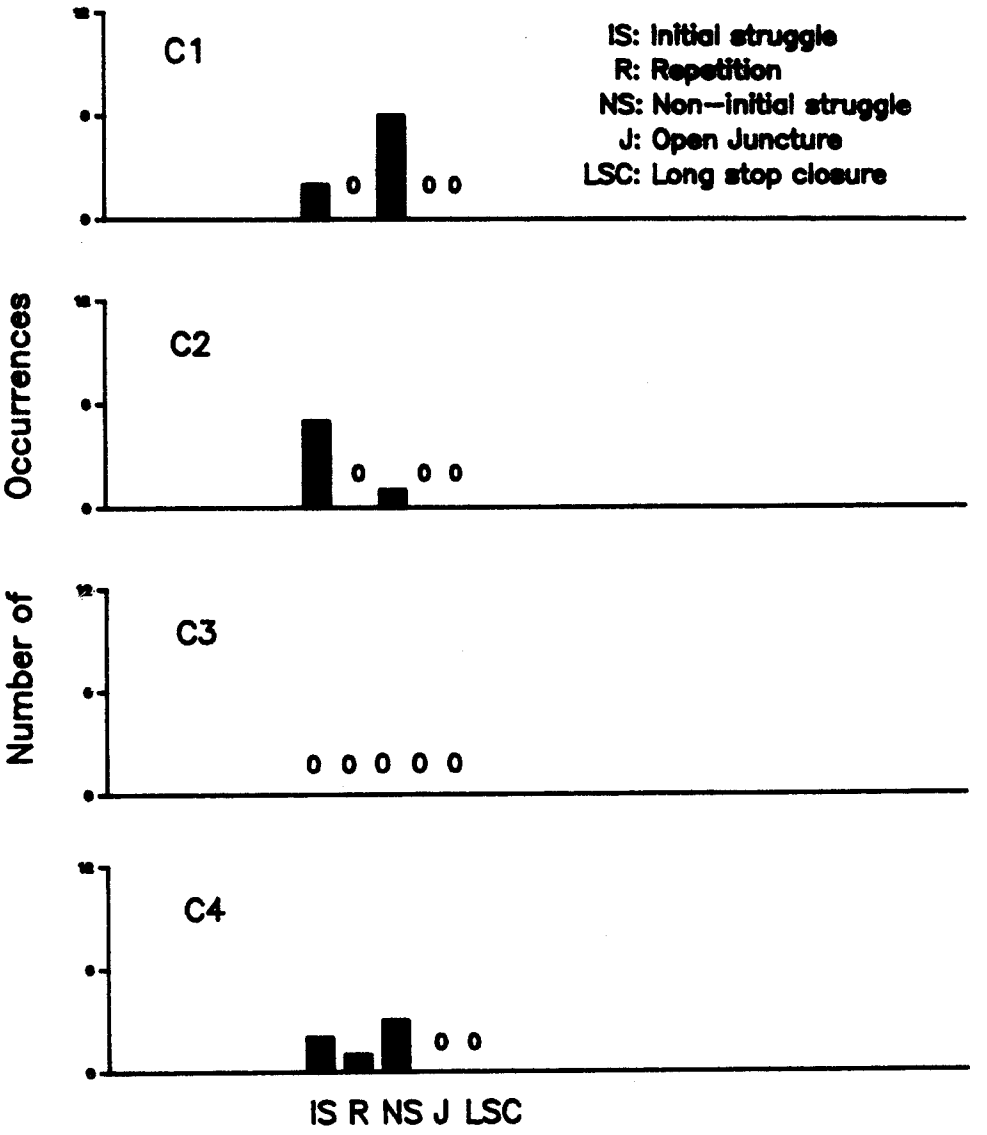


Fig. 27-4. Frequency of occurrence (0 to 12 instances) of nonstress prosodic features of speech produced by individual conduction aphasic subjects.

shown in Figure 27-4. One subject (C3), however, produced none of these prosodic deviations.

DISCUSSION

The group data in this study support the literature on prosodic disturbances in apraxia of speech (AOS). For conduction aphasia, these data provide a heretofore unreported description of the prosodic distur-

bance, albeit for only four subjects, for few tokens judged from the audio signal only and at the single-word level. While the groups differ in some, rather predictable ways, they are not as different as the literature and common clinical knowledge would suggest.

Results support previous reports indicating substantial problems in the accurate production of syllabic stress in apraxia of speech. Reports in the literature do not call attention to syllabic stress abnormalities in conduction aphasia, perhaps indicating that this speech feature is not notably impaired in this group. Data in the current study support this view.

Comparison of initial and noninitial struggles in each group indicate that these AOS subjects had more difficulties in initial than in noninitial portions of words. This finding is consistent with the traditional view of articulation in apraxic speech that holds that word initial position is especially vulnerable to disruption. The conduction aphasic subjects in the current study produced similar numbers of initial and noninitial struggles, suggesting that there was no preferential locus of prosodic breakdown.

Comparison of open juncture and long stop closure in the two groups suggests that sound and syllable transitions were a substantial articulatory obstacle for the apraxic but not the aphasic subjects. This finding supports a similar contention proposed by Canter, Trost, and Burns (1985) for these groups. However, there is reason for cautious generalization because of the small number of subjects, the limited speech targets, and intersubject variability.

While there is a general notion among speech-language pathologists that these groups can be differentiated on the basis of speech prosody, no profile emerged from these data that adequately or reliably identified any single subject as a member of either group. The methods used in this investigation failed to provide a differentiation between groups that we subjectively believe to exist. It is possible that the features chosen to characterize the prosodic differences were not the ones on which differentiation can be made. It also might be that the features were the correct ones or a subset of the correct ones. However, the search for the presence or absence of a feature is the wrong strategy, and an analysis more akin to the cluster analysis that Darley, Aronson, and Brown (1975) used for differentiating the dysarthrias would provide a more accurate assignment of individuals to groups. It is also likely that segmental and suprasegmental properties of production interact to form a gestalt from which the recognition of prosodic differences is formed; examination of both segmental and suprasegmental features may be necessary for adequate differentiation of these subjects. This study did not examine segmental characteristics such as sound prolongation, a feature argued by some (e.g., Hyman, 1975) to be central to the overall perception of pros-

ody. Thus these data on syllabic stress and prosodic production are in need of verification and replication on word-level as well as contextual-level speech.

This study is part of a larger research effort using an extensive corpus of spontaneous and imitative speech productions and multiple layers of analysis to identify phonologic and phonetic signs that may characterize these two groups. The specific stimuli and analysis methods reported here were selected because of their potential clinical efficiency. Given the traditional wisdom about apraxia of speech and conduction aphasia, the differential diagnostic power of words of increasing length, produced imitatively, was a reasonable expectation. Indeed, some subjects were differentially grouped, although performance from subjects in each group overlapped. Among the clinical and research implications of this study, three seem especially noteworthy: (1) prosodic features produced in words of increasing length were inadequate to differentiate these groups, (2) narrow prosodic judgments are difficult to make reliably, and (3) prosodic profiles for apraxia of speech and conduction aphasia may be more complex than anecdotal reports imply.

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