Oral Apraxia and Aphasic Misarticulations

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The clinical descriptions of articulatory impairment in aphasia that have appeared in the literature have generally agreed upon the observed output characteristics of patients with left anterior cortical lesions. In the years that have passed since the introduction of the term aphemia, a tremendous amount of conceptual and theoretical confusion has surrounded Broca's findings. The speech-language deficit which frequently follows left anterior cerebral infarction secondary to vascular disease has been referred to as apraxia of speech (Johns and Darley, 1970; Aten, Johns and Darley, 1971; Deal and Darley, 1972). Darley, Aronson and Brown (1975) define apraxia of speech as a "disorder of motor speech programming manifested primarily by errors in articulation and secondarily by compensatory alterations of prosody." The motor programming nature of the disorder has been challenged in recent years. Martin (1974) wrote that "the concept of an apraxia of speech is a reflection of an outdated dichotomous model of language functioning that obscures the complex interactions involved in normal and aphasic language." Martin argues that there is not a discrete separation of motor activity from other language processes.

Aphasic misarticulations are often accompanied by disordered nonspeech oral movements. Oral apraxia has been viewed as a complicating factor that affects the articulatory impairment relative to the severity of disordered nonspeech oral movements. De Renzi, Pieczuro and Vignolo (1966) investigated the relationship between oral apraxia and phonemic-articulatory disorders by evaluating 40 patients with focal lesions of the right hemisphere and 134 patients with lesions in the left hemisphere. An independent observer classified the articulation deficits on the basis of quality of speech. De Renzi et al. concluded that the severity of oral apraxia was highly correlated with the severity of phonemic-articulatory disturbances. However, there were some patients with severe oral apraxia and only a mild articulation disorder. LaPointe and Wertz (1974) investigated the oral movement and articulatory performance of normal and brain-injured adults. Results of the experiment revealed that brain-injured patients exhibited more difficulty imitating isolated oral movements and oral-motor-sequencing tasks than normals. They also found that "there was no relationship between the severity of a patient's articulatory deficit and his performance on isolated oral movement and oral-motor-sequencing tests."

In view of the paucity of research regarding the nature of oral apraxia and its affect on articulation, the general purpose of this study was to further investigate the relationship between oral apraxia and aphasic misarticulations.

METHOD

Subjects. Twenty aphasic subjects who demonstrated an articulation disorder related to vascular brain injury were selected. Subjects were obtained from the intermediate medical services of the Veterans Administration Hospitals in Danville, Illinois, and Marion, Indiana, and the Americana Nursing Home in Normal, Illinois. All subjects were at least 3 months post-onset. The subjects exhibited a clinical pattern that was commensurate with a diagnosis of Broca's aphasia based on results of the Boston Diagnostic Aphasia Examination (1972).

Oral Apraxia Test. An oral apraxia test was developed to identify subjects with disordered nonspeech oral movements. The tasks listed in Table 1 were elicited with a verbal command and responses were scored with a 15-point multidimensional scoring system. The maximum possible score was 150, and a score of 120 was chosen as an arbitrary cut-off; i.e., subjects with scores of 120 or less were diagnosed as exhibiting oral apraxia. Ten subjects exhibited oral apraxia.

Table 1. Oral apraxia evaluation.

Verbal Commands	
Stick out your tongue	Pucker your lips
Smile	Yawn
Puff out your cheeks	Open your mouth
Bite your lower lip	Lick your lips
Blow	Clear your throat

Phonological Process Analysis. Current trends in articulation assessment reveal that there are phonological processes which need to be identified in order to establish the dominant patterns of articulation errors (Ingram, 1976; Weiner, 1979; Hodson, 1980; and Shriberg and Kwiatkowski, 1980). Phonological processes provide a description of the systematic strategies that reduce or modify the number of contrastive elements in an utterance. Measurement of the occurrence of phonological processes was conducted to provide a basis for comparison of subjects with oral apraxia and subjects who exhibited no oral or facial apraxia. This assessment also provided data on the occurrence of processes in a sample of Broca's aphasic subjects. A phonology procedure which evaluates processes was developed by Hodson (1978). The process analysis allowed for obtaining percentage of occurrence scores for 10 basic phonological processes. Percentage of occurrence scores for each of the processes listed in Table 2 were obtained.

Table 2. Basic phonological processes.

Reduction of Syllables	Omission of Non-syllabic Sonorant Singletons
Reduction of Consonant Clusters	Stopping of Continuants
Deletion of Stridency	Fronting of Velars
Omission of Prevocalic Obstruent Singletons	Gliding of Prevocalic Liquids
Omission of Postvocalic Obstruent Singletons	Vowelization of Syllabic Liquids

In addition to the 10 basic processes, frequency of occurrence scores were obtained for 16 miscellaneous processes listed in Table 3.

Table 3. Miscellaneous phonological processes.

Postvocalic Devoicing
Prevocalic Voicing
Prevocalic Devoicing
Depalatalization
Epenthesis
Vowel Deviations
Affrication
Deaffrication
Palatalization
Velar Preference
Stridency Addition
Metathesis
Alveolar Preference
Labial Assimilation
Velar Assimilation
Nasal Assimilation

Procedure. Subjects who agreed to participate in the investigation were tested during two sessions, which ranged in length from 1 to 1-1/2 hours. The Boston Diagnostic Aphasia Examination and the oral apraxia test were administered during the first session. During the second session, the phonology procedure was administered by eliciting spontaneous verbal identification of 54 photographs. All responses were recorded on magnetic tape with an Uher 4000 portable tape recorder and transcribed later using narrow phonetic transcription. Each response was analyzed to determine the percentage of occurrence score for the 10 basic processes. The score was obtained for each process by dividing the total number of occurrences by the number of possible occurrences. A frequency of occurrence score for each of the 16 miscellaneous processes was also obtained.

RESULTS AND DISCUSSION

Phonological analysis of the misarticulations revealed that the speech deviations of subjects with Broca's aphasia can be described in terms of phonological processes. Over 4,800 phonemes were uttered in this investigation and only 17 substitutions could not be classified as a phonological process.

An analysis of variance was used to evaluate differences among the means of the 10 basic phonological processes and also the means of subjects with oral apraxia and subjects with normal nonspeech oral movements. Performance of the two groups did not differ significantly ($F=.59$, $df=1, p > .05$). There were significant differences among the means of the 10 basic processes ($F=13.51$, $df=9$, $p < .05$). Results of the Tukey HSD are shown in Table 4. The five processes that were found to be prevalent in the speech of Broca's aphasic subjects included: reduction of clusters, deletion of stridency, vowelization of liquids, omission of postvocalic obstruents, and stopping of continuants.

Table 4. Tukey HSD pairwise comparison of percentage of occurrence means for the 10 basic phonological processes.

Process	% of Occurrence	1	2	3	4	5	6	7	8	9	10
1. Reduction of Clusters	39.9	-	17.5*	22.6*	28.8*	30.6*	31.6*	34.6*	37.0*	38.2*	38.7*
2. Deletion of Stridency	22.4		-	5.1*	11.1*	13.1*	14.1*	17.1*	19.5*	20.7*	21.2*
3. Vowelization of Liquids	17.26			-	6.14*	8.0*	9.0*	12.0*	14.4*	15.6*	16.0*
4. Postvocalic Obstruents	11.12				-	1.9	2.9	5.8*	8.3*	9.5*	9.9*
5. Stopping of Continuants	9.21					-	1.0	3.9	6.3*	7.5*	8.0*
6. Fronting of Velars	8.21						-	2.9	5.3*	6.5*	7.0*
7. Prevocalic Obstruents	5.25							-	2.4	3.6	4.0
8. Non-syllabic Sonorants	2.82								-	1.2	1.6
9. Reduction of Syllables	1.62									-	.4
10. Gliding of Liquids	1.19										-

*Tukey HSD = 4.4; $p < .05$

Frequency of occurrence scores for 16 miscellaneous phonological processes were calculated and the results are shown in Table 5. Miscellaneous processes that occurred with regularity included postvocalic devoicing, prevocalic voicing, depalatalization, and epenthesis.

Table 5. Frequency of occurrence of 16 miscellaneous phonological processes.

Miscellaneous Phonological Processes	# of Occurrences
Postvocalic Devoicing	72
Prevocalic Voicing	50
Depalatalization	43
Epenthesis	40
Vowel Deviations	36
Affrication	35
Deaffrication	27
Palatalization	18
Velar Preference	17
Prevocalic Devoicing	15
Stridency Addition	15
Metathesis	13
Alveolar Preference	13
Labial Assimilation	11
Velar Assimilation	9
Nasal Assimilation	7

These findings do not support the De Renzi, Pieczuro and Vignolo (1966) investigation. The data do not support the conclusion that there is a relationship between the severity of oral apraxia and the severity of aphasic misarticulations. The basic phonological process means for the 10 subjects with oral apraxia and the 10 subjects with normal nonspeech oral movements did not reveal the expected significant differences. Further, many of the utterances of the two groups were strikingly similar, indicating a lack of

support for previous findings of a strong association between oral apraxia and aphasic misarticulations.

In summary, the results of the present investigation indicate that the assessment of phonological processes in Broca's aphasic subjects revealed systematic error patterns that are not readily accessible through "traditional" testing procedures. Based on the phonological analysis of misarticulations, error patterns were readily identifiable and to a limited extent, predictable. These assessment procedures revealed the dominant patterns of aphasic misarticulations through the analysis of general processes that affect large classes of sounds.

REFERENCES

Aten, J., Johns, D., and Darley, F. Auditory perception of sequenced words in apraxia of speech. J. Speech Hearing Res., 14, 131-143 (1971).

Darley, F., Aronson, A. and Brown, J. Motor Speech Disorders. Philadelphia: W.B. Saunders Co. (1975).

Deal, J. and Darley, F. The influence of linguistic and situational variables on phonemic accuracy in apraxia of speech. J. Speech Hearing Res., 15, 639-653 (1972).

DeRenzi, E., Pieczuro, A. and Vignolo, L. Oral apraxia and aphasia. Cortex, 2, 50-73 (1966).

Goodglass, H. and Kaplan, E. Boston Diagnostic Aphasia Examination. Philadelphia: Lea and Febiger (1972).

Hodson, B.W. Hodson Phonology Instrument. Unpublished manuscript (1978).

Hodson, B.W. Assessment of Phonological Process. Danville, Illinois: Interstate (1980).

Ingram, D. Phonological Disability in Children. New York: Elsevier (1976).

Johns, D. and Darley, F. Phonemic variability in apraxia of speech. J. Speech Hearing Res., 13, 556-583 (1970).

Martin, A. Some objections to the term "apraxia of speech." J. Speech Hearing Dis., 39, 53-64 (1974).

Shriberg, L. and Kwiatkowski, J. Natural Process Analysis. New York: Wiley (1980).

Weiner, F. Phonological Process Analysis. Baltimore: University Park Press (1979).

DISCUSSION

Q: Maybe we should be more conservative, because Shriberg is coming out with a process analysis and they have a number of processes. Hodson's has 42. Ingram has 29. I think that the issue is that we don't know truly what is a process just yet.

A: The most important finding in this study was that these Broca's aphasic subjects used phonological processes as a strategy to change the target utterances. A second finding was that phonological processes provide an accurate description of general processes that affect entire classes of sounds.

Q: I'm troubled by how you differentiate between oral apraxia and apraxia of speech or verbal apraxia. In my mind oral apraxia is nonverbal. You can't talk about articulation or misarticulations.

A: We didn't try to differentiate between apraxia of speech and oral apraxia. We diagnosed whether or not a patient had oral apraxia. All of the patients exhibited misarticulations. We were not concerned with whether or not those errors were the result of an apraxia of speech.

Q: Did you test to see if these patients had pure oral apraxia?
A: Yes, the approach was similar to the procedures followed by LaPointe and Wertz (1974). Based on the oral apraxia test, 10 of the subjects exhibited oral apraxia.

Q: Did you find any correlation between time post onset and presence of oral apraxia? It has been suggested by some in the literature that oral apraxia is an early attribute that clears.
A: We were not interested in answering that question.

Q: What you are doing is plugging these errors into what you call an error process. Now it seems to me that a lot of our apraxic patients, given a word, don't just say it once with one error, they might say it five times with five errors. So I'm wondering how we deal with that and how you plug that into an error process?
A: We were mainly interested in the patient's first production. If a patient produced a target with 3 different errors, we analyzed only the first production. We did not specifically look at the variability of the different productions. However, although individual productions for the same target varied, the use of phonological processes as a strategy for reducing the number of contrastive elements in an utterance remained constant.

Q: You touched on something that troubles a lot of people. When Johns was talking about apraxia of speech, he summarized the characteristics of those patients in terms of their inconsistency. He talked about the unpredictability and inconsistency of those patients. Now we seem to be finding that with different kinds of analysis and perhaps different attitudes that the patients are more predictable. Is it possible that both people are right? Is it possible that Johns was right and you are right and that it's a difference in methodology or presentation of data that explains what at least on the surface is an inconsistency?
A: I think that both groups gathered similar kinds of data and then analyzed those data with highly dissimilar approaches. With the kind of analysis that we employed, the relationship among the various errors and the processes that affect large classes of sounds are readily identifiable. The same thing has happened in the child literature. For a long time we were saying that children with severe articulation disorders exhibited inconsistent errors, but since our attention has focused on the phonological literature for the past 10 years you'll notice that people are discovering the underlying system. Once that is accomplished, the inconsistency disappears.

Q: I don't see how you can say that you are finding consistency if you throw out everything that isn't consistent; that is to say, the rest of their errors. You choose to look at the first error, but you did ignore all the rest of them, and there is a problem.

A: We did not specifically look at different productions for individual target items. I think that is a logical next step. As I was collecting the data, it became increasingly apparent that even though some subjects gave different responses for the same target item, they were essentially using the same or a similar process to achieve the different productions. I'm not bothered by whether or not a subject used a different phoneme each time he produced a target. Each subject employed phonological processes during every production.

Q: Some of our patients do that and some of them don't. Do you have any idea how many might have been consistent and how many might have been inconsistent?
A: We did not collect that kind of data. It is a small study and I think that with a larger study the patterns may emerge more clearly.

Q: Did you record everything they said and then just study the first response?
A: Yes.

Q: Why do you choose to call these aphasic misarticulations rather than apraxia of speech?
A: I don't know if I want to answer that. I did not use the term apraxia of speech because it implies an underlying mechanism that may or may not account for the errors.

Q: Did all of the patients use the same processes?
A: Variability between subjects is present. There were four processes that all of the subjects utilized. Beyond that, each subject selected processes that were unique to the individual subject.

Q: Was there any relationship between severity of oral apraxia and severity of articulation errors?
A: No. The overall purpose of the study was to further investigate the DeRenzi findings. Of course after we began the investigation the process analysis was much more interesting than the oral apraxia controversy. If this study had supported the DeRenzi findings, the subjects with oral apraxia should have had a higher percentage of occurrence of the basic processes.

Q: What was the level of oral apraxia in the people who had oral apraxia?
A: It varied from mild to severe.