The Efficacy of Phonological Process Analysis for Apraxia of Speech

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Recently it has been proposed that phonological process analysis, which has been primarily associated with childhood articulation disorders, should be used to describe the articulation errors produced by adults with apraxia of speech. Studies related to this topic have shown that a number of phonological processes (i.e., fronting, stopping, denasalization, etc.) are present in apractic speech, implying that this disorder is linguistic in nature (Bowman, 1982; Wolk-Tuch, 1982). Another implication is that their presence can lead to the treatment of apraxia--namely the teaching of phonological rules.

Unfortunately, these investigations have merely reported the presence of various phonological processes and not whether they occur frequently or consistently within apractic speech. Thus, it is not known whether the presence of processes is characteristic of apraxia of speech or is merely due to happenstance. One method of answering this efficacy question has been proposed by McReynolds and Elbert (1981). Their method entails eliciting speech samples from a given population and categorizing the articulation errors made into the various types of phonological processes. A quantitative criterion is then applied to each process to determine which are characteristic of the speech sample. If the number of occurrences of a process falls above the criterion (i.e., a proportion of the total number of phonemic environments a process could possibly occur) then it is said to be characteristic. If not, then it is said to be random or inconsistent.

Employing a similar methodology the present investigation has attempted to determine:

1. whether various types of phonological processes are present in apraxia of speech.
2. whether the presence of different types of processes changes as a function of experimental conditions.
3. whether different types of processes occur frequently and consistently in apractic speech. That is, whether phonological processes are characteristic of apraxia of speech.

Subjects

Two female subjects (HB and JT) with relatively pure apraxia of speech were employed. The presence or absence of aphasia and apraxia of speech was determined by the subjects' performance on three clinical tests: the Porch Index of Communicative Ability, the Token Test, and the Mayo Test for Apraxia of Speech. Identification information is shown in Table 1. As it can be seen, the Overall and Modality scores on the PICA as well as the scores obtained on Part V of the Token Test are all relatively high. In fact, scores obtained on these tests fell within the norms established by Duffy and Keith (1981) for the PICA and those established by Wertz, Keith, and Custer (1971) for the Token Test. In addition, these subjects were selected since they both exhibited symptoms characteristic of moderately apractic speech; the type of subject to which we felt a phonological process analysis was most clinically applicable.

Table 1. Identifying information.

Subject	Sex	MPO	Etiology	PICA Overall	PICA Gest.	PICA Verb.	PICA Graph.	Token Test Part V
HB	F	12	Vascular	14.09	15.00	12.25	14.17	1
JT	F	20	Vascular	14.51	15.00	13.28	14.67	0

Method

Each subject was required to read aloud a 76-word passage three times in succession under each of three experimental conditions. These conditions were a no stress condition in which the subject read aloud the passage at his own pace, a situational stress condition where each oral reading trial was performed in front of an audience, and a communicative stress condition in which the subject was asked to read at twice the normal rate. To control for possible adaptation effects, each reading trial was separated by having the subjects recite the "Pledge of Allegiance" and/or orally describe a series of pictures. Experimental conditions were separated by at least two hours.

The subjects' readings were tape recorded and later phonetically transcribed by each investigator independently. The transcriptions were then compared and any disagreements were resolved through negotiation. If a disagreement could not be resolved, the particular word under discussion was discarded.

For the purposes of analysis, only the nouns, verbs, adjectives, and adverbs from the reading passage were considered, resulting in a total of 40 words per reading trial. Each articulation error produced within these words was categorized into one of thirty-three phonological processes (Table 2). These processes are those identified and discussed by Ingram (1976), Weiner (1979), and Hodson (1980) and are composed of five major process groups; deletion, cluster reduction, substitution, assimilation, and other phonological processes. Two additional processes were added by the investigators in an attempt to categorize some additional prevalent errors occurring in each of our subjects' speech. These were voice confusions and place confusions. Voice confusions were those consonant productions in which the transcriber could not determine the voicing feature. That is, whether a consonant was voiced or voiceless. It was presumed that these errors were either due to faulty voice-onset timing or to the inappropriate presence or absence of aspiration. Place confusions, on the other hand, were those consonant errors produced by our subjects where the place of articulation was between two articulatory targets; for example, slight retraction of the tongue from the alveolar position resulting in a palatalized /s/. Both types of errors were grouped under "Phonetic Processes" rather than "Phonological Processes" since we believe these errors reflect the motoric incoordination difficulties associated with apraxia of speech.

Analysis

Two kinds of analyses were employed for determining the presence or absence of a process; non-quantitative and quantitative. For the non-quantitative analysis, the only criterion for demonstrating the presence of a process was that an error representative of that process occur once somewhere in the subject's speech sample. For the quantitative analysis, there

Table 2. Phonological and phonetic processes.

I. Phonological Processes

A. Deletion Processes
1. Final consonant deletion
2. Deletion of unstressed syllables
3. Deletion of segments

B. Cluster Reduction
1. Schwa insertion
2. Deletion of one consonant
3. /s/ deletion
4. Liquid deletion
5. Nasal reduction
   a. Nasal deletion with voiceless consonant
   b. Stop deleted when voiced
6. Substitution of one consonant

C. Substitution Processes
1. Stopping
2. Fronting
   a. Palatal + velar ⟶ alveolar
   b. ŋ ⟶ n
   c. Liquids ⟶ stops
   d. Liquids ⟶ glides
   e. Liquids ⟶ liquids
   f. Glide ⟶ fricative
   g. Denasalization
3. Syllabic liquids + nasals ⟶ vowel
4. Reduplication
5. Affrication

D. Assimilation
1. Nasal assimilation
2. Velar assimilation
3. Labial assimilation
4. Alveolar assimilation

E. Other possible processes
1. Voicing
   a. Initial position
   b. Final position
2. Spirantization
   a. Initial position
   b. Final position

II. Phonetic Processes

A. Voicing confusions (defined in text)
1. Initial position #___V
2. Intervocalic position V___V
3. Interconsonantal V(c) (c) (c) V
4. Final position V___#

B. Place confusions (defined in text)

were two criteria that a given process had to meet to be included. These criteria were: (1) The specific error representative of the process had to occur in at least four instances; and (2) if this criterion was met, the error had to be present in at least 20% of those phonemic environments in which the process could possibly occur.

Results

From this analysis three findings were obtained. First, according to the non-quantitative analysis, both apractic speakers exhibited numerous phonological and phonetic processes (Table 3). For HB, 25 different processes occurred at least once, while JT exhibited 14 different processes. It also can be seen that these processes were elicited for both subjects across all six of the process groups. That is, the subjects did not exhibit one type of phonological process exclusively. A second finding was that the presence of processes did not change as a function of experimental condition. Both subjects tended to produce essentially the same types of phonemic as well as phonetic processes regardless of whether they were speaking in front of an audience or at a faster rate of speech.

The last and probably the most important finding of this study was that few phonologic and phonetic processes produced by either subject met the quantitative criteria. For HB, of the 25 processes which met the non-quantitative criteria only two fulfilled the requirements imposed by the quantitative analysis; that is, occurred 4 times and in at least 20% of those phonemic environments in which the process could occur. For JT, of the 14 phonologic and phonetic processes found in her speech, none met the quantitative criteria. Figure 1 shows that, of those deletion and cluster reduction processes which occurred in at least four instances of either subjects' speech, none met the second quantitative criteria. In other words, none were found in more than 20% of the possible phonemic environments. Figure 2 is similar to Figure 1, with one notable exception. Of the four substitution and two assimilation processes which met the first quantitative criterion, one met the second. This was the substitution process of denasalization, which occurred in 47% of the possible phonemic environments within HB's oral readings. The remaining substitution and assimilation processes fell below the 20% level. Figure 3 shows that when the other phonologic and phonetic processes are analyzed, only one conforms to both criteria. This is the phonetic process of voice confusions produced in the initial word position. This process was found in 20% of the environments within HB's speech. None of the other phonologic or phonetic processes occurred more than 20% of the time.

In summary, of the 25 and 14 processes present in HB and JT's speech respectively only two occurred in at least 20% of the phonemic environments in which that process could occur. These were the phonologic process of denasalization and the phonetic process of voice confusion.

Conclusions

The major finding of this investigation was that, while phonologic as well as phonetic processes are present in apraxia of speech, they are neither frequently nor consistently produced by speakers with this syndrome. When arbitrary but liberal quantitative criteria are used to determine the presence of these processes, most do not meet minimum requirements for inclusion. We feel that this finding is in agreement with one of the primary characteristics associated with apraxia of speech, namely that apractic speakers produce errors which are "inconsistent and unpredictable" (Johns and Darley, 1970;

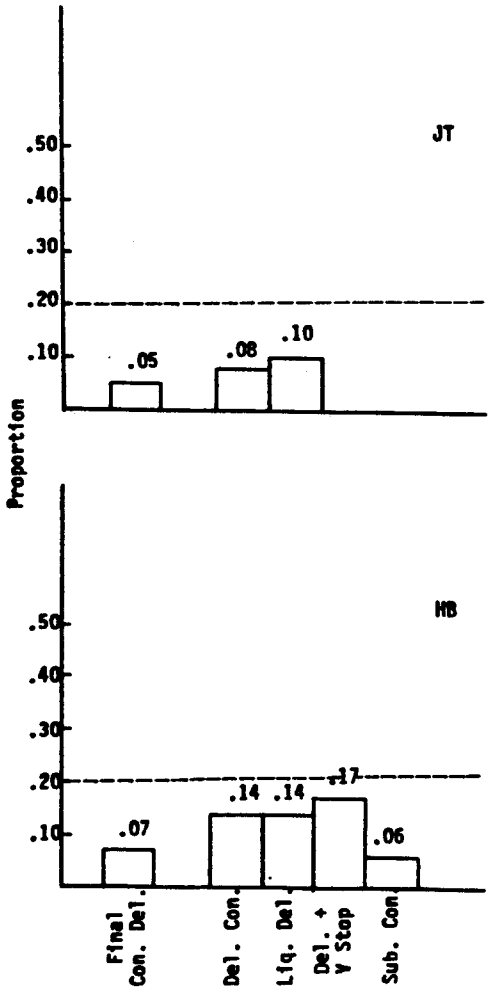

Figure 1. Deletion and cluster reduction processes produced by subjects JT and HB.

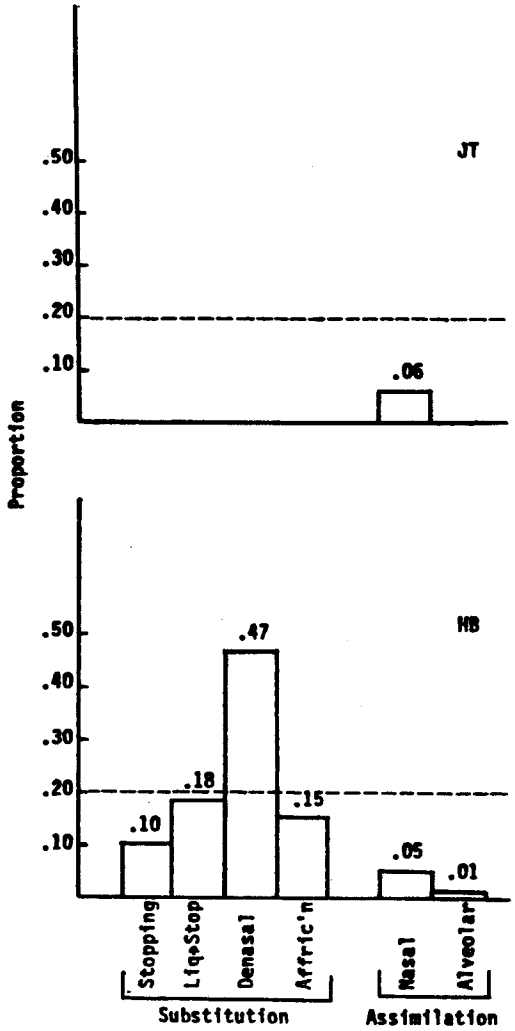

Figure 2. Substitution and assimilation processes produced by JT and HB.

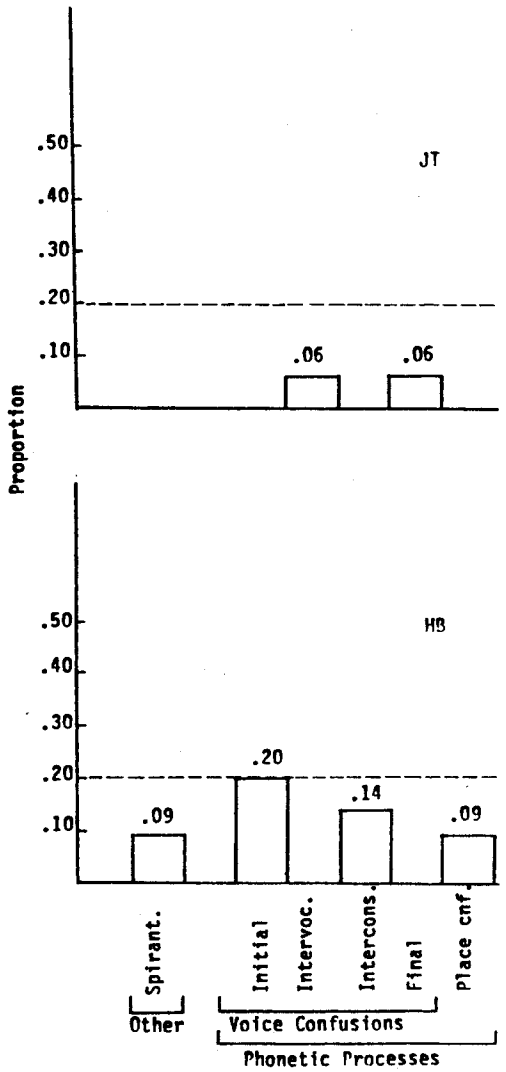

Figure 3. Other phonologic and phonetic processes produced by J and HB.

Table 3. Qualitative analysis. "X" indicates that phonological process is present in subject's speech.

I. Phonological Processes	HB	JT
A. Deletion Processes		
1. Final consonant deletion	X	X
2. Deletion of unstressed syllables	X	
3. Deletion of segments	X	
B. Cluster Reduction		
1. Schwa insertion	X	
2. Deletion of one consonant	X	X
3. /s/ deletion		
4. Liquid deletion	X	X
5. Nasal reduction		
a. Nasal deletion with voiceless consonant		
b. Stop deleted when voiced	X	
6. Substitution of one consonant	X	X
C. Substitution Processes		
1. Stopping	X	
2. Fronting		
a. Palatal + velar ⟶ alveolar	X	
b. ŋ ⟶ n	X	X
c. Liquids ⟶ stops	X	
d. Liquids ⟶ glides		
e. Liquids ⟶ liquids		
f. Glide ⟶ fricative		
g. Denasalization	X	
3. Syllabic liquids + nasals ⟶ vowel		
4. Reduplication		
5. Affrication	X	X
D. Assimilation		
1. Nasal assimilation	X	X
2. Velar assimilation	X	X
3. Labial assimilation	X	
4. Alveolar assimilation	X	X
E. Other possible processes		
1. Voicing		
a. Initial position		
b. Final position		
2. Spirantization		
a. Initial position	X	
b. Final position	X	X
II. Phonetic Processes		
A. Voicing confusions (defined in text)		
1. Initial position #___V	X	X
2. Intervocalic position V___V	X	X
3. Interconsonantal V(c) (c) (c)V	X	X
4. Final position V___#	X	X
B. Place confusions (defined in text)	X	

Mlcoch, Darley, and Noll, 1982). At best, a phonological process analysis can only provide us with trends. Even so, trends associated with articulatory skills of apractic speakers are few. Only two processes found in one subject's speech met the criteria imposed by a liberal quantitative analysis. That is, the articulatory behavior of our apractic speakers did not appear to be rule governed; at least not in a phonologic sense.

The clinical utility of a phonologic process analysis as it pertains to the description or treatment of apraxia of speech is questionable. Since apractic speakers (at least the ones we employed) produced inconsistent phonological processes, it is doubtful that the clinical aphasiologist could utilize this information planning treatment. The articulation errors produced by the apractic speaker seem unpredictable, and so are the processes that underlie them. Phonologic process analysis does not appear to be an efficient clinical tool for description and treatment of apractic speech.

REFERENCES

Bowman, C.A., A process analysis of verbal apraxia. In R.H. Brookshire (Ed.), Clinical Aphasiology: Conference Proceedings. Minneapolis, MN: BRK Publishers, 1982.

Duffy, J.R., and Keith, R.L. Performance of non-brain injured adults on the PICA: Descriptive data and a comparison to patients with aphasia. Aphasia-Apraxia-Agnosia, 2, 1-29, 1980.

Hodson, B.W., The Assessment of Phonological Processes. Danville, ILlinois: Interstate, 1980.

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

Johns, D.F., and Darley, F.L., Phonemic variability in apraxia of speech. Journal of Speech and Hearing Research, 13, 556-583, 1970.

McReynolds, L.V., and Elbert, M., Criteria for phonological process analysis. Journal of Speech and Hearing Disorders, 46, 197-204, 1981.

Mlcoch, A.G., Darley, F.L., and Noll, J.D., Articulatory consistency and variability in apraxia of speech. In R.H. Brookshire (Ed.), Clinical Aphasiology: Conference Proceedings. Minneapolis, MN: BRK Publishers, 1982.

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

Wertz, R.T., Keith, R.L., and Custer, P.D. Normal and aphasic behavior on a measure of auditory input and a measure of verbal output. Paper presented to the annual convention of the American Speech and Hearing Association, Chicago, 1971.

Wolk-Tuch, L., Phonological impairment in aphasia. Paper presented to the annual convention of the American Speech-Language-Hearing Association, Toronto, Canada, 1982.