Phonological Variability In Left Brain-Damaged Adults

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Introduction and Background

One aspect of the speech of left brain damaged patients that has received attention is the variability of phonological errors made by these patients. More specifically, variability of phonological errors has been described as one characteristic of apraxia of speech (Johns and Darley, 1970; Johns and LaPointe, 1976; LaPointe, 1976; Shankweiler and Harris, 1966).

Descriptively, numerous authors have referred to this variability, including Weisenberg and McBride (1935), Luria (1966), and Shankweiler and Harris (1966).

A year ago, LaPointe and Horner (1976) discussed the importance to aphasiologists of study of the phonological errors of brain-injured patients.

Purpose of the Study

The purpose of this study was to analyze the phonological variability of a group of left brain-damaged patients utilizing the analog computer to project an infinite number of stimulus (word) repetitions.

To accomplish this aim, 8 subjects whose overall PICA scores were between the 45th and 90th percentiles were asked to complete the experimental tasks. The subjects were asked to repeat each of the following stimulus words ten times in each of two counterbalanced conditions: impossibility, responsibility, snowman, gingerbread, artillery, television, Episcopalian, tornado, refrigerator and catastrophe.

The two conditions for presentation of stimulus material were: (1) Each stimulus item was played from audio-tape once and the subject was asked to repeat the word 10 times; and (2) The subject was presented each word printed on a 3 x 5 card for a period of two seconds. The subject then repeated each word ten times. All responses were recorded on a Wollensak cassette recorder, Model 2520.

Analysis

Each response was phonetically transcribed by the authors. To make a reliability comparison one complete set (10 words) was independently transcribed by each of the experimenters. A sound by sound comparison was made for each of the experimenters for each of the possible combinations of repetitions. A Pearson Product Moment Correlation (Underwood, 1954) was computed between the variability values obtained by each of the experimenters, resulting in an r of .84. The procedure used to derive variability values will be described later in this paper.

Following establishment of transcription reliability, each of the authors transcribed the responses from half of the subjects. These transcriptions were utilized to derive variability values for comparison in the following manner.

Figure 1 will be used to illustrate how subject variability values were derived. Three transcriptions are presented. The first transcription represents the target word. In the auditory condition this was the transcribed model presented on the tape. In the visual condition the target was a transcription of the word from Kenyon and Knott Pronouncing Dictionary of American English (Kenyon and Knott, 1953). Transcriptions 2 and 3 represent words as produced by the subject. Actually, there were eleven transcriptions for each subject for each condition. For explanation purposes only three transcriptions are represented on Figure 1.

To allow for comparison of all combinations of two transcriptions the 3 x 3 matrix was constructed and the sum of phonemes differing between the two transcriptions was entered in the appropriate cell. For example, the number of differing phonemes between transcription one and transcription two is two. Since there are seven phonemes in the target production of tornado each cell value was divided by seven to indicate a percent variability value. These percentages were used for all analyses.

Data Analyses and Discussion

There is indication in the literature that one might logically expect to find differences in performance on experimental tasks such as this one based on any number of possible variables such as presence or absence of apraxia of speech (Johns and Darley, 1970), anterior versus posterior lesion (Geschwind, 1972), etc. Rather than to preselect subjects on the basis of variables such as these, which is difficult at best, we selected only patients with evidence of left brain damage as indicated by hospital records.

Utilizing the mean variability percentage for each subject in each condition, the audio and visual modes were compared. The paired F tests (Tektronix, 1973) resulted in an F value of less than one (.655) and was not significant. It was concluded that the difference between the mean for the auditory condition (27.5% variability) and the visual condition (30.5% variability) were not significant.

Since it was not possible to differentiate between the auditory and visual conditions, the variability data combining both conditions was used for further analysis.

Initially, using the percent variability data, the question was asked: If factor analyzed, would the left brain damaged subjects group themselves on the basis of their variability? To answer this question the variability data were subjected to a factor analysis procedure utilizing an SPSS, Type PA 2 factor analysis computer program. Results of this analysis identified three distinct subject groups. Figure 2 represents variability performance for these groups and for all subjects combined over time.

At this point I would like to note that the data presented in Figure 2 do not represent an analog print out. Following examination of the data it was noted that the phonological variability of subjects so closely approximated linearity that projections onto future time could best be represented utilizing linear regression equations.

Table 1. Patient Identification Information

Name	Date Of Onset	Months Post Onset	Site Of Lesion	Age	Sex
G.B.	5/71	73	CVA	54	M
G.P.	6/76	12	Left temporal parietal subdural hematoma	19	M
F.M.	10/7/74	31	Left middle cerebral artery distribution	65	M
E.G.	3/20/74	38	Left CVA postoperative to coronary bypass surgery	56	M
R.J.	11/22/74	30	Left CVA	69	M
E.L.	9/72	68	Left temporal lobe abscess secondary to meningitis	55	M
C.M.	10/74	19	Left MCA thrombosis	67	F
R.S.	10/3/76	7	Left temporal and frontal parietal	80	M

GROUP I - R.S., E.G. $\overline{x}$ = 22.5 MPO
GROUP II - G.P., E.L., G.B. $\overline{x}$ = 50.67 MPO
GROUP III - R.J., C.M., F.M. $\overline{x}$ = 26.67 MPO

Table II. Percent Variability For Stimulus Items By Modality

Stimulus	Modality	Mean %
Snowman	A	6.08
Television	A	9.53
Television	V	14.22
Artillery	V	15.40
Snowman	V	15.76
Gingerbread	A	18.38
Impossibility	A	18.94
Tornado	A	19.02
Responsibility	A	19.28
Artillery	A	20.20
Responsibility	V	21.44
Impossibility	V	21.83
Tornado	V	22.14
Gingerbread	V	23.16
Refrigerator	V	23.65
Refrigerator	A	27.13
Catastrophe	V	30.84
Episcopalian	A	32.29
Catastrophe	A	33.61
Episcopalian	V	35.22

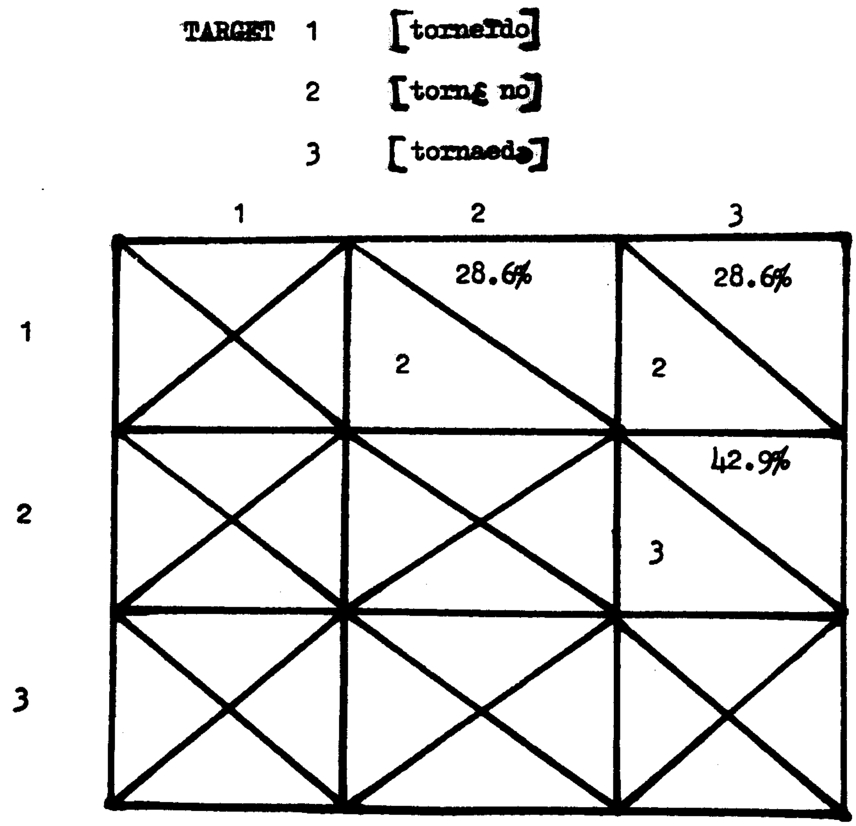

Figure 1. Matrix for determination of subject variability values.

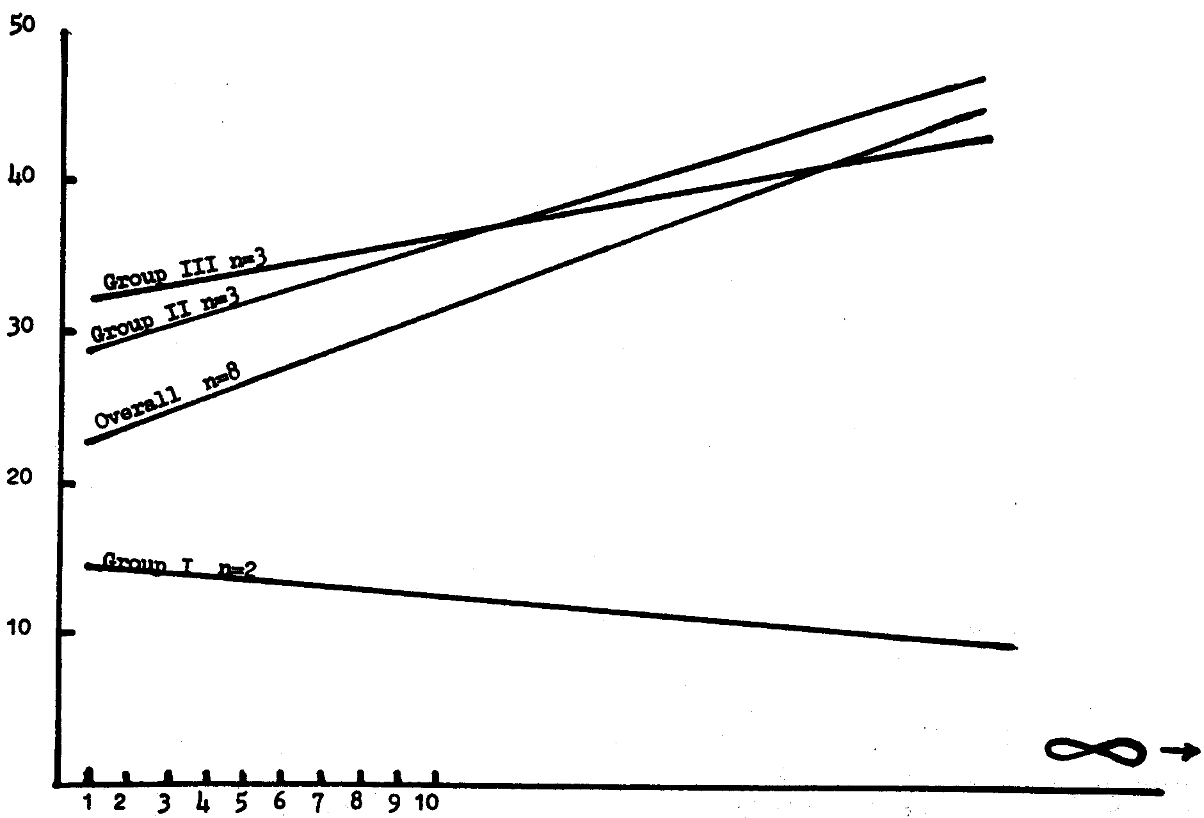

Figure 2. Variability performance for three groups of subjects identified by factor analysis and overall performance for all Ss.

From Figure 2 it can be seen that for subjects that fell into groups II and III and for the overall combined subject group the phonological variability did not decrease. It should be noted that this also indicates that the word productions did not move toward target. Over time, when performing a similar task, one would expect similar subjects to exhibit more, rather than less, phonological variability.

The two subjects in group II showed an opposite effect. These data indicate that, over time, subjects of this type would vary slowly, over considerable time, move toward zero variability and consequently to target.

The obvious question at this point is, what was the commonality within the subject groups causing them to behave as they did? Our answer can only be that we have no idea. It does not, on the surface at least, appear to be related to months post onset, age, or our sketchy site-of-lesion data. In group I we think one of the subjects would be classified as having apraxia of speech, while the other would not. These data do not appear to answer questions but do raise other questions. For example: Does site of lesion contribute to phonological variability? Is phonological variability a characteristic of specific types of communication disorders associated with left brain damage such as "apraxia of speech"? If re-examined, would we find that some patients do in fact become less variable and move toward target over time?

In our opinion these questions need continued examination.

Next, the words standardly used on the Mayo Clinic Apraxia Battery reflect phonological variability in aphasics to varying degrees. Table 2 indicates, by stimulus condition (A or V), the stimulus words and the percent of variability for each word.

Next, the factor analyses suggest a need to combine possible variables if we are to subgroup aphasic individuals.

Finally, the methodology described may be useful for evaluating the effectiveness of, and predicting the outcomes of treatment paradigms.

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Discussion

Q. How did you count the errors?

A. We tried to match the productions up - if you will go back to the first figure. We found that we could match them up and that the judges could agree on what was the difference. We thought once about doing something like a distinctive feature analysis to come up with how many feature steps away errors were. We felt that we could make this kind of judgment more easily, and we found we could do it with reliability. How did we do it? I guess that we did it operationally by practicing and developing some skills and then getting agreement.

Q. Do the data relate to the earlier information about 65% variability?

A. If you go to Table 4, those percentages represent the overall variability for each of our subjects. The problem is, how do you decide what variability is? We tried to devise a method of assignment in numerical value to state what variability is.