Phonemic Cueing: An Investigation of Subject Variables

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The clinical treatment of naming disturbances is of interest to aphasiologists because of the prevalence of naming problems in the aphasic population. One of the major approaches in naming therapy is the use of cueing. Much of the previous research on cueing has focused on the types of cues which facilitate naming. Several studies (Love and Webb, 1977; Pease and Goodglass, 1978) have demonstrated that among various cueing techniques, phonemic cueing is most beneficial for aphasic patients.

Although there has been considerable research on the cues which facilitate naming, there are few definitive data on the type of patient who benefits from cues. There is reason to believe that certain subject variables influence response to cues. One of these is type of aphasia. Pease and Goodglass (1978) found that anomic aphasic persons responded best to various cues, followed by Broca's and then Wernicke's. However, it was unclear whether diagnostic category of aphasia was the primary determinant of cueing response. The authors suggested that differences in cueing response were probably a reflection of severity of naming impairment. Because type of aphasia was confounded with severity of naming impairment in this study, it was difficult to determine the unique influence of each factor.

That type of aphasia is an important variable in cueing responsiveness is also suggested by the clinical observations of Luria (1966, 1970) and more recently of Benson (1979). For example, these authors noted that Broca's or motor aphasic patients respond well to phonemic cueing. Since these patients already possess an intact auditory image of the word, the cue serves to trigger the corresponding motor pattern.

If the phonemic cue does serve to trigger the appropriate articulatory act in Broca's aphasia, the variable of articulatory competence may be important. Patients with difficulty in articulating the target word might derive more benefit from cueing. Love and Webb (1977) presented some evidence suggesting that persons with Broca's aphasia and severe apraxia of speech respond particularly well to cueing. Another key variable which may be related to cueing is auditory comprehension. The crucial role of auditory comprehension in aphasia therapy and language recovery has been demonstrated by Schuell (1964) and others. There is reason to believe that a relationship between auditory comprehension and cueing response exists.

In summary, previous research has suggested that four subject variables (type of aphasia, severity of naming impairment, articulatory performance, and auditory comprehension level) may have important influences on responsiveness to cueing. The purpose of this study was to investigate these variables in relation to phonemic cueing, the type of cue shown to be most beneficial to aphasic patients.

METHOD

Selection of Subjects

Forty aphasic patients--10 Broca's, 10 conduction, 10 Wernicke's, and 10 anomic--served as subjects for the study. They ranged from 31 to 84 years of age with a mean age of 60.6 years. Subjects were native English speakers with a wide range of education levels (from grade school to graduate school). All were alert, cooperative, and medically stable at the time of testing. All subjects had passed an audiometric screening test at frequencies of 500, 1000, and 2000 Hz. Screening level was set at 25 dB ISO in the better ear. Only patients with unilateral left hemisphere lesions were included in the study. CVA was the cause of aphasia for thirty-five patients of the forty patients.

Type of aphasia was determined by the investigators after assessing spontaneous speech, auditory comprehension, and repetition. Criteria for classification according to speech were the six features of speech production used in the Boston Diagnostic Aphasia Examination (Goodglass and Kaplan, 1972) rating scale. The scales were applied to ten-minute samples of spontaneous speech. To assess comprehension, the Complex Ideational Materials subtest from the Boston examination was used. Since Wernicke's patients score consistently lower on the auditory comprehension subtests than patients with other aphasic syndromes (Goodglass and Kaplan, 1972), patients classified as Wernicke's aphasia were required to demonstrate negative $\underline{z}$-scores on the Complex Ideational Materials subtest. Broca's, conduction, and anomic aphasic subjects all had positive $\underline{z}$-scores.

To help differentiate conduction from anomic aphasic subjects, a repetition task was used. Conduction aphasic patients typically display repetition skills commensurate to or worse than their spontaneous speech performance (Brown, 1972; Goldstein, 1948; Benson et al., 1973). Anomic aphasia patients, on the other hand, show relatively good repetition ability (Benson and Geschwind, 1977). To assess repetition, at least four high-probability and four low-probability phrases from the Repeating Phrases subtest of the Boston examination were used.

Materials for the Naming and Cueing Tasks

The materials on two key tasks, naming and cueing, consisted of picture cards to be named. The stimuli were 4-1/2" by 2-3/4" colored drawings of objects selected from the Basic Word Making Cards (Word Making Productions, Salt Lake City). To insure that these pictures were visually unambiguous and likely to elicit consistent verbal responses, they were presented to twenty normal subjects prior to investigation with aphasic subjects. For a stimulus picture to be included in the study, 95% of the normal subjects had to provid- either the anticipated target word or an acceptable synonym. In addition, no more than 30% of the responses could be synonyms.

From the pool of available words which fulfilled the foregoing criteria, target words were selected to form two tasks: the naming task consisting of 30 words and the cueing task consisting of 124 words. The lists were constructed such that both tasks contained equal proportions of words at three frequency levels, defined by the Thorndike-Lorge Word Count (1944). One-third of the words in each task were high-frequency (the first and second thousand most frequent), one-third were middle frequency (the third and fourth thousand most frequent), and one-third were low-frequency (the fifth thousand most frequent or beyond).

The Naming Task

The aphasic subjects completed four experimental tasks. The naming task, used to assess severity of naming impairment, was composed of thirty pictures to be named on confrontation. Subjects were allowed up to thirty seconds for naming. Timing of response latency began when the picture card was presented and ended when the subject emitted his first whole-word response. Response latencies were recorded for each subject. It was desirable in the scoring procedure to separate articulatory difficulties from pure word-retrieval problems. Insofar as possible, only the latter were to be scored as errors, since the naming task was intended to tap word retrieval and not other processes involved in naming. Responses scored as errors included semantic paraphasias, neologisms, circumlocutory responses, perseverative responses, and unintelligible responses. Normal responses, as well as those marred by articulatory or syntactic errors, were all scored as correct. The percentage of words named correctly constituted the patient's naming score.

The Cueing Task

The task used to assess responsiveness to cueing was made up of 124 items. If the subject failed to name the stimulus picture correctly within a predetermined time (called the "expected response period"), the initial sound was given by the examiner. The expected response period varied depending on the individual subject. In the present study, it was important to maximize naming success before the cue was given. If the response period that is allowed for the original naming response is not of sufficient length, a simple increase in latency (produced by the cueing situation) and not the cue itself might be responsible for the naming improvement. The expected response period was determined by rank-ordering the individual subject's latencies on all correct responses from the naming task and calculating the 75th percentile latency.

The phonemic cue, given after the expected response period, consisted of an alerting signal, "Listen and watch me," followed by the initial sound of the target word. Continuant consonants and vowels were produced alone, while stop consonants were produced as a CV syllable with the schwa vowel. Following the cue, the subject was allowed a response period of a length equal to his expected response period to respond.

The cueing task continued until the subject had misnamed and been cued on twenty items or until 124 cards had been presented. For inclusion in the study, the subject was required to miss at least 15% (19 words) of the cueing task items. This was necessary so that an adequate pool of misnamed words would be available to assess responsiveness to cueing. Responses were scored as correct or incorrect in the same manner as the naming task. Percentage of correct responses on the cued items served as the cueing task score.

The Articulation Task

To obtain a measure of articulatory proficiency, a single-word repetition task was used. The use of repetition rather than spontaneous production was intended to minimize word-finding problems and focus on word-production difficulties. The test materials were twenty common words containing twenty-four different singleton consonants in at least one word position (initial, medial, or final), five consonant clusters in at least one word position, and twelve vowels and diphthongs. The subject was instructed to listen and watch the experimenter, then to repeat the word. Each stimulus word was presented once. If the subject did not respond, the word was presented again. All subjects were given the entire twenty-item test.

Performances on the articulation test were scored according to a 3-point scale. A score of 3 represented a fluent, phonetically correct response. A

score of 2 was given for productions which were easily intelligible; but in which a mild articulatory disturbance (phoneme distortion, substitution) and/or a mild dysfluency (phoneme reapproach, prolongation) was present. Responses in which intelligibility was judged to be poor because of articulatory errors (multiple phoneme substitutions) and/or marked fluency breaks were given a score of 1. The maximum score on this test was 60 points. The actual range of scores obtained was from 25 to 60.

The Comprehension Task

The Complex Ideational Materials subtest from the Boston examination, used in the classification of aphasic subjects, was also utilized as a general measure of auditory comprehension. This test assesses comprehension of sentences and paragraphs and yields a range of scores from 0 to 12 points.

RESULTS

Cueing Responsiveness and Type of Aphasia

Severity of naming disturbance was related to the dependent variable. There was a significant correlation of 0.75 ($p < .001$) between naming severity and cueing response. To ascertain whether cueing responsiveness differed among aphasic groups without the confounding effect of naming severity, it was necessary to perform an analysis of covariance with severity of naming impairment as the covariate and cueing responsiveness as the dependent variable. The raw data for each variable consisted of the percentage of correct responses for each patient on the cueing task and on the naming task. From Table 1, it can be seen that the F-ratio for aphasic groups was significant ($F = 3.50$: $df = 3, 35$: $p < .025$).

Table 1. Analysis of covariance comparing cueing responsiveness of the four aphasic groups with effects of severity of naming impairment as covariate.

Source of Variance	df	Mean Square	F-Ratio	Probability
Group	3	.079	3.50	< .025
Regression	1	.317	14.09	< .001
Within Cells	35	.023		

This indicates that even with the effects of naming severity covaried out, aphasic groups differed significantly in cueing responsiveness. Broca's aphasic subjects were most responsive to cueing and Wernicke's were least responsive, with conduction and anomic aphasic subjects between, but closer in performance to Wernicke's patients. Multiple comparisons, summarized in Table 2, through Tukey's HSD procedure, indicated that only the contrast between the Broca's and Wernicke's groups was statistically significant.

Table 2. Results of the Tukey's HSD test comparing mean cueing task scores for the four aphasic groups with naming task scores covaried out.

	Percentage Correct			
	Broca's	Conduction	Anomic	Wernicke's
Mean	61%	44%	43%	36%

NOTE: The same line underlining more than one mean score indicates that these means did not differ significantly from each other at the .05 level of significance.

Cueing Responsiveness and Severity of Naming Impairment, Articulation, and Comprehension

To evaluate how responsiveness to cueing was related to severity of naming impairment, articulatory proficiency, and auditory comprehension, a multiple regression analysis was performed. Cueing responsiveness was the criterion variable and the other three were predictor variables. The results of the analysis are summarized in Table 3. When all forty subjects were included in the analysis, the multiple R was significant ($R = .78$, $p < .001$); thus, a significant amount of variance was accounted for with three predictor variables. Among the individual predictor variables, only naming severity (beta weight[1] = .577, $p < .001$) contributed significantly toward the prediction of cueing responsiveness. Neither articulation nor comprehension were significant predictors of cueing. The finding of a significant relationship between naming severity and cueing responsiveness in the multiple regression analysis reinforced the earlier finding that these two variables were significantly correlated ($r = 0.75$, $p < .001$).

Table 3. Summary of regression of cueing responsiveness on severity of naming impairment, articulation, and comprehension for forty subjects.

Source Table						
Multiple R	R^2	Source of Variance	df	Mean Square	F-Ratio	Probability
.781	.610	Regression	3	.484	18.799	< .001
		Residual	36	.026		

Individual Predictor Variables			
Variable	Beta Weights (Standardized Regression Coefficients)	F-Ratio	Probability
Severity of Naming Impairment	.577	16.567	< .001
Articulation	.020	.022	< .884
Comprehension	.256	2.904	< .097

An examination of the comprehension and cueing scores for individual aphasic subgroups revealed a discrepancy in the direction of the correlations. Positive correlations were seen in three subgroups: Broca's and anomic aphasic subjects had moderate but nonsignificant correlation coefficients ($r = 0.62$, $p < .054$ and $r = 0.56$, $p < .089$ respectively), while conduction aphasic subjects exhibited a low correlation ($r = 0.28$, $p < .432$). In contrast to these groups,

[1] A beta weight is a standardized regression coefficient which indicates the relative and unique contribution of a particular predictor variable with the effects of the other predictor variables removed.

the Wernicke's group exhibited a negative correlation ($r = -0.24$, $p < .503$). Since the results from the Wernicke's aphasic subjects were the reverse of the other groups, a decision was made to reanalyze the data without this group.

The multiple regression procedure was performed with the same predictor and criterion variables as the previous analysis; however, only thirty aphasic patients were included, the data from the Wernicke's group being excluded. The results are summarized in Table 4. In this analysis, a signigicant amount of variance was accounted for through the use of three predictor variables ($R = .645$, $p < .003$). Both naming severity (beta weight = .537, $p < .002$) and comprehension (beta weight = .431, $p < .015$) contributed significantly to cueing responsiveness. Thus, comprehension emerged as a significant predictor of cueing responsiveness when only the Broca's, anomic, and conduction groups were considered.

Table 4. Summary of regression of cueing responsiveness on severity of naming impairment, articulation, and comprehension for ten Broca's, ten conduction, and ten anomic aphasics.

Source Table						
Multiple R	R^2	Source of Variance	df	Mean Square	F-Ratio	Probability
.645	.416	Regression	3	.168	6.168	< .003
		Residual	26	.027		

Individual Predictor Variables			
Variable	Beta Weights (Standardized Regression Coefficients)	F-Ratio	Probability
Severity of Naming Impairment	.537	12.361	< .002
Articulation	-.193	1.337	< .258
Comprehension	.431	6.853	< .015

DISCUSSION

The purpose of this study was to examine four variables related to aphasic patients' responsiveness to phonemic cueing. The finding that patients with different types of aphasia respond differently is not consistent with the findings of Pease and Goodglass (1978). These authors suggested that the apparent differences in their diagnostic groups' degree of responsiveness to cueing were merely a reflection of differences in severity of naming impairment. In the present study, however, group differences in cueing responsiveness remained even after naming severity had been covaried out of the analysis. Thus, it is probable that these differences represent genuine differences in responsiveness to cueing among aphasic groups--particularly between the Broca's

and Wernicke's groups. The superior performance of the Broca's aphasic patients relative to other diagnostic groups is consistent with the theoretical positions of both Luria (1966, 1970) and Benson (1979). These authors proposed that the auditory image of the word is relatively intact in Broca's (motor) aphasia enabling these patients to utilize phonemic cueing. A minimal cue serves to trigger the appropriate word. In contrast to this, the Wernicke's (sensory) aphasic patient is unable to use prompting (Luria, 1966, 1970). The auditory image is disrupted to such a degree that phonemic cueing does not aid in word retrieval.

Results from the multiple regression analysis indicated that severity of naming impairment had the strongest relationship to cueing responsiveness among the three predictor variables. The finding that aphasic individuals with relatively good naming skills tend to perform best on the cueing task was consistent with the results of Pease and Goodglass (1978). Clinically, it may be beneficial to reserve phonemic cueing for aphasic patients with mild to moderate naming difficulties and to use a general stimulation approach, such as Schuell's intensive auditory stimulation (Schuell et al., 1964) for those with severe anomia.

Auditory comprehension was significantly related to cueing responsiveness when three of the diagnostic groups (excluding the Wernicke's group) were considered together. A likely explanation for the positive relationship between comprehension and cueing response is the crucial role of auditory comprehension in the recovery of language processes (Schuell et al., 1964). The correlation between auditory comprehension and cueing response in the present study could be viewed as an indication that more intact patients respond better to cueing.

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Q: Did you say that for the target words that started with stops, that the phoneme cue you used was the stop phoneme plus the schwa vowel? Why did you decide to do it that way, rather than using the stop consonant and the vowel that was the appropriate one for that word?

A: This (the stop consonant and the following vowel) would have given more information than we wished. It would have constituted a syllable cue (e.g. "ba" for "baby"). We wanted to keep the plosive cue consistent with the continuant cue, in which only the initial phoneme was given.

Q: Why did you feel that the Complex Ideational Materials subtest was an adequate look at auditory comprehension?

A: It would have been ideal to administer the entire auditory comprehension battery from the Boston examination. Because of time limitations, we chose the Complex Ideational Materials subtest because three of our groups had relatively good comprehension and that test reflects enough variation among higher level patients so that there is not a ceiling effect in their scores.

Q: What was your range out of 12 points?

A: The actual scores ranged from 0 to 12.