23. The Effects of Semantic and Phonemic Prestimulation Cues on Picture Naming in Aphasia

Mark A. Stimley and J. Douglas Noll

Over the past 20 years, several studies have examined the effects of phonemic and semantic cues on visual confrontation naming in aphasia (Li & Canter, 1983; Li & Williams, 1989; Love & Webb, 1977; Pease & Goodglass, 1978; Podraza & Darley, 1977). In most cuing studies, phonemic cues involved auditory presentation of information about the first sound or sounds of a picture's name, and semantic cues took the form of an auditory description of some aspect of the object depicted in the picture to be named. Results of previous cuing studies have indicated that both types of cues significantly increase naming accuracy.

Although repeatedly demonstrating that phonemic and semantic cues facilitate naming accuracy, previous studies have generated only a minimal amount of data on which to base explanations for the effects of cues. One source of information that might prove useful in understanding the effects of cues is the analysis of errors made by aphasic subjects under different cued conditions. An examination of changes in the relative frequency of occurrence of specific error types that aphasic subjects make in response to various types of cues has the potential of providing a better understanding of the naming process, its disruption, and the effects of cues.

The present study was designed to investigate the effects of phonemic and semantic prestimulation cues on naming in aphasia. This experiment was designed to examine quantitative and qualitative effects in terms of the number of correct responses and the frequency of occurrence of specific error types that were produced in response to these two types of cues.

METHODOLOGY

Subjects were 20 aphasic adults who ranged in age from 30 to 83 years ($M = 65.5$ years). The etiology of the aphasia in all cases was a single left cerebrovascular accident. Type and severity of aphasia were determined using the *Western Aphasia Battery* (Kertesz, 1982). There were 4 Broca's, 2 transcortical motor, 2 conduction, 2 Wernicke's, and 10 anomic aphasic subjects in the experimental sample. Aphasia Quotients ranged from 46.8 to 90.4 with a mean of 71. Prior to participation in this study, each subject was screened to ensure that the subject had adequate visual perception, auditory discrimination, auditory comprehension, and naming skills to perform the experimental task.

Each subject was administered a cued visual confrontation naming test that consisted of a total of 324 stimulus items. The 324 stimulus items were created by combining 108 pictures with three different prestimulation cues. Each picture was paired with a neutral prestimulation cue, a semantic prestimulation cue, and a phonemic prestimulation cue.

The following are examples of prestimulation cues for the picture or "target word" *sock:*

> Under the *neutral* cue condition the examiner said: This is something that you will name.
>
> Under the *semantic* cue condition the examiner said: This is something that you wear on your foot.
>
> Under the *phonemic* cue condition the examiner said: This is something that starts with [s].

The presentation order of the 324 stimulus complexes was randomized to control for a number of possible confounding effects. After providing the cue, the examiner elicited a response from the subject by presenting the picture to be named and a carrier phrase designed to elicit the response. The carrier phrase that was used was, "It's a ______." Subjects were allowed up to 15 seconds to produce a response. All responses were audiotaped, but only the first response given to each stimulus item was analyzed.

Responses were analyzed using a classification system that was adapted by the investigators from classification systems used by Williams and Canter in 1982 and Kohn and Goodglass in 1985. Responses were singly coded as being self-corrects, phonemic paraphasias (e.g., *pipe* → *kipe*), phonemically and semantically related errors (e.g., *toaster* → *toast*), semantic paraphasias (e.g., *cat* → *dog*), phonemically flawed semantic paraphasias (e.g., *lion* → *miger*), morphologically and semantically related errors (e.g., *screw* → *screwdriver*), part-whole errors (e.g., *truck* → *door*), circumlocutions (e.g., *hat* → *you put it on your head*), unrelated word errors (e.g., *book* → *horse*), neologisms (e.g., *hammer* → *glocket*), perseverations, nonspecific responses (e.g., *bed* → *I have one of those, It's a big . . . , It's not a bed, or thing*), and no responses. Point-to-point intra- and interjudge reliabilities were determined to be 96% and 94%, respectively.

A series of one-factor analyses of variance (ANOVAs) with repeated measures for experimental conditions (Winer, 1971) was performed to analyze the effects of type of prestimulation cue on responses made. Individual ANOVAs were completed for each of the 13 response types. Significant *F* ratios ($p < .05$) were followed with Newman-Keuls multiple comparison tests.

RESULTS

Results of a one-factor ANOVA with repeated measures for experimental conditions on correct responses indicated that significant differences existed among experimental conditions ($F[2,38] = 5.25$, $p < .01$). Newman-Keuls multiple comparisons revealed that subjects named significantly more pictures correctly under the phonemic and semantic conditions than under the neutral condition. The difference between the phonemic and semantic conditions was nonsignificant (Table 23.1).

This pattern of response to phonemic and semantic prestimulation cues is similar to those reported in previous cuing studies (Li & Canter, 1983; Li & Williams, 1989; Love & Webb, 1977; Pease & Goodglass, 1978; Podraza & Darley, 1977). However, when compared to the effect sizes reported in other studies that have examined the effects of cues that were given after the subject made an error, the effect sizes associated with phonemic and semantic prestimulation cues are very small. The typical post-error cuing study (e.g., Li & Williams, 1989; Pease & Goodglass, 1978) reports that phonemic cues result in a 50% to 60% increase in naming accuracy, while semantic cues result in a 30% to 35% increase. The effect size associated with phonemic cues in this study was equal to only a 10% increase in naming accuracy, whereas the effect size of semantic cues in this study was equal to only a 9% increase in naming accuracy. The differences between the two sets of effect sizes (post-error vs. prestimulation cues) are most likely associated with either differences in when the cues were given or differences in scoring procedures. It is important to remember that this study (a) used prestimulation cues that may have better isolated the effects of the information contained in the cues and (b) used a scoring system that examined only the first specific response that was made to any given stimulus item.

An examination of the effects of phonemic and semantic prestimulation cues on the frequency of occurrence of specific error types revealed three significant differences.

The first significant difference involved the frequency of occurrence of semantic paraphasias ($F[2,38] = 8.69$, $p < .001$). Subjects produced significantly greater proportions of semantic paraphasias under the seman-

TABLE 23.1. RESULTS OF NEWMAN-KEULS TESTS COMPARING MEAN NUMBER OF CORRECT RESPONSES FOR THE THREE EXPERIMENTAL CONDITIONS

	Phonemic	*Semantic*	*Neutral*
Correct responses	52.8_a	51.8_a	46.5

Note: Criterion measure is number of correct responses. Means having the same subscript were not significantly different at $p < .05$.

TABLE 23.2. RESULTS OF NEWMAN-KEULS TESTS COMPARING MEAN PERCENTAGE OF SEMANTIC PARAPHASIAS, UNRELATED WORD ERRORS, AND PHONEMIC PARAPHASIAS FOR THE THREE EXPERIMENTAL CONDITIONS

	Phonemic	*Semantic*	*Neutral*
Semantic paraphasias	27.2_a	36.2	29.4_a
Unrelated word errors	26.0_b	19.3	24.6_b
Phonemic paraphasias	22.5	18.6_c	19.6_c

Note: Mean percentages are reported in the place of arcsin values. Means having the same subscript were not significantly different at $p < .05$.

tic condition than under the neutral and phonemic conditions. The difference between the phonemic and neutral conditions was nonsignificant (Table 23.2).

The second significant difference involved unrelated word errors ($F[2,38] = 7.39$, $p < .01$). Subjects produced a significantly smaller proportion of unrelated word errors in the semantic condition than in the phonemic and neutral conditions. Again, the difference between the phonemic and neutral conditions was nonsignificant (Table 23.2).

The third significant difference involved phonemic paraphasias ($F[2,38] = 4.80$, $p < .05$). Subjects produced a significantly greater proportion of phonemic paraphasias under the phonemic condition than under the semantic and neutral conditions. The difference between the semantic and neutral conditions was nonsignificant (Table 23.2).

Notice that the first two differences in the distribution of specific errors are associated with the semantic prestimulation condition alone, and the third difference is associated only with the phonemic prestimulation condition. These three sets of differences prove useful in concluding that semantic and phonemic prestimulation cues have different mechanisms responsible for their effects.

DISCUSSION

Overall, the results of this study indicate that naming performance in aphasic subjects varies as a function of the type of information provided by phonemic and semantic prestimulation cues.

The results of this study are best understood within the framework of the normal naming process. Although there currently are several models for visual confrontation naming of pictures (e.g., Ellis, 1985; Forster, 1976; Morton, 1985; Riddoch & Humphreys, 1987; Stemburger, 1985), all of them contain common elements. Minimally, these models require (a) visual analysis of the stimulus to extract visual features, (b) recognition and/or categorization of the stimulus, (c) access of semantic representations, and (d) access of corresponding phonological representations in the phonological output lexicon. These phonological representations are then used to assemble and articulate verbal responses.

Interactive or cascade models of visual confrontation naming are a class of models that allow information to be transmitted in parallel from one stage to the next before completion of processing at any single stage. As a result of this parallel transmission, the overall system is initially very "noisy," with the representations of several items at the structural, semantic, and phonological levels being activated at any given time. It has been hypothesized by Riddoch and Humphreys (1987) that as further visual processing of the stimulus items occurs, inhibition of perceptually and/or semantically similar items spreads through the system until the target item can be unambiguously named.

In normal adults, visual confrontation naming processes are completed quickly and accurately, but in the aphasic adult both speed and accuracy are diminished. As a result of various types of interference at and between stages in the naming process, errors occur (Howard & Orchard-Lisle, 1984). Within visual confrontation naming models, cues would have their effect by temporarily reducing the consequences of breakdowns or interference occurring at or between stages in the naming process.

The results of this study support the hypothesis that semantic cues influence the access of semantic representation information. Interpreted within the framework of cascade models of visual confrontation naming, activation of semantically related representations by the semantic cue facilitates subsequent activation of some of the same semantically related representations by the visual recognition/categorization system. These two forms of activation combine and increase the amount of relevant information that is available on which to base the selection of the phonological word forms. "Noise" within the visual confrontation naming system is reduced not only by further visual processing of the target item (Riddoch & Humphreys, 1987), but also by increased inhibition of semantically unrelated representations within the semantic system afforded by the semantic cue. As a result, subjects are more likely to make correct responses and semantic paraphasias, and less likely to make unrelated word errors.

Once a picture has been recognized, word-finding difficulties can arise either at the level of the semantic system or at the level of the speech output lexicon (Ellis & Young, 1988). One consequence of a breakdown at either of these levels is that the correct phonological representations of the target words are not sufficiently activated to allow production of correct verbal responses. Although semantic cues ultimately affect access of phonological word forms, these cues would not have resulted in the pattern of responses observed in this study unless they had their initial influence within a defective semantic system. If the semantic system had been working properly, increased activation of semantic representations by semantic cues would not have significantly facilitated the access of phonological forms of target words and their close semantic associates, and would not have significantly inhibited the access of phonological forms of unrelated words. The results of this study suggest that semantic cues facilitate access of phonological representations by increasing the accuracy and completeness of semantic representations used in the access process.

The effects of phonemic cues, on the other hand, appear to influence only the stage of the naming process that involves phonological aspects of selecting and producing the word-level response. In terms of the model, activation at the phonological-representation level by the phonemic cue facilitates subsequent activation by the semantic system of phonological word forms that share the phoneme presented in the cue. Activation at the phonological-representation level by the phonemic cue also inhibits activation of phonological word forms that do not share the phoneme presented in the cue. "Noise" within the visual confrontation naming system is reduced not only by further visual processing of the target item (Riddoch & Humphreys, 1987), but also by inhibition of inappropriate phonological word forms. As a result, the disordered naming system is more likely to make a response based on the appropriate phonological word form.

Although they reflected increased accuracy in selecting and/or activating correct phonological word forms, increases in phonemic paraphasias also reflected the more generalized consequences of increased activation levels of particular phonemic-level representations. Increases in the proportions of phonemic paraphasias may result from subjects producing verbalizations that have not been completely and accurately specified. The increases in phonemic paraphasias seen in this study suggest a failure to inhibit inappropriate but sufficiently activated phonemic representations that may exist either before or after the phonological word form has been correctly selected.

Howard and Orchard-Lisle (1984) note that phonemic cues could result in increased naming accuracy whether naming deficits result from failure to initiate verbal responses, raised thresholds in the output lexicon, or deficiencies in the verbal semantic system. Results of the Howard and Orchard-Lisle study suggest that phonemic cues facilitate access of phonological representations without specifying how or why access would have been insufficient without the cue.

REFERENCES

Ellis, A. W. (1985). The production of spoken words: A cognitive neuropsychological approach. In A. W. Ellis (Ed.), *Progress in the psychology of language* (Vol. 2). Hillsdale, NJ: Erlbaum.

Ellis, A. W., & Young, A. W. (1988). *Human cognitive neuropsychology.* Hillsdale, NJ: Erlbaum.

Forster, K. I. (1976). Accessing the mental lexicon. In R. J. Walker (Ed.), *Explorations in the biology of language.* Montgomery, VT: Bradford Books.

Howard, D., & Orchard-Lisle, V. (1984). On the origin of semantic errors in naming: Evidence from the case of a global aphasic. *Cognitive Neuropsychology, 1,* 163–190.

Kertesz, A. (1982). *Western Aphasia Battery.* New York: Grune & Stratton.

Kohn, S. E., & Goodglass, H. (1985). Picture-naming in aphasia. *Brain and Language, 24,* 266–283.

Li, E. C., & Canter, G. J. (1983). Phonemic cueing: An investigation of subject variables. In R. H. Brookshire (Ed.), *Clinical aphasiology* (Vol. 13, pp. 90–103). Minneapolis, MN: BRK Publishers.

Li, E. C., & Williams, S. E. (1989). The efficacy of two types of cues in aphasic patients. *Aphasiology, 3,* 619–626.

Love, R., & Webb, W. (1977). The efficacy of cueing techniques in Broca's aphasia. *Journal of Speech and Hearing Disorders, 42,* 170–178.

Morton, J. (1985). Naming. In S. Newman & R. Epstein (Eds.), *Current perspectives in dysphasia.* New York: Churchill Livingston.

Pease, D. M., & Goodglass, H. (1978). The effects of cuing on picture naming in aphasia. *Cortex, 14,* 178–189.

Podraza, B. L., & Darley, F. L. (1977). Effect of auditory prestimulation on naming in aphasia. *Journal of Speech and Hearing Research, 20,* 669–683.

Riddoch, M. J., & Humphreys, G. W. (1987). Picture naming. In M. J. Riddoch & G. W. Humphreys (Eds.), *Visual object processing: A cognitive neuropsychological approach.* Hillsdale, NJ: Erlbaum.

Stemburger, J. P. (1985). An interactive activation model of language production. In A. W. Ellis (Ed.), *Progress in the psychology of language* (Vol. 2). Hillsdale, NJ: Erlbaum.

Williams, S. E., & Canter, G. J. (1982). The influence of situational context on naming performance in aphasic syndromes. *Brain and Language, 17,* 92–106.

Winer, B. J. (1971). *Statistical principles in experimental design.* New York: McGraw-Hill.