Methodology for Assessing Auditory Comprehension of Discourse in Aphasia

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The number of papers dealing with discourse processing in aphasia has increased during the last few years. The primary reason for this shift in focus to larger chunks of language has been the inadequacy of word and sentence level measures to predict the aphasic individual's ability to communicate. In addition, it is generally acknowledged that language cannot be explained by looking primarily at the complexity of the vocabulary and length and complexity of sentences which comprise a sample of discourse (Shewan and Canter, 1971; Nicholas and Brookshire, 1983). Davis (1983) suggests that a task which creates a condition in which a correct response to a sentence depends upon integration of the sentence with its context may shed light on patients' functional communication abilities.

Purpose. The purpose of this paper is to present a methodology for assessing the ability of aphasic individuals to interpret sentences within the context in which these sentences occur. Specifically, the proposed task was used to investigate the ability of a group of moderately impaired aphasic individuals to use contextual cues to identify the antecedent and noun referent for pronouns.

Rationale. The critical dimension of discourse focused on in this experimental task was that of reference. Reference is an expression used by a speaker to identify "someone" or "something" in the world which is known or recoverable by the listener (Halliday and Hasan, 1976). Bates (1984) claims that understanding "who" did "what" is essential for the ongoing processing of discourse. In linguistic terminology, keeping track of "who" is doing "what" is called tracing reference.

In particular, the frequently occurring referential device of pronominalization was adopted for this task. Pronouns were chosen for two basic reasons. First, because pronouns convey little semantic information, these elements require that the listener go elsewhere in the context for full interpretation of the sentence. Thus, pronouns can be manipulated to create a condition in which a correct response to a sentence depends upon integration of this sentence with its linguistic or extralinguistic context. Second, pronouns appear to be particularly sensitive to language disruption, as shown in the spontaneous productions of aphasic individuals (Berko-Gleason et al., 1980; Ulatowska et al., 1983). The reported behavioral manifestations include excessive use of pronouns, pronouns without previous nominalization and infrequent reidentification of the pronoun by a noun.

Task Design. Six experimental stories were designed for this study. The stories were controlled for length and complexity. Each story had four sentences, with a mean number of 15 propositions and 45 words.

In formulating the stories, two variables were manipulated--plausibility and specificity of the referent. Plausibility is defined by the level of predictability or level of expectation of certain events being carried out by specified participants. For example, a highly plausible item would be one which had high predictability in terms of how events typically happen in the world around us. Specificity of reference was manipulated by signalling the participants by nouns in one version of the story and by pronouns in the other version.

The stories were designed such that the first sentence in the story provided the setting for the story by introducing the two participants with explicit nouns. The two participants could be signalled by the same pronoun in subsequent statements. The plausibility for the participants performing certain actions was manipulated in sentences two through four. For one of the sentences, the plausibility of a participant action was high, another was low, and for the other, both participants were equally likely. In order to disambiguate the pronouns in the low and equally plausible conditions, textual cues had to be considered to resolve the referent. For the high plausibility condition, extratextual cues could be used to determine the referent for the pronoun.

Sample Story

Pronoun Story

1. The customer shouted angrily at the waitress that the meal was awful.
2. She was new at the job and did not know how to respond.
3. She hoped the food would be better next time.
4. She was still mad and threw the food at the chef.

Noun Story

1. The customer shouted angrily at the waitress that the meal was awful.
2. The waitress was new at the job and did not know how to respond.
3. The waitress hoped the food would be better next time.
4. The customer was still mad and threw the food at the chef.

Objectives. This procedure was designed to address the following issues:

1. What, if any, differences exist in the processing of nouns versus pronouns embedded within brief narrative texts for aphasic individuals?
2. What is the effect of different types of contextual cues--specifically, textual versus extratextual cues--on identifying the antecedent and referent for pronouns?
3. What, if any, relationship exists between comprehension and production? The processing of discourse requires utilization of textual and extratextual cues. In addition, the processing of nouns and pronouns embedded within the text is necessary to fully interpret text.

Therefore, it is hypothesized that unless one can perform all four of these processes, production will be affected. Primarily, the question was, Will type of input (i.e., noun versus pronoun referent) have an affect on comprehension, and what effect, in turn, will this have on production?

Subjects. Five subjects between the ages of 45 and 65 years were selected for this study. Each of the five patients had sustained an injury to the left hemisphere. One was head trauma and four were cerebrovascular accidents. At the time of testing, the five subjects were rated as moderate on the Boston Diagnostic Aphasia Examination Rating Scale. A control group of five subjects was matched to the experimental population on the basis of gender, age and education.

Materials. The following tests were administered:

I. Standardized Diagnostic Tests
   - Language: Boston Diagnostic Aphasia Examination
     Token Test Short Form
   - Cognition: Subtests from the Wechsler Adult Intelligence Scale
     Picture Arrangement
     Digit Span
     Block Design

II. Experimental Battery: The 12 experimental stories. (6 Pronoun Stories and 6 Noun Stories)

Procedure. The standardized diagnostic tests and the experimental battery were administered in three one-hour sessions. The experimental stories were read to the subjects. Each story was presented on two different occasions. On one occasion, half of the stories were heard with all nouns and half were heard with pronouns. For the other session, the condition was reversed. The noun stories in the first session were heard with pronouns in the next session and the pronoun stories were heard with noun referents. The order of the stories was randomized across subjects and sessions. A training story was given to familiarize each subject with the task.

Following a subject's retelling of the story, the story was then visually presented to the subject, typed on a card in Orator type face. The participants were reidentified in the first sentence by explicit nouns, but there were blanks for the participants in the rest of the sentences. The subject was asked to fill in the blank as the story was read again by the examiner. The first sentence was read with the noun participants, as it was in the initial story.

Processing of Nouns Versus Pronouns

Correct versus incorrect identification of the referents in the noun and pronoun stories were tallied for all subjects. A correct response was operationally defined by the performance of normal controls. See Table 1 and Figures 1 and 2 for results.

Table 1. Number of correct responses on Referent Identification Task at three plausibility levels. (Total number of correct responses possible per condition was 30.)

Subject	Story Type	PLAUSIBILITY High	Equal	Low
Normal	Pronoun	29	28	28
Aphasic	Pronoun	22	22	16
Aphasic	Noun	27	24	25

The differences between performance on the Identification Task for Pronoun Stories and Noun Stories by the aphasic subjects in this study were tested statistically by comparing the two distributions with a chi-square test, which yielded a value of 6.16 ($p < .05$). These results suggest that aphasic individuals have significantly more difficulty determining the referent for pronouns than they do for recalling the referent when it is stated with a noun form in the text.

The differences between aphasic subjects on the Identification Task for Pronoun Stories and normal subjects on the same task were tested statistically by comparing the two distributions shown in Table 1 with a chi-square test, which yielded a value of 8.117 ($p < .05$). The results show that aphasic subjects perform poorer on identifying referents for pronouns than normal subjects do.

The differences between aphasic subjects on the Identification Task for Noun Stories and normal subjects on the Identification Task for Pronoun Stories were tested statistically by comparing the two distributions shown in Table 1 with a chi-square test, which yielded a value of 1.03 ($p < .75$).

The results show that the aphasic subjects in this study did not perform significantly worse on identifying referents expressed in noun form than normal subjects did on identifying referents expressed as a pronoun.

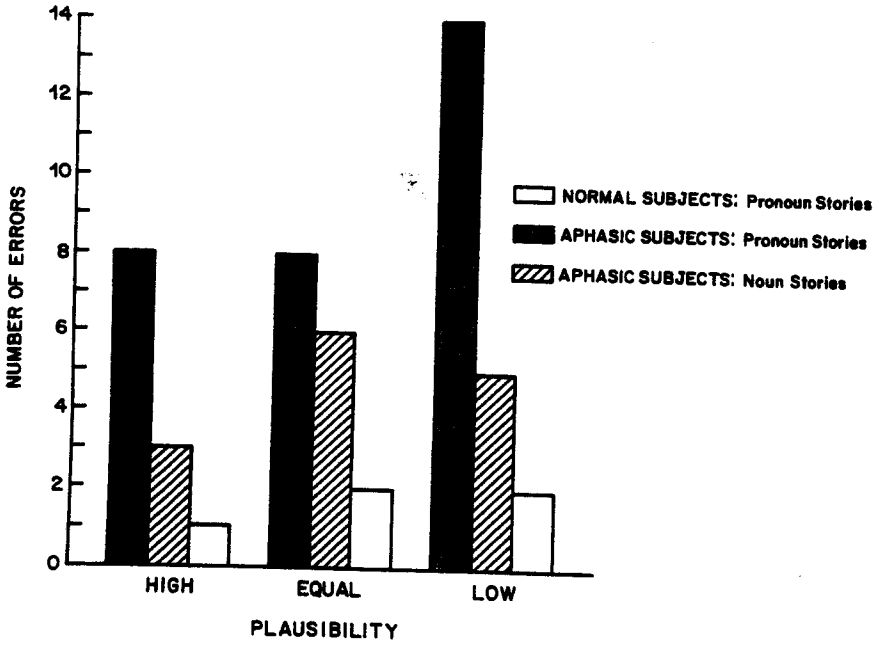

Figure 1. Numbers of errors on noun and pronoun stories of high, equal, and low plausibility for normal and aphasic subjects.

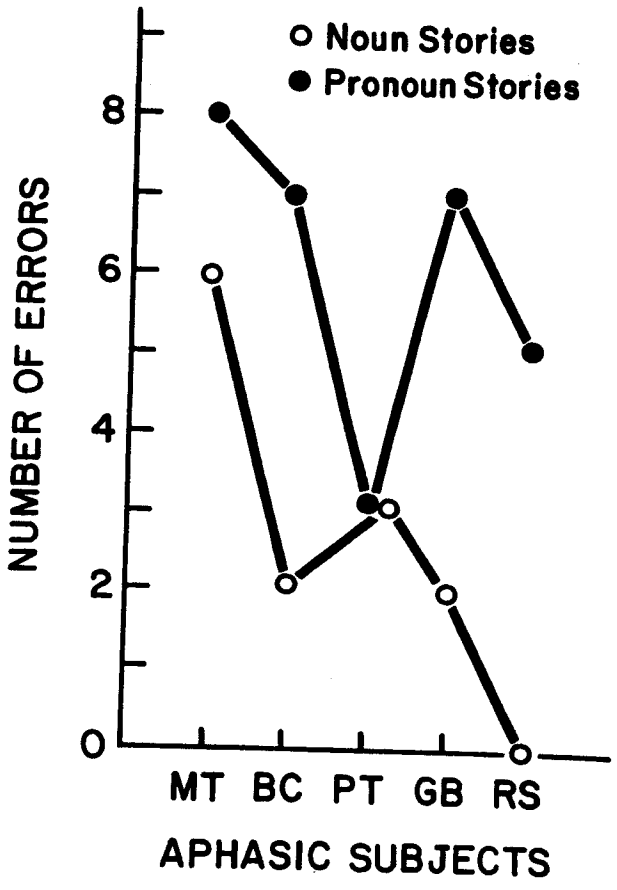

Figure 2. Number of errors on noun and pronoun stories for each of five aphasic subjects.

Subjects' incorrect responses were tallied according to the three plausibility conditions. In the high plausibility condition, the referent could be correctly resolved by using extratextual cues or knowledge of the world. In the equal and low plausibility conditions, textual cues were necessary to identify the referent. See Figure 1 for results.

These data were not tested statistically because of the small amount of data, but the following patterns were observed. (a) Aphasic individuals made more errors than normal subjects for all three plausibility conditions. (b) As expected, aphasic individuals had the most difficulty in the low plausibility condition. (c) Unexpectedly, aphasic subjects had difficulty with identifying referents which should have been accessible to them through world knowledge or extratextual cues.

Amount of Language Produced

Amount of language was assessed by counting the number of propositions. The method for segmenting the text into propositions was the method described by Kintsch and vanDijk (1978). A proposition is defined as a predicate, or relational term, and one or more arguments. Predicates may be verbs, adjectives, adverbs, or sentence connectives. The propositions were then divided into three types: (a) Propositions accurately recalled, (b) Added propositions which did not change the meaning of the text, and (c) Added propositions which changed the information presented in the text. The specificity of referents in production also was measured by calculating noun to pronoun ratios.

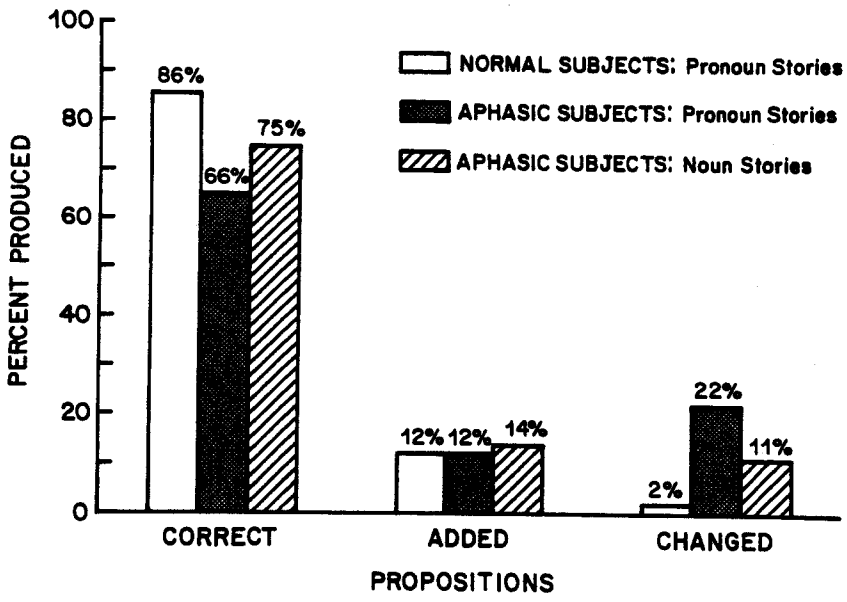

Figure 3. Percent of correct, added, and changed propositions by normal and aphasic subjects in noun and pronoun stories.

Aphasic individuals made more errors on the comprehension task for the pronoun stories (Figure 3). These subjects produced less information on the pronoun story, as well as producing a higher percentage of incorrect information than they did for noun referent stories (Figures 4 and 5). The differences on type of proposition produced between the normal subjects on the Story Recall Task on the Pronoun stories and the aphasic subjects on the noun and pronoun stories were tested statistically by comparing the distributions shown in Table 2 with a chi-square test, which yielded a value of 46.22 ($p < .001$). The results indicate that there was a difference between experimental condition and type of proposition produced.

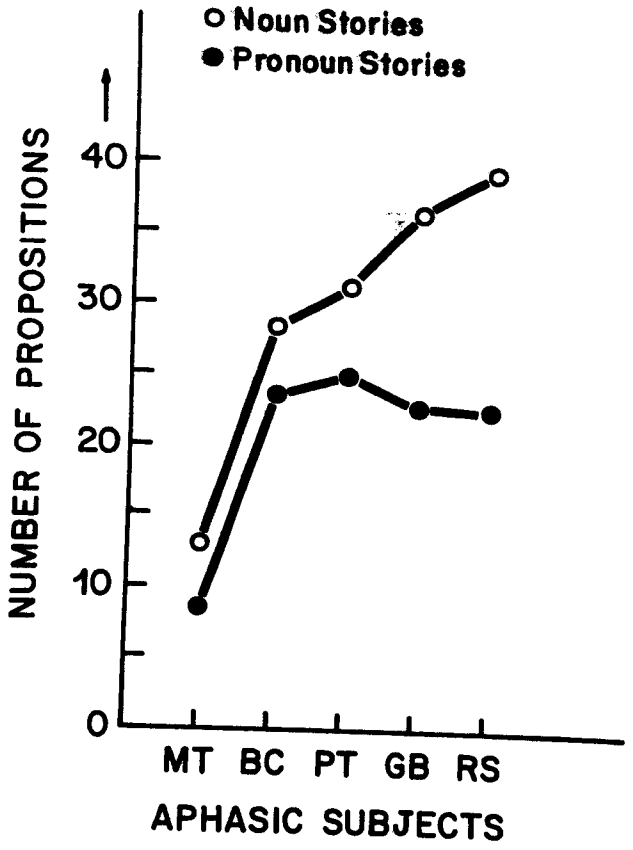

Figure 4. Number of propositions produced in noun stories and pronoun stories for each of five aphasic subjects.

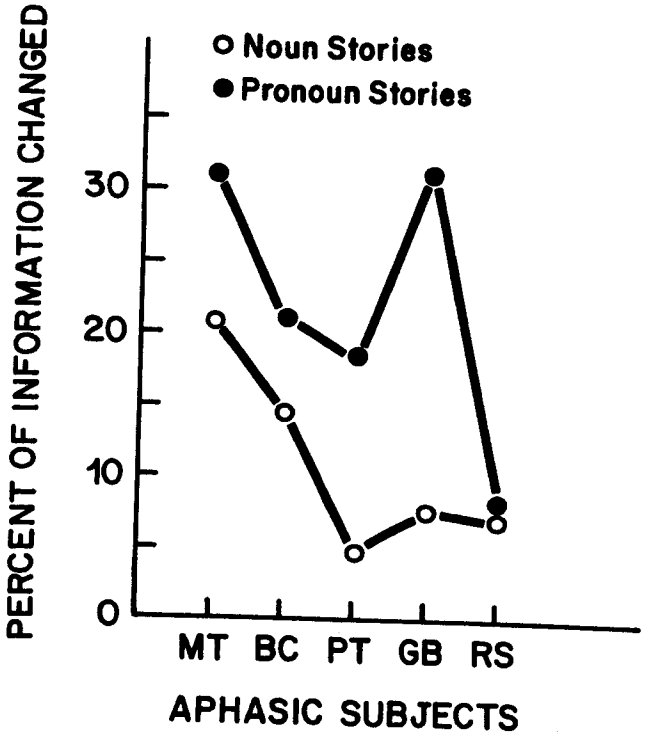

Figure 5. Percent of information changed in noun stories and pronoun stories by each of five aphasic subjects.

Table 2. Number of propositions, by category, produced on the Story Recall Task.

Subject	Story Type	TYPE OF PROPOSITION Correct	Added	Changed
Normal	Pronoun	431	62	11
Aphasic	Pronoun	103	18	35
Aphasic	Noun	147	27	21

The manner in which the referents were coded (i.e., pronoun versus noun) for input stimuli did not seem to affect the output in terms of noun to pronouns used (Figure 6).

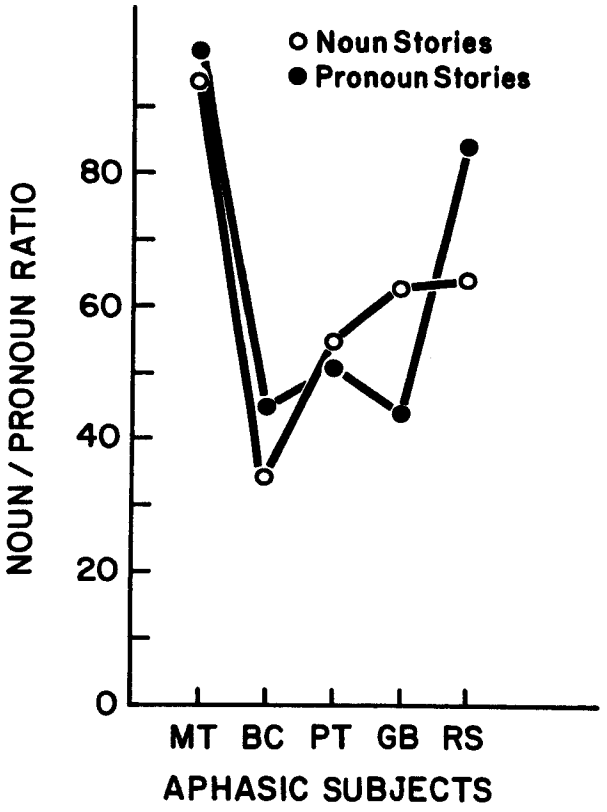

Figure 6. Noun/pronoun ratios in noun stories and pronoun stories for each of five aphasic subjects.

There is currently a need for procedures to assess the ability of aphasic individuals to process discourse. One of the major deficits in the study of language in aphasia is the lack of procedures to assess the effects of brain injuries upon natural use of language or use of language in context. Tasks are needed which require the individual to contextualize the sentences. Contextualization of sentences means that cues outside the sentence must be taken into account to allow for complete interpretation of the text. The method designed for this study is based upon linguistic principles to require contextualization of sentences for identifying the antecedents for pronouns.

At this point, the results from this study cannot be generalized because of the small sample size. However, the results suggest that the proposed procedure may be halpful in assessing the ability of aphasic individuals to

contextualize a sentence. The results of this study suggest that the more a sentence depends upon its context for full interpretation, the more difficult the text will be to process for aphasic individuals.

In conclusion, this procedure attempts to make a contribution to the complex and poorly understood process of comprehension of discourse by focusing on one critical element (reference) which is highly sensitive to language disruption. In addition, by looking at the effects of nouns versus pronouns on comprehension and production, this procedure may provide some insight into relationships which may exist between comprehension and production.

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