

10. Contextualized Sentence Comprehension in Nonfluent Aphasia: Predictiveness and Severity of Comprehension Impairment

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The pervasive role of context in language comprehension has been widely recognized (Marslen-Wilson & Tyler, 1980; Salasoo & Pisoni, 1985). Furthermore, different varieties of context (e.g., linguistic vs. extralinguistic) may make differential contributions to the comprehension process (Clark & Carlson, 1981). Recently, it has been demonstrated that prior linguistic contexts in the form of short narrative paragraphs are facilitative of aphasic persons' auditory comprehension of sentences, in comparison to similar sentences presented in isolation (Boyle & Canter, 1986; Cannito, Jarecki, & Pierce, 1986; Cannito, Vogel, & Pierce, 1989; Hough, Pierce, & Cannito, 1989; Nicholas & Brookshire, 1983). A crucial issue that has arisen in this literature concerns the predictiveness of outcome (represented in a target sentence) from the information contained in the preceding paragraph (Huber, 1990): Does the context enhance sentence comprehension *per se*, or "merely provide enough information to make those sentences superfluous" (p. 159)?

In the Cannito and colleagues (1986) study, the paragraphs were all determined to be nonpredictive on logical grounds by consensus of three judges, but degree of predictiveness was not determined empirically. Boyle and Canter (1986) observed that when results from highly predictive paragraphs were excluded from their analysis, the contextual facilitation effect failed to achieve statistical significance. Because of this, these authors argued that it was not comprehension of the target sentence that had been enhanced, but, rather, the aphasic subjects had inferred the

outcome from predictive information in the antecedent text. It should be recognized, however, that the predictive-versus-nonpredictive contrast had not been treated systematically within their overall research design, and that removal of test items in itself decreased the possible range of accuracy scores, making it more difficult to achieve statistical significance.

Hough and colleagues (1989) examined the comprehension performance of "low-comprehension" aphasic patients across isolated reversible passive sentences and similar sentences embedded in paragraphs that had been empirically determined to contain high or low levels of predictive information content. They found a significant facilitation effect on sentence comprehension for both predictive and nonpredictive paragraph contexts. This effect was more stable for the predictive contexts in that 20% of the subjects did not benefit from nonpredictive contexts. Furthermore, two subjects with Wernicke's aphasia did not benefit from context.

Nevertheless, significant facilitation for nonpredictive paragraphs is important because it suggests that aphasic subjects were able to capitalize on linguistic information other than predictiveness that was present in the prior context. It was the purpose of this study to replicate and extend the work of Hough et al. (1989) by administering the original stimulus materials to a new subject group restricted to nonfluent aphasics, who were subdivided into moderate and severe levels of auditory comprehension impairment.

METHOD

Subjects

Fourteen male aphasic subjects receiving speech-language therapy in a large Veterans Administration hospital served as subjects. Each had suffered a single, unilateral left-hemisphere cerebrovascular accident. All were premorbidly right handed and were reportedly able to read and write prior to the stroke. Their clinical characteristics are summarized in Table 10.1. The mean age at onset of aphasia was 59.6 years with a standard deviation of 5.4. All subjects had moderate to severe auditory comprehension deficits and nonfluent speech production as demonstrated by the *Boston Diagnostic Aphasia Examination (BDAE)* (Goodglass & Kaplan, 1983). All received a combined score of less than 22 on the *BDAE* Complex Materials and Oral Commands subtests but were able to identify the nouns used in the experimental task when named by the examiner with at least 80% accuracy. Hearing assessments performed within 1 week prior to participation in the study assured that subjects' speech reception

TABLE 10.1. APHASIC SUBJECT CHARACTERISTICS

<i>Subject Number</i>	<i>Age at Onset</i>	<i>Weeks Post-Onset</i>	<i>Comprehension Level^a</i>
1	56	4	8
2	52	68	15
3	62	11	5
4	58	21	9
5	50	74	7
6	63	2	3
7	61	10	9
8	65	2	18
9	65	118	22
10	63	6	11
11	56	2	2
12	53	5	5
13	67	4	17
14	64	9	6

^aSum of *Boston Diagnostic Aphasia Examination* complex ideational materials and oral commands subtests.

thresholds (SRT = average thresholds of 500 Hz and 1 kHz - 2 dB) were no poorer than 40 dB in the better ear. Severity subgroups were defined on the basis of a composite comprehension score greater than or less than 10 points. Five subjects were classified as moderately auditory comprehension impaired and nine as severely impaired.

Materials

Details of the development of the stimulus materials were originally provided by Hough and colleagues (1989). Materials consisted of 10 items in each of three conditions: (a) reversible passive sentences presented in isolation, (b) reversible passive sentences preceded by paragraphs that did not predict the specific subject-object relationships of the target sentences, and (c) reversible passive sentences preceded by paragraphs that did predict the specific subject-object relationships of the target sentences. Sample paragraphs are provided in Figure 10.1. The level of predictiveness for each paragraph had been established on the basis of ratings by 32 normal subjects using a 5-point ordinal scale. Only paragraphs with extreme ratings were included as experimental items. Distracter items consisting of active sentences in isolation and preceded by

Nonpredictive Context

Many kings and queens were partying in a garden. This garden was filled with visiting royalty. Suddenly, a king began walking toward an old friend among the royalty. Soon there was a polite kiss in the courtyard. *The king was kissed by the queen.*

Predictive Context

Many kings and queens were partying in a garden. This garden was filled with visiting royalty. Suddenly, a king saw someone whom he loved very much. Soon there was a polite kiss in the courtyard. *The queen was kissed by the king.*

Figure 10.1. Sample paragraphs.

paragraphs (with intermediate predictiveness ratings) were added to create a 45-item test. Two different test versions were constructed such that specific passive sentences occurred under a different paragraph condition within each version. Stimuli were fully randomized within each version.

Procedures

Subjects were tested individually via live voice in a quiet room. The examiner read each stimulus and instructed the subject to "show me what happened" by choosing between two pictures. The pictured response choices were black-and-white line drawings that depicted the two possible subject-object relations. These were exposed to the aphasic subject following the reading of the auditory stimulus (see Figure 10.2). Each test version was administered to half of the subjects. The number of correct responses for the passive sentences in each condition was tabulated for statistical analysis.

RESULTS

Means, standard deviations, and ranges for each of three contextual conditions (i.e., isolated sentences, predictive paragraphs, and non-predictive paragraphs) are presented in Table 10.2. The dependent variable was the number of correct responses, of a possible 10, in each condition. It was evident that mean accuracy was increased for the predictive contexts and that for this condition the entire scoring distribution was displaced in the positive direction, relative to both isolated sentences and



Figure 10.2. Line drawings illustrating the two possible subject-object relations for "The king was kissed by the queen" and "The queen was kissed by the king."

TABLE 10.2. SUMMARY STATISTICS FOR 14 NONFLUENT APHASIC SUBJECTS IN THREE CONTEXTUAL CONDITIONS

<i>Group</i>	<i>Isolated Sentences</i>	<i>Predictive Context</i>	<i>Nonpredictive Context</i>
<i>Low Comprehension^a</i>			
\bar{X}	4.00	5.22	4.44
SD	1.19	1.09	1.33
<i>High Comprehension^b</i>			
\bar{X}	5.60	6.80	4.20
SD	1.14	0.84	1.30
<i>Total</i>			
\bar{X}	4.57	5.79	4.38
SD	1.34	1.25	1.28
Range	2-7	4-8	3-7

^a*n* = 9. ^b*n* = 5.

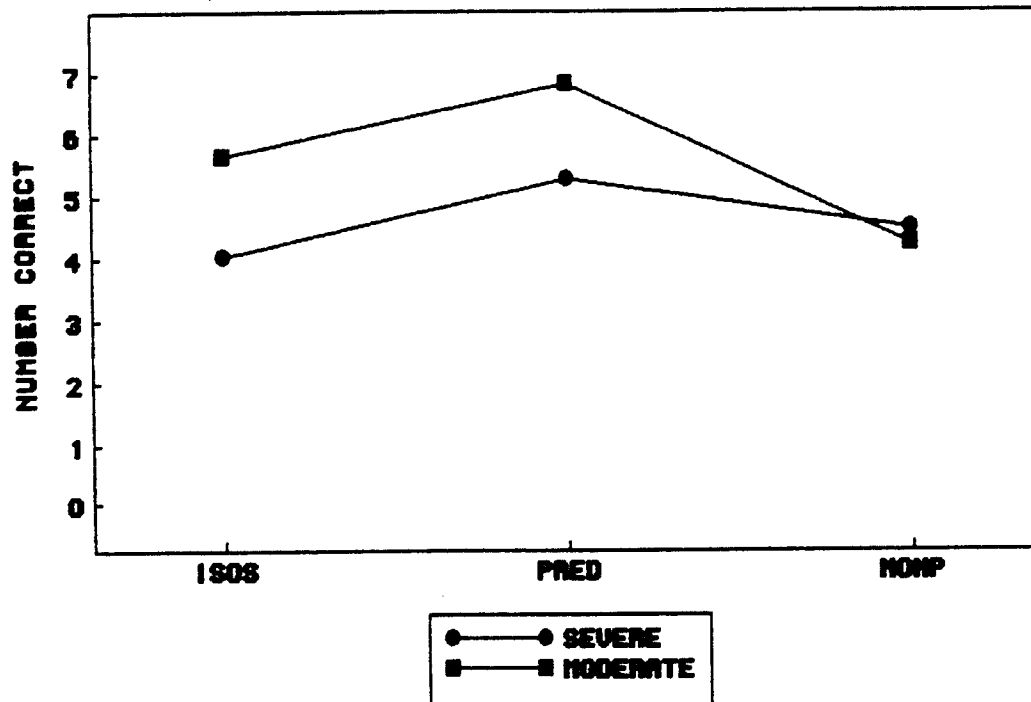


Figure 10.3. Plot of interaction of comprehension subgroup (moderate vs. severe) by type of context (isolated sentence vs. predictive paragraph vs. non-predictive paragraph).

nonpredictive contexts. To assess the statistical significance of these observations and explore potential interactions on the basis of severity of auditory comprehension impairment, the data were subjected to a two-way repeated-measures analysis of variance (Winer, 1971), consisting of two comprehension levels by three contextual conditions (see Figure 10.3). Results indicated significant main effects for comprehension severity level ($F = 4.80$; $df = 1,12$; $p \leq .049$) and for contextual condition ($F = 9.17$; $df = 2,24$; $p \leq .001$), as well as a marginally significant interaction ($F = 3.39$; $df = 2,24$; $p \leq .05$) of comprehension severity with contextual condition. As expected, the moderately comprehension-impaired subjects were significantly more accurate, overall, than the severely impaired. Newman Keuls post hoc comparisons revealed that predictive contexts differed significantly from both isolated sentences and nonpredictive contexts ($p < .01$). In addition, both comprehension severity groups performed better for predictive contexts than for isolated sentences ($p < .05$). While the severely comprehension-impaired subjects understood isolated sentences and those in nonpredictive contexts equally poorly, the moderately comprehension-impaired group exhibited significantly less accuracy for sentences in nonpredictive contexts than for

TABLE 10.3. CORRELATIONS AMONG EXPERIMENTAL AND SUBJECT VARIABLES FOR 14 APHASIC SUBJECTS

	<i>ISOS</i>	<i>PRED</i>	<i>NONP</i>	<i>COMP</i>	<i>AAO</i>
<i>PRED</i>	.582*				
<i>NONP</i>	.231	-.093			
<i>COMP</i>	.660**	.725**	.021		
<i>AAO</i>	.535*	.418	.086	.397	
<i>WPO</i>	.070	.280	.258	.520*	-.214

Note: *ISOS* = isolated sentences, *PRED* = predictive contexts, *NONP* = nonpredictive contexts, *COMP* = composite comprehension score, *AAO* = age at onset, *WPO* = weeks post-onset.

* $p < .05$. ** $p < .01$.

isolated sentences. In contrast to the moderately impaired subjects, for the severely impaired group nonpredictive contexts represented an intermediate level of performance accuracy (between that of isolated sentences and that of predictive contexts) that did not differ significantly from either of the other two conditions. The severity subgroups differed from each other on isolated sentences and predictive contexts, but not on the nonpredictive contexts. No other comparisons approached statistical significance.

Pearson product moment correlations were computed among experimental comprehension measures and aphasic subject variables. The resultant correlation matrix is presented in Table 10.3. Statistically significant relationships ($p < .05$) were obtained between isolated sentences and predictive contexts, isolated sentences and composite comprehension scores, and predictive contexts and composite comprehension scores. Isolated sentence comprehension was also correlated with age at onset. Composite comprehension scores were significantly correlated with time post-onset.

Difference scores were computed for each subject between (a) isolated sentence performance and (b) predictive context and nonpredictive context. It should be remembered that for the former predictive difference these scores were typically positive in sign, indicating improvement, whereas the latter nonpredictive difference scores were typically negative in sign, indicating decrement. Isolated sentence performance was significantly negatively correlated with both difference scores. Thus the more severe the syntactic comprehension impairment, the greater the benefit derived from predictive context and the smaller the decrement from nonpredictive context. Twelve of 14 aphasic subjects exhibited improved performance for predictive context in comparison with isolated sentences. Seven of these gained at least 2 points (20% of the possible range).

For nonpredictive contexts, three of five moderately comprehension-impaired subjects declined by at least 2 points in comparison to isolated sentences. However, three of the nine severely comprehension-impaired subjects improved by at least 2 points in comparison to the isolated sentences.

DISCUSSION

The subjects in this study benefited from paragraph contexts that established prior expectations congruent with the content of target sentences. This finding is compatible with the general premise that context can facilitate aphasic comprehension. However, when such prior expectations were not established, most of the subjects' performance was either unaffected or even further impaired by the presence of the narratives. We have argued previously that discourse context is a powerful facilitative variable that may be manipulated to advantage in aphasia therapy (Cannito et al., 1989). The present results suggest that different types of aphasic patients respond differently to different types of contexts, and that not all contextual conditions are necessarily beneficial. It is possible that contexts might be used selectively in treatment to decrease or increase the level of difficulty of otherwise similar sentence comprehension activities. The significant negative correlations observed between severity of comprehension impairment and contextual difference scores (re: isolated sentences) indicate that the more severely impaired aphasic patient is the most susceptible to the influence of contexts of this type. Similar correlations have been reported in previous research (Cannito et al., 1986; Cannito et al., 1989; Hough et al., 1989). Finally, a small number of severely comprehension-impaired subjects also appeared to benefit from the nonpredictive contexts.

It is significant that this study, although replicating the often noted facilitative effect of context in a general sense, failed to replicate the specific findings of Hough and colleagues (1989) for nonpredictive contexts. The present study, along with that of Boyle and Canter (1986), seems to suggest that inference of outcome may be the most critical factor underlying the contextual facilitation effect. In view of previous research (Cannito et al., 1986; Hough et al., 1989), however, we were in fact puzzled by this conclusion: Was the original facilitation effect for nonpredictive contexts spurious? We think not. The picture is complicated by an additional study that was recently completed. Pierce and Germani (1990) have replicated the Hough et al. (1989) results for both predictive and nonpredictive contexts for reading comprehension in aphasia. As a result, we are hesitant to dismiss the original finding as a random occurrence.

TABLE 10.4. COMPARISON OF SUBJECTS IN PRESENT STUDY WITH SUBJECTS IN TWO RECENT STUDIES DEMONSTRATING FACILITATIVE EFFECT OF NONPREDICTIVE CONTEXT

<i>Study</i>	<i>Time Post-Onset, in Months</i>	<i>Comprehension Score</i>
Cannito, Vogel, & Pierce (1989) ^a	5	9.8
Hough, Pierce, & Cannito (1989) ^a	31	13.8
Pierce & Germani (1990) ^b	11	20.6

^aAuditory comprehension experiment. ^bReading comprehension experiment.

Therefore, we deemed it instructive to reexamine the clinical characteristics of the aphasic subjects in these studies. Summary statistics for months post-onset and composite comprehension scores are provided in Table 10.4 for the three most directly comparable studies.

It is of interest that Hough and colleagues' (1989) and Pierce & Germani's (1990) subjects were considerably farther along post-onset than the subjects in the present study. The difference is statistically significant. Our subjects' auditory comprehension was also somewhat more severely impaired. It is notable that auditory comprehension was significantly correlated with time post-onset in the present study, but not in that of Hough and colleagues (1989).

Given these observations, we hypothesize that the lack of facilitation afforded by nonpredictive contexts in the present study may be a direct consequence of the short post-onset course of these aphasic subjects. It is striking that even very severely impaired patients, soon after onset, were able to make use of the powerful explicit cues that were available in the predictive contexts. It is not surprising, however, that such patients lacked the cognitive and linguistic capacity to utilize less explicit forms of discourse information (e.g., schematic, thematic, or referential content) to assist in sentence processing. Perhaps some of these subjects were additionally compromised by edema and diaschisis prior to spontaneous recovery, or perhaps compensatory reliance on suprasentential information only develops later in recovery. Such questions underscore the need for continued research into this interesting and potentially useful neuro-linguistic phenomenon.

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