

Time Post Onset and Contextualized Sentence Comprehension in Nonfluent Aphasia

Michael P. Cannito, Deanie Vogel, Robert S. Pierce,
and Monica Hough

Most speech-language pathologists accept that aphasic patients, like normal listeners, can use contextual information to comprehend auditory sentences (Huber, 1990). Numerous studies have demonstrated that aphasic subjects perform significantly better on picture pointing tasks that assess auditory comprehension of difficult sentences when those sentences are embedded at the end of narrative paragraphs than when they are presented in isolation (Boyle & Canter, 1986; Cannito, Jarecki, & Pierce, 1986; Cannito, Vogel, & Pierce, 1989; Hough, Pierce, & Cannito, 1989; Nicholas & Brookshire, 1983). However, controversy concerning the predictiveness of outcome (represented in a target sentence) has arisen: Does the context enhance sentence comprehension *per se*, or "merely provide enough information to make those sentences superfluous" (Huber, 1990)?

Facilitation from predictive contexts can be attributed to inferential processes, but other factors, such as depth of semantic processing, memory, and attention, must be invoked to explain facilitation based on nonpredictive contexts (Cannito et al., 1989; Hough et al., 1989). The facilitative effect of predictive contexts is now well established; however, findings for nonpredictive paragraph contexts have remained equivocal. Recently, Cannito, Vogel, & Pierce (1991) failed to replicate a significant facilitative effect of nonpredictive paragraphs reported by Hough et al. (1989) in a group of nonfluent aphasic subjects using materials and procedures identical to those of the original study. The aphasia's average time post onset differed significantly between studies, leading Cannito et al. (1991) to hypothesize that the lack of facilitation afforded by the nonpredictive contexts may be due to the short post onset course of their aphasic subjects' recovery. The average time post onset for the Hough et al. (1989) sample was 31 months, whereas for the Cannito et al. (1991) sample it was 5 months.

The present study evaluated this hypothesis by comparing the auditory comprehension of nonfluent aphasic subjects, for isolated versus narrative embedded sentences, across three duration groupings of time post onset of aphasia by pooling the data from the Hough et al. (1989) and Cannito et al. (1991) studies.

METHOD

Twenty-three aphasic patients who have suffered a single left hemisphere cerebrovascular accident (CVA) served as subjects. Their clinical characteristics are summarized in Table 1. All exhibited moderate-to-severe auditory comprehension deficits and nonfluent speech production as demonstrated

TABLE 1. APHASIC SUBJECT CHARACTERISTICS

<i>Subject Number</i> ¹	<i>Gender</i>	<i>Age at Onset</i>	<i>Months Post Onset</i>	<i>Comprehension Level</i> ²
1	M	56	1	8
2	M	52	17	15
3	M	62	3	5
4	M	58	5	9
5	M	50	19	7
6	M	63	<1	3
7	M	61	3	9
8	M	65	<1	18
9	M	63	2	11
10	M	56	<1	2
11	M	53	1	5
12	M	67	1	17
13	M	64	2	6
14	M	70	4	3
15	M	62	10	11
16	M	47	8	10
17	F	62	42	20
18	M	64	1	17
19	M	64	5	21
20	F	64	7	8
21	M	50	4	6
22	M	60	6	9
23	M	64	14	12

¹Subjects 1-14 are from Cannito, et al., (1991); subject 15 is a new subject not previously reported; subjects 16-23 are from Hough et al. (1989).

²Sum of *BDAE* complex ideational materials and oral commands subtests.

TABLE 2. SAMPLE PARAGRAPHS*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.*

by the Boston Diagnostic Aphasia Examination (BDAE) (Goodglass & Kaplan, 1983). Screening established that the subjects could identify the nouns used in the experiment with 80 percent accuracy. Each subject was assigned to one of three time post onset groupings: acute (0-4 weeks), post acute (6 weeks-6 months), and chronic (greater than 6 months). The mean age of the aphasic sample was 59.87 years (S.D. = 6.04) and the mean composite BDAE comprehension score was 10.09 (S.D. = 5.55). One way analysis of variance (ANOVA) yielded no significant differences ($p > .40$) between time post onset subgroups for either of these variables. The mean time post onset of the acute group ($n = 7$) was .83 months; the post acute group ($n = 9$) was 3.78 months; the chronic group ($n = 7$) was 16.71 months.

Materials consisted of 10 items in each of three stimulus conditions: (1) reversible passive sentences presented in isolation, (2) reversible passive sentences preceded by paragraphs that predicted the outcome of the target sentences, and (3) reversible passive sentences preceded by paragraphs that did not predict the outcome of the target sentences (see Table 2). Paragraph predictiveness was empirically determined on the basis of ratings obtained from normal judges. Distractor items consisting of active sentences, both in isolation and preceded by paragraphs were added to create a 42-item test with fully randomized order of item presentation. See Hough et al. (1989) for details of stimulus development. The examiner read each stimulus aloud and instructed the subject to "show me what happened" by choosing between two pictures. Numbers of correct responses for passive sentences in three contextual conditions were tabulated.

RESULTS

Means, standard deviations, and ranges for each of three contextual conditions are presented in Table 3. Results of a two-way repeated measures

TABLE 3. SUMMARY OF DESCRIPTIVE STATISTICS FOR THREE CONTEXTUAL CONDITIONS

	<i>Isolated Sentences</i>	<i>Predictive Context</i>	<i>Nonpredictive Context</i>
	<i>Acute Group (n = 7)</i>		
\bar{x}	4.29	5.43	4.29
S.D.	1.60	1.81	0.95
Range	2-7	4-9	3-6
	<i>Post Acute Group (n = 9)</i>		
\bar{x}	4.44	6.11	4.67
S.D.	4.92	1.05	1.80
Range	2-7	5-8	3-7
	<i>Chronic Group (n = 7)</i>		
\bar{x}	2.86	6.00	6.57
S.D.	1.21	2.08	1.81
Range	1-4	3-9	4-10
	<i>All Groups Combined (n = 23)</i>		
\bar{x}	3.83	5.88	5.04
S.D.	1.55	1.57	2.60
Range	1-7	3-9	3-10

ANOVA (time post onset grouping X contextual condition; Winer, 1971) indicated a significant main effect for contextual condition ($F = 9.92$; $df = 2,40$; $p < .001$) and significant interaction of time post onset with contextual condition ($F = 3.57$, $df = 4,40$; $p = 0.14$). Post hoc comparisons (Tukey's HSD) indicated that for all subjects combined both predictive and nonpredictive contexts resulted in significantly better subject performance than the no context condition ($p < .05$). Simple effects were analyzed to explore the context by time post onset interaction. There was no significant effect of context in the early acute stage ($F = 1.31$; $df = 2,40$; $p = .282$), a marginally significant effect of context in the post acute stage ($F = 3.16$; $df = 2,40$; $p = .053$), and a highly significant effect of context in the chronic stage ($F = 12.02$; $df = 2,40$; $p < .001$). The time post onset subgroups differed significantly from each other only in the nonpredictive context condition ($F = 4.65$; $df = 2,60$; $p = .013$). These relationships are depicted in Figure 1. In the acute stage, performance was somewhat superior in the predictive contexts, but this difference did not achieve statistical significance. In the post acute stage, performance was similarly low for the isolated sentences and nonpredictive contexts but markedly enhanced for the predictive contexts. In the chronic stage, performance for predictive contexts remained high, but nonpredictive contexts were enhanced and accompanied by a decline for the isolated sentences.

Difference scores reflecting amount of facilitation gain were computed for each subject by subtracting the number correct in the isolated sentence

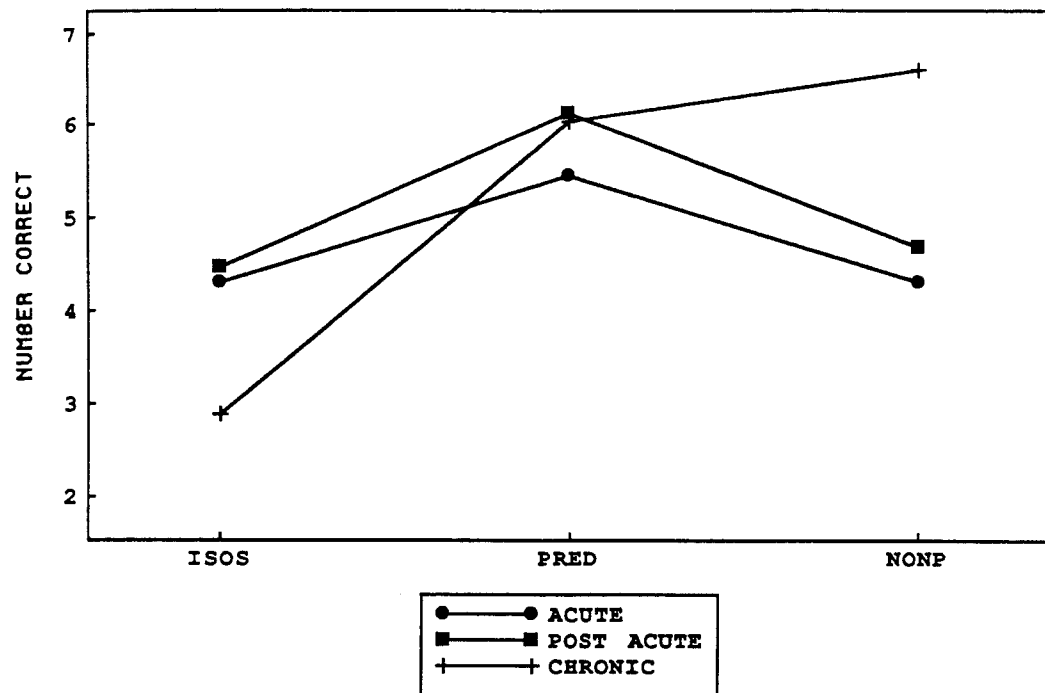


Figure 1. Interaction of time post onset groupings with contextual conditions of isolated sentences (ISOS), predictive paragraphs (PRED), and nonpredictive paragraphs (NONP).

condition from the number correct in each paragraph condition. Regression analysis revealed a significant positive, linear relationship between time post onset stage and amount of contextual facilitation for nonpredictive paragraphs ($F = 9.42$; $df = 1.21$; $p = .006$) (Figure 2). More than 30 percent of the variance in facilitation gain for nonpredictive contexts was accounted for on the basis of time post onset. Table 4 provides a statistical summary of the difference score data for contextual conditions in each subgroup.

Pearson product moment correlation coefficients were computed for all subjects combined for comprehension performance in the three contextual conditions, contextual facilitation gain scores, and subject variables of age, months post onset, and *BDAE* composite comprehension scores. Table 5 provides the resultant correlation matrix. No significant correlations were observed among performance in the three contextual conditions. Isolated sentences were negatively correlated ($p < .01$) with contextual facilitation gain scores from both paragraph context conditions. Contextual facilitation gain scores from the two paragraph context conditions were positively correlated ($p < .01$) with each other. *BDAE* composite comprehension scores exhibited moderate positive correlations with predic-

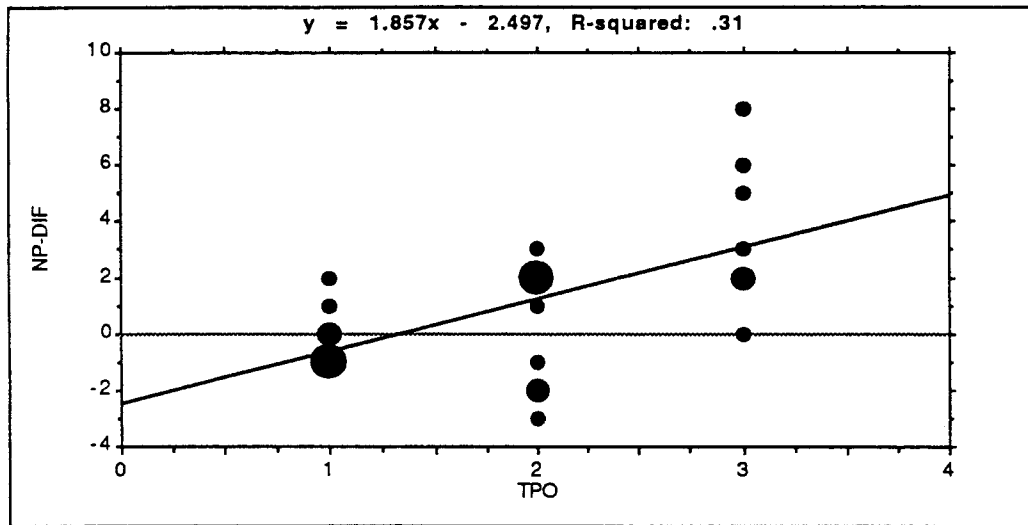


Figure 2. Scatterplot and regression analysis of the difference scores for non-predictive contexts (NP-DIF) across three time post onset (TPO) conditions. Enlarged circles indicate overlapping data points.

TABLE 4. MEAN CONTEXTUAL FACILITATION SCORES^a FOR TWO PARAGRAPH CONDITIONS IN THREE POST ONSET OF APHASIA SUBGROUPS: ACUTE (0-4 WEEKS), POST ACUTE (6 WEEKS-6 MONTHS), CHRONIC (GREATER THAN 6 MONTHS)

<i>Group</i>	<i>Predictives</i>	<i>Nonpredictives</i>
Acute	1.14 (2.73) ^b	0.00 (1.16)
Post Acute	1.67 (1.50)	0.22 (3.22)
Chronic	2.29 (3.54)	2.57 (3.65)
Combined	1.96 (2.46)	1.22 (2.66)

^aContextual facilitation equals number correct in paragraph contexts minus number correct for isolated sentence.

^bStandard deviations are given in parentheses.

tive and nonpredictive contexts and contextual facilitation gain scores for the predictive paragraph condition. Age was not correlated with any other variable.

DISCUSSION

The present findings support the hypothesis stated at the outset. The degree to which nonpredictive contexts facilitated auditory sentence com-

TABLE 5. CORRELATION MATRIX OF EXPERIMENTAL AND SUBJECT VARIABLES FOR 23 APHASIC SUBJECTS

	<i>ISOS</i>	<i>PRED</i>	<i>NONP</i>	<i>NP-DIF</i>	<i>PR-DIF</i>	<i>MPO</i>	<i>COMP</i>
<i>PRED</i>	-.226						
<i>NONP</i>	-.257	.334					
<i>NP-DIF</i>	-.752**	.358	.830**				
<i>PR-DIF</i>	-.772**	.794**	.378	.703**			
<i>MPO</i>	-.389	.405*	.653**	.670**	.508*		
<i>COMP</i>	-.154	.497*	.405*	.365	.420*	.384	
<i>AAO</i>	.097	.298	.196	.078	.134	-.154	.238

ISOS = isolated sentences, *PRED* = predictive contexts, *NONP* = nonpredictive contexts, *NP-DIF* = difference score for nonpredictive contexts minus isolated sentences, *PR-DIF* = difference score for predictive contexts minus isolated sentences, *COMP* = composite comprehension score, *MPO* = months post onset, *AAO* = age at onset.

* $p < .05$

** $p < .01$

prehension was related to time post onset of aphasia. In addition, the ability to benefit from predictive contexts, while present early in recovery, continued to increase over time. It is striking that even very severely impaired patients were able, soon after onset, to make use of the powerful inferential cues that were available in the predictive contexts. Only at later stages of recovery, however, were patients able to make use of less explicit forms of contextual information (thematic, schematic, or referential content) to assist in sentence processing.

An overall finding of significant benefit of antecedent narrative context, regardless of whether the narratives were predictive or nonpredictive of the semantic content of the target sentence, is congruent with earlier reports by Hough et al. (1989) and Pierce and Germani (in press). This disparity regarding the facilitative influence of nonpredictive contexts, with findings reported by Cannito et al. (1991) does indeed appear to be a consequence of the patient samples' time post onset. The present data indicate that while predictive contexts were significantly facilitative by six weeks post onset, nonpredictive contexts did not emerge as a facilitator until six months or later in the recovery sequence. This result was further supported by the significant regression relationship of time post onset stage with facilitation gain for nonpredictive contexts, as well as the significant correlations noted for actual months post onset and both performance in the nonpredictive condition and the associated facilitation gain scores. The facilitative benefit for predictive contexts was also significantly related to months post onset. The general conclusion to be gleaned from this research is that *narrative contextual facilitation of sentence com-*

prehension in nonfluent aphasia is a significant positive function of time post onset of aphasia.

The situation, however, is confounded by the factors of initial severity of aphasia, severity of comprehension deficit, and the stage of recovery. It was noted in this and other studies, (Cannito et al., 1986; Cannito et al., 1989; Hough et al., 1989) that amount of facilitation gained from context is negatively correlated with performance in the isolated sentence condition; i.e., the poorer the syntactic comprehension the greater the benefit derived from context. Interpretation of the time post onset effect, then, must take into account the fact that many patients recover. Therefore, patients exhibiting this degree of comprehension impairment early in recovery are not qualitatively the same as patients exhibiting similar severity of impairment on a chronic, long-term basis. The latter group demonstrated a large facilitative influence for nonpredictive narratives. These patients also demonstrated greatest difficulty with comprehension of isolated reversible passive sentences, suggesting a dense, persistent syntactic comprehension deficit. This may be a unique subpopulation and results for this group cannot necessarily be generalized to other types of aphasic patients. Obviously, longitudinal studies with large aphasic samples will be needed to tease apart these complex interacting phenomena. Further, it is clear that time post onset, stage of recovery, and the nature and severity of aphasia and of the comprehension deficit must be carefully controlled in future studies of contextual facilitation of comprehension. Previously, Cannito et al. (1989) have asserted that discourse context is a powerful facilitative variable that may be manipulated to advantage in aphasia therapy. However, the present results suggest that different types of aphasic patients may respond differently to different types of contexts at different times. A greater understanding of these complex inter-relationships is needed before contextual facilitation techniques can be systematically incorporated into the broader framework of aphasia rehabilitation.

REFERENCES

- Boyle, M., & Canter, G. (1986). Verbal context and comprehension of difficult sentences by aphasic adults: A methodological problem. In R. H. Brookshire (Ed.), *Clinical Aphasiology* (Vol. 16, pp. 38-44). Minneapolis, MN: BRK Publishers.
- Cannito, M., Jarecki, J., & Pierce, R. (1986). Effects of thematic structure on syntactic comprehension in aphasia. *Brain and Language*, 27, 38-49.
- Cannito, M., Vogel, D., & Pierce, R. (1989). Sentence comprehension in context: Influence of prior visual stimulation? In T. E. Prescott (Ed.), *Clinical Aphasiology* (Vol. 18, pp. 433-446). Boston: Little, Brown & Co.
- Cannito, M., Vogel, D. & Pierce, R. (1991). Contextualized sentence comprehension in nonfluent aphasia: Predictiveness and severity of comprehension impair-

- ment. In Prescott, T. E. (Ed.), *Clinical Aphasiology* (Vol. 20, pp. 111-120). Austin, TX: PRO-ED.
- Goodglass, H., & Kaplan, E. (1983). *Boston Diagnostic Aphasia Examination*. Philadelphia, PA: Lea & Febiger.
- Hough, M., Pierce, R., & Cannito, M. (1989). Contextual influences in aphasia: Effects of predictive versus nonpredictive narratives. *Brain and Language*, 36, 325-334.
- Huber, W. (1990). Text comprehension and production in aphasia: Analysis in terms of micro- and macro-processing. In Y. Joanette and H. Brownell (Eds.), *Discourse ability and brain damage: theoretical and empirical perspectives*. New York: Springer-Verlag.
- Nicholas, L., & Brookshire, R. (1983). Syntactic simplification and context: effects on sentence comprehension by aphasic adults. In R. H. Brookshire (Ed.), *Clinical Aphasiology* (Vol. 13, pp. 166-172). Minneapolis, MN: BRK Publishers.
- Pierce, R., & Germani, M. (in press). Contextualized influences and reading comprehension in aphasia. *Brain and Language*. Duluth, MN: Academic Press, Inc.
- Winer, B. J. (1971). *Statistical principles in experimental design*. New York: McGraw Hill.