CHAPTER

8

Reading Comprehension of Directly Stated and Inferred Information in Paragraph-Length Material by Nondemented and Demented Elderly Subjects

Donna J. Graville
Marie T. Rau

Investigations of the communicative behaviors of persons with dementia have focused primarily on verbal production, linguistic reasoning, and aspects of auditory-verbal comprehension (Appel, Kertesz, and Fisman, 1982; Bayles and Kaszniak, 1987; Cummings et al., 1985). Studies examining the effects of dementia on reading abilities have found that reading comprehension progressively declines as dementia severity increases, while at the same time the ability to read aloud is relatively well preserved until the late stages of the disease (Bayles et al., 1986; Cummings, Houlihan, and Hill, 1986; Schwartz, Marin, and Saffran, 1979; Sevush, 1984; Warrington, 1975). Schwartz, Marin, and Saffran (1979), for example, found that although those with Alzheimer's disease were able to read single words aloud, they were unable to match these words to their pictured referents. Cummings, Houlihan, and Hill (1986) confirmed that the ability to read aloud was generally spared, while the ability to comprehend declined with advancing dementia. They also speculated that reading deterioration in Alzheimer's disease was not perceptually based but semantically based. Although these and other studies agree that reading comprehension deteriorates as the severity of dementia increases, they did not explore whether there is a difference in the deterioration rates of the comprehension of factual versus inferential information.

In a pertinent study, Nicholas and Brookshire (1987) looked at reading comprehension of multiple-sentence-length material in a group of 15 aphasic and 15 non-brain-damaged adults. Specifically, they asked whether the level of inference required to respond to multiple-choice questions designed to test reading comprehension influenced subjects' performance. Although the aphasic subjects performed more poorly than the non-brain-damaged group, the patterns of performance between the two groups did not differ. Items requiring a high level of inference were significantly more difficult for both groups, while both groups answered literal and simple-inference questions equally well.

It has been established that the ability to utilize inferential reasoning is impaired in patients with dementia (Bayles and Kaszniak, 1987; Beeson et al., 1987, LeDoux, Blum, and Hirst, 1983). There has not, however, been a systematic examination of whether reading comprehension of literal and inferred information declines at the same rate over the course of a dementing illness. In addition, it is not known whether the pattern of performance of patients with mild and moderate dementia on reading tasks requiring different levels of inference is different from, or similar to, that of nondemented elderly persons or other neurologically impaired populations.

The questions posed in this study were—

1. In patients with mild and moderate dementia, is the pattern of performance on reading tasks requiring different levels of inference different from that of nondemented elderly adults?
2. Do patients with mild dementia perform more poorly than normal elderly adults on reading comprehension tasks at all levels of inference?
3. Is the pattern of performance of persons with dementia different from that reported in the literature for aphasic adults on the same reading comprehension tasks?

METHODS AND PROCEDURES

SUBJECTS

Two groups of subjects were examined. The first group, described in Table 8-1, consisted of 18 male subjects who fit the *Diagnostic and Statistical Manual of Mental Disorders*, 3d ed., revised *(DSM-III-R)* (American Psychiatric Association, 1987), criteria for primary dementia of the Alzheimer's type (DAT) and who carried a medical diagnosis of probable DAT. They were divided into mildly (N = 9) and moderately (N = 9)

TABLE 8-1. DESCRIPTIVE CHARACTERISTICS OF SUBJECTS WITH DEMENTIA

Subject	*Age (yrs)*	*Education (yrs)*	*Dementia severity*	*MMSE score*
1	63	18	Mild	27
2	70	8	Mild	24
3	72	12	Mild	23
4	64	11	Mild	21
5	62	8	Mild	22
6	64	16	Mild	20
7	71	14	Mild	20
8	75	14	Mild	27
9	57	12	Mild	25
Mean	66.4	12.6		23.20
SD*	5.8	3.4		2.73

Table 8-1. (continued)

Subject	*Age (yrs)*	*Education (yrs)*	*Dementia severity*	*MMSE score*
10	45	14	Moderate	18
11	67	12	Moderate	13
12	91	8	Moderate	17
13	76	7	Moderate	14
14	72	10	Moderate	19
15	60	14	Moderate	14
16	70	12	Moderate	16
17	87	8	Moderate	18
18	71	16	Moderate	17
Mean	71.0	11.2		16.20
SD	13.7	3.0		2.10

*SD = standard deviation.

impaired subgroups based on their scores on the Mini-Mental State Examination (MMSE) (Folstein, Folstein, and McHugh, 1975).

The control group, described in Table 8-2, consisted of 20 male subjects with no previous history or medical evidence of neurologic damage. All subjects scored in the nondemented range (28–30) on the MMSE. None exhibited clinical evidence of aphasia or dementia.

Analyses of variance (Winer, 1971) indicated that there were no statistically significant main effects among groups for age or education (0.05). As expected, a significant main effect ($p < 0.001$) was found among groups for MMSE score ($F = 164.81$, $df = 2.35$). Post hoc analyses (Tukey, 1977) indicated that all the groups were statistically significantly different from each other ($p < 0.001$).

Subjects with dementia were recruited from dementia evaluation clinics and local day care programs. Control subjects were recruited from the community and from among volunteers at a VA medical center.

ASSESSMENT INSTRUMENTS

The MMSE is a screening tool used for the assessment of mental status. It consists of 11 questions that evaluate orientation, memory, and ability to follow verbal and written commands, name objects, write a spontaneous sentence, and copy a geometric figure. A maximum score of 30 is

TABLE 8-2. DESCRIPTIVE CHARACTERISTICS OF NONDEMENTED ELDERLY SUBJECTS

Subject	*Age (yrs)*	*Education (yrs)*	*MMSE score*
1	70	12	28
2	67	16	29
3	70	12	28
4	70	8	28
5	81	8	28
6	76	15	28
7	66	18	30
8	65	12	28
9	69	14	29
10	74	12	29
11	71	12	28
12	67	18	30
13	72	14	29
14	71	18	29
15	70	14	30
16	68	16	29
17	67	16	29
18	69	14	29
19	70	12	30
20	75	8	28
Mean	70.4	13.6	28.80
SD*	3.8	3.2	.77

*SD = standard deviation.

possible. All subjects were screened with the MMSE. A score of 28 to 30 on the MMSE is considered a normal geriatric performance when the instrument is used clinically.

The Nelson Reading Skills Test (NRST) (Hanna, Schell, and Schreiner, 1977) is a standardized test that assesses silent reading comprehension and vocabulary skills at grade levels 3 through 9. It consists of three levels of difficulty and requires the reader to answer three types of questions. *Literal* questions require selecting answers that are explicitly stated in the text. *Translational* questions require selecting answers that are paraphrased from the text and require the ability to make simple inferences. *Higher-level* questions require selecting answers that are implied from the text. Nicholas, MacLennan, and Brookshire (1986) ex-

amined the validity of multiple-sentence reading comprehension tests for aphasic adults, specifically looking at passage dependency of the texts. They determined that the NRST was a more valid measure of reading comprehension than other measures currently used with aphasic adults because of greater passage dependency. Nicholas and Brookshire (1987) later confirmed these findings regarding the NRST.

Level B of the NRST reading comprehension subtest, assessing grade levels 4 to 6, was selected for this study, based on previous work by Nicholas and Brookshire (1987). This subtest contains five multiple-sentence passages with five to eight questions following each passage. After excluding questions relating only to vocabulary or found to be ambiguous by judges in the Nicholas and Brookshire study, a total of 33 questions were included (10 literal questions, 12 translational questions, and 11 higher-level questions).

PROCEDURES

All subjects were first administered the MMSE. Reading stimuli were typed, one passage per page, in large print, double spaced, on 8½ by 11 inch paper. Subjects were tested individually, either in a well-lit, quiet clinic room or in the subject's home. Subjects were requested to read each passage aloud and then read each question pertaining to that passage and point to the correct answer in a multiple-choice format. Elapsed time in minutes to complete the test was recorded. All responses were scored on-line as right or wrong.

RESULTS

A series of analyses of variance (Winer, 1971) and post hoc analyses (Tukey, 1977) revealed statistically significant differences among the groups in reading comprehension performance at all levels of inference (literal, translational, and higher level). These data are summarized in Tables 8-3 and 8-4. As expected, the nondemented elderly performed statistically significantly better in terms of overall score than either of the demented groups ($p < .001$). The nondemented elderly also performed statistically significantly better than either of the demented groups at each level of inference ($p < .05$). The mildly demented group performed statistically significantly better overall than the moderately demented group ($p = .002$), as well as on literal and higher-level infer-

TABLE 8-3. SUMMARY OF THE ANALYSES OF VARIANCE FOR PERFORMANCE ON THE NRST

	*SS**	*DF†*	*MS‡*	*F*	*Probability*
Total score:					
Between	1052.280	2	526.140	43.765	.000§
Within	420.772	35	12.022		
Literal:					
Between	80.149	2	40.075	28.018	.000§
Within	50.061	35	1.430		
Translational:					
Between	142.807	2	71.404	28.379	.000§
Within	88.061	35	2.516		
Higher level:					
Between	135.710	2	67.855	18.833	.000§
Within	126.106	35	3.603		
Time:					
Between	2425.038	2	1212.519	6.784	.003§
Within	6255.172	35	178.719		

*SS = sum of squares.
†DF = degrees of freedom.
‡MS = mean squares.
§Significant (p = .05).

TABLE 8-4. TUKEY-KRAMER HSD MULTIPLE COMPARISON TEST SUMMARIES OF PERFORMANCE ON THE NRST: TOTAL SCORE, QUESTION-TYPE SCORE, AND TIME

Matrix of pairwise comparison probabilities for MMSE score

Total score:			
*Group**	*1*	*2*	*3*
1	1.000		
2	0.000†	1.000	
3	0.000†	0.002†	1.000
Literal score:			
Group	*1*	*2*	*3*
1	1.000		
2	0.007†	1.000	
3	0.000†	0.004†	1.000
Translational score:			
Group	*1*	*2*	*3*
1	1.000		
2	0.001†	1.000	
3	0.000†	0.106	1.000

Table 8-4. (continued)

Matrix of pairwise comparison probabilities for MMSE score			
Higher level score:			
Group	*1*	*2*	*3*
1	1.000		
2	0.033†	1.000	
3	0.000†	0.017†	1.000
Time:			
Group	*1*	*2*	*3*
1	1.000		
2	0.274	1.000	
3	0.002†	0.191	1.000

*1 = nondemented elderly; 2 = mild DAT; 3 = moderate DAT.
†Significant (p = 0.05).

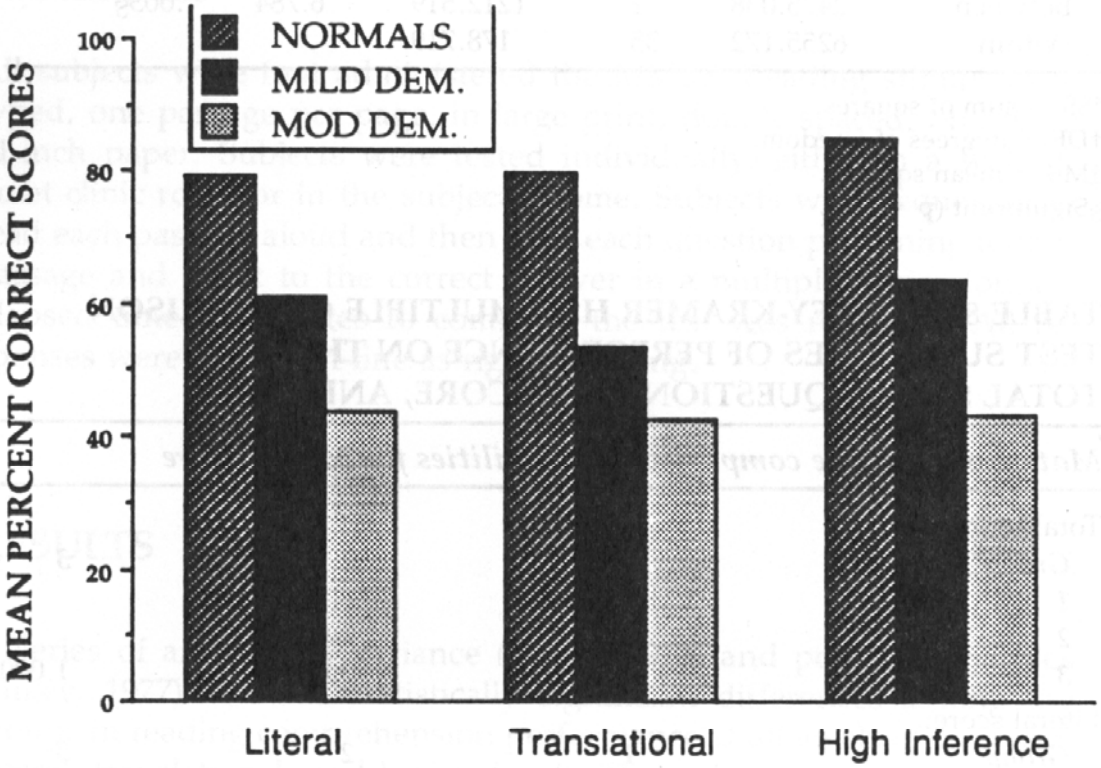

Fig. 8-1. Mean percent correct scores on NRST by level of inference.

ence questions ($p < .02$). No statistically significant difference (0.05) was found between the demented groups for translational scores.

Figure 8-1 displays the mean percent correct scores on the NRST for the three groups for all levels of inference. Visual inspection indicates that a similar pattern of performance was found across groups for all

levels of inference. This is a surprising finding in that no pattern of best to worst performance among inference levels was found within the groups. In other words, all subjects found each question type essentially equal in difficulty.

DISCUSSION

The results of this study conform to the predicted pattern. The nondemented elderly subjects performed better than the demented groups both in terms of total score and across question types. The mildly demented subjects performed better than the moderately demented group, with the exception that no significant difference was found between the demented groups in performance on the translational questions.

While this study demonstrates that reading comprehension of paragraph-length material deteriorates over the course of a dementing illness, it raises some questions about the pattern of performance observed. One would have predicted a decline in subjects' performance from literal to higher-level inference questions, similar to the findings of Nicholas and Brookshire (1987). Our data showed, however, that the nondemented and demented groups performed equally well across different levels of inference. This may reflect differences in the two samples and/or in the procedures utilized. Whereas our subjects were required to read each passage aloud, presumably focusing their attention and concentration, subjects in the Nicholas and Brookshire study read the passages silently. This may have eliminated the apparent hierarchy of difficulty across levels of inference found in the Nicholas and Brookshire study. If this is the case, our results may reflect that for adults, even those with a dementing illness, different types of tasks may be required in order to evaluate literal versus inferential processing.

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