Portland State University

PDXScholar

Dissertations and Theses

Dissertations and Theses

1989

Reading comprehension in dementia of the Alzheimer's type : factual versus inferential

Donna Jensen Graville
Portland State University

Follow this and additional works at: https://pdxscholar.library.pdx.edu/open_access_etds

Part of the [Gerontology Commons](#), and the [Speech and Hearing Science Commons](#)

Let us know how access to this document benefits you.

Recommended Citation

Graville, Donna Jensen, "Reading comprehension in dementia of the Alzheimer's type : factual versus inferential" (1989). *Dissertations and Theses*. Paper 3911.

<https://doi.org/10.15760/etd.5795>

This Thesis is brought to you for free and open access. It has been accepted for inclusion in Dissertations and Theses by an authorized administrator of PDXScholar. Please contact us if we can make this document more accessible: pdxscholar@pdx.edu.

AN ABSTRACT OF THE THESIS OF Donna Jensen Graville for the
Master of Science in Speech Communication: Emphasis in
Speech and Hearing Science presented April 28, 1989.

Title: Reading Comprehension in Dementia of the
Alzheimer's Type: Factual versus Inferential

APPROVED BY MEMBERS OF THE THESIS COMMITTEE:

[REDACTED]
Joan McMahon, Co-Chair

[REDACTED]
Marie T. Rau, Co-Chair

[REDACTED]
Mary T. Withers

[REDACTED]
Leonard Cain

The purpose of this study was to investigate the
reading comprehension abilities of those with mild and
moderate dementia of the Alzheimer's type (DAT) and compare
their performance to that of a sample of non-demented
elderly. Thirty-eight male subjects were used, 20 non-
demented elderly, nine mild DAT and nine moderate DAT. All

were administered level B of the NRST. This test contains questions requiring three levels of inference: literal, translational, and high-level inference.

Results indicated that the non-demented elderly subjects consistently performed significantly better than either of the demented groups in all areas of performance. The mildly demented performed consistently better than the moderately demented across all levels of performance. The exception was that no significant difference was seen between the demented groups in translational scores. The results did not indicate the predicted pattern of best performance on literal questions and worst performance on high level inference questions for all subjects. This raised questions about the validity of the NRST and its ability to differentiate between levels of inference.

READING COMPREHENSION IN DEMENTIA
OF THE ALZHEIMER'S TYPE: FACTUAL
VERSUS INFERENTIAL

by

DONNA JENSEN GRAVILLE

A thesis submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE
in
SPEECH COMMUNICATION
with emphasis in
SPEECH AND HEARING SCIENCE

Portland State University

1989

TO THE OFFICE OF GRADUATE STUDIES:

The members of the Committee approve the thesis of
Donna Jensen Graville presented April 28, 1989.

Jean McMahon, Co-Chair

Marie T. Rau, Co-Chair

Mary T. Withers

Leonard Cain

APPROVED:

Theodore G. Grove, Head, Department of Speech Communication

Bernard Ross, Vice Provost for Graduate Studies

ACKNOWLEDGEMENTS

It is with great pleasure that I can extend my appreciation to Dr. Marie (Judy) T. Rau for her knowledge and encouragement in helping me to plan and complete this study. Special appreciation goes to Joan McMahon who patiently provided advice and support throughout this project. Acknowledgement of their advice and suggestions is extended to the other members of my committee, Mary T. Withers and Dr. Leonard Cain, who provided valuable input in finalizing the thesis product. Appreciation is extended to the Alzheimer's Disease Center of Oregon who provided an abundance of help in obtaining the DAT subjects for this study.

Loving appreciation is expressed to my husband, Steven, for his support, encouragement, wisdom and fortitude in helping me to complete this project and to my parents for their steadfast belief in my abilities.

TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENTS	iii
LIST OF TABLES	vi
LIST OF FIGURES	viii
CHAPTER	
I INTRODUCTION	1
II REVIEW OF THE LITERATURE	5
Alzheimer's Type Dementia	5
Comparison Population	16
III METHODS AND PROCEDURES	19
Subjects	19
Human Subject Concerns	27
Instrumentation	29
Administration	31
Scoring and Data Analysis	31
IV RESULTS AND DISCUSSION	33
Results	33
Discussion	45
V SUMMARY AND IMPLICATIONS	50
Summary	50
Clinical Implications	51
Implications for Further Research	51

	PAGE
REFERENCES	54
APPENDICES	
A HUMAN SUBJECT COMMITTEE APPROVAL	58
B CONSENT FORMS USED FOR BOTH SUBJECT GROUPS	63
C EXAMPLE OF NRST PASSAGES AND QUESTIONS . .	66
D REVISED NELSON SCORE SHEET	69

LIST OF TABLES

TABLE		PAGE
I	Summary of the Diagnostic Criteria for Dementia	7
II	Descriptive Characteristics of Subjects with Dementia	21
III	Descriptive Characteristics of Non- Demented Elderly Subjects	22
IV	Summary of the Analysis of Variance for Age, Education, and MMSE Score	23
V	Tukey-Kramer HSD Multiple Comparisons for MMSE Score by Groups	28
VI	Summary of the Descriptive Statistics for Performance Scores: Total Score, Question Type Score, Time	34
VII	Summary of Analysis of Variance for Performance on the NRST	35
VIII	Tukey-Kramer HSD Multiple Comparison Test Summaries of Performance on the NRST: Total Score, Question Type Score and Time	38
IX	Summary of Analysis of Variance by Question Type within Groups	43

X	Summary of Chi-Square Tests for Effects of Age, Education and MMSE Score on Correct Total Score	43
---	---	----

LIST OF FIGURES

FIGURE	PAGE
1. Comparison of study groups by age	24
2. Comparison of study groups by education . . .	25
3. Comparison of study groups by MMSE score . . .	26
4. Average total percentage correct on the NRST by group	36
5. Mean percentage correct scores on NRST by level of inference	39
6. Average time to complete the NRST by group . .	40
7. Total percentage correct score of individual passages by group	44

CHAPTER I

INTRODUCTION

Dementia has become an increasing concern around the world because as life expectancy increases and birth rates decrease, the population becomes older and the prevalence of this condition increases. An estimated two to four million Americans suffer from dementia (Coughlin & Liu, 1989). This is not to say that dementia is an inevitable result of the aging process, but it is associated with a number of conditions and diseases which increase in prevalence with increasing age. One of these conditions is Alzheimer's disease. Dementia of the Alzheimer's type (DAT), according to Heston (1983), is the most common dementing illness and accounts for approximately half of all dementias at any age. Prevalence of DAT in those who reach their mid-80's is 20-30 percent.

In DAT the brain undergoes neurological damage characterized by neuron loss, neurofibrillary tangles, neuritic plaques and granovacuolar degeneration (Rousseau, 1987). The cortical areas affected by these neuropathologic changes in DAT are the frontal, parietal and temporal lobes. These lobes are primarily responsible for the motor system, as well as memory, personality, communication,

comprehension, problem-solving and visuospatial ability. Some or all of these functions will be affected in DAT to varying degrees, depending upon the progression of the disorder and specific brain areas affected in individual cases (Cummings & Benson, 1983).

Because of their relationship to language and verbal communication, cortical areas involving memory, comprehension, association and problem-solving, as they are affected in those with DAT, are of particular interest to speech-language pathologists. According to Bayles and Boone (1982), analysis of a patient's performance on certain language tasks will enable the clinician to understand the effects of progressive cortical atrophy and degeneration on communication. Patients with DAT exhibit such behaviors as fluent verbalizations and preserved repetition ability along with impaired comprehension and anomia (Appell, Kurtesz, & Fisman, 1982; Cummings, Benson, Hill & Read, 1985).

Little research regarding comprehension of linguistic information in DAT patients has been conducted (Cummings, Houlihan & Hill, 1986). Linguistic comprehension can be broken down into two components, factual and inferential. Factual comprehension is a process of recognition or remembering information one has been exposed to previously (Camp, 1981). Inferential comprehension is being able to analyze the information one has been exposed to and draw a

conclusion (Bayles & Kaszniak, 1987). When comparing the differences between factual and inferential comprehension, the results may yield valuable answers to diagnostic questions regarding DAT.

The most common methods of testing linguistic comprehension abilities are through stimuli presented in the form of auditory information or through reading textual material. Studies on the reading performance of patients with DAT have shown that their ability to read aloud remains intact until the symptoms of dementia become severe, while reading comprehension ability begins to deteriorate in the early stages (Cummings et al., 1986).

Although reading comprehension ability has been found to deteriorate in DAT, it has not been determined whether there is a difference in the deterioration rates of comprehension of factual versus inferential information in these patients. Although the Cummings et al. (1986) study did examine reading comprehension of sentences and short paragraph length material, it did not differentiate between factual versus inferential comprehension. The authors did state, however, that further detailed analysis of reading comprehension and DAT would be valuable because it might aid in distinguishing DAT from other dementias, aid in determining if comprehension deficits are perceptually based or secondary to linguistic deterioration and aid in deciding

if the language deterioration in dementia is similar to that seen in aphasia or if it represents a more generalized cognitive decline.

The purpose of this study was to determine whether a significant difference exists between the comprehension of factual and inferential information in DAT patients, and how their performance compares to that of the non-demented elderly. The research questions posed in this study were:

1. How does the reading comprehension performance of non-demented elderly subjects compare to the performance of DAT subjects with regard to accuracy and length of time required to perform the task?
2. How does the reading comprehension performance of mildly demented subjects compare to the performance of moderately demented subjects with regard to accuracy and length of time required to perform the task?
3. Is there a difference in performance accuracy between question type, inferential versus factual, within subject groups?

CHAPTER II

REVIEW OF THE LITERATURE

Alzheimer's disease is now recognized to be the most common cause of decline of intellectual function in the elderly. It is the fourth leading cause of death in the United States. The etiology is unknown and the effects are irreversible (Alzheimer's Disease and Related Disorders Association, 1988).

This chapter briefly reviews the literature concerning DAT, language, and reading comprehension, as well as the comparison population of normal elderly.

ALZHEIMER'S TYPE DEMENTIA (DAT)

Definition

DAT is defined in the revised third edition of the Diagnostic and Statistical Manual of Mental Disorders or DSM-III-R (American Psychiatric Association, 1987) as a "primary degenerative dementia." This definition was previously sub-divided into pre-senile and senile, classified by time of onset with pre-senile representing onset prior to 65 years of age and senile representing onset at 65 years or older. There appear to be, however, no difference histopathologically between pre-senile and senile

dementia (Bayles & Kaszniak, 1987; American Psychiatric Association, 1987), thus Primary Degenerative Dementia of the Alzheimer's Type is the term currently used regardless of time of onset. DSM-III-R states that to diagnose Primary Degenerative Dementia of the Alzheimer's Type, onset must be insidious and progressive and all other causes (i.e., subdural hematoma, normal pressure hydrocephalus, cerebral neoplasm, B₁₂ deficiency, hypothyroidism, intoxication, depression, multiple infarcts or Parkinson's disease) of dementia must be excluded. DSM-III-R (1987) criteria for diagnosis of dementia of the Alzheimer's Type are summarized in Table I.

Although a patient must meet the DSM-III-R criteria to be given the clinical diagnosis of DAT, a definitive diagnosis can only be made at autopsy with a neuropathological examination of the brain. Until then, diagnosis of DAT is presumptive based on clinical data (American Psychiatric Association, 1987; McKhann, Drachman, Folstein, Katzman, Price & Stadlan, 1984). The accuracy of the diagnosis of DAT based on clinical data confirmed at autopsy ranges from 64 to 100 percent depending on the stringency of criteria. The higher rates of clinicopathologic agreement were associated with the studies using more stringent criteria (Cummings & Benson, 1986;

TABLE I

SUMMARY OF THE DIAGNOSTIC
CRITERIA FOR DEMENTIA

-
-
- A. Demonstratable evidence of impairment in short- and long-term memory.
- B. At least one of the following:
1. Impairment in abstract thinking, as indicated by inability to find similarities and differences between related words, difficulty in defining words and concepts, and other similar tasks
 2. Impaired judgement, as indicated by inability to make reasonable plans to deal with interpersonal, family and job-related problems and issues
 3. Other disturbances of higher cortical function, such as aphasia, apraxia, agnosia, and constructional difficulty
 4. Personality change, i.e., alteration or accentuation of premorbid traits
- C. The disturbance in A and B significantly interferes with work or usual social activities or relationships with others.
- D. Not occurring exclusively during the course of Delirium.
- E. Either 1 or 2:
1. There is evidence from the history, physical examination, or laboratory tests of specific organic factor/s judged to be etiologically related to the disturbance
 2. In the absence of such evidence, an etiologic organic factor can be presumed if the disturbance cannot be accounted for by any nonorganic mental disorder
-

Katzman, 1987; McKhann, et al., 1984; Tierney, Fisher, Lewis, Zorizitto, Snow, Reid & Nieuwstraten, 1988).

Etiology

Many theories exist regarding the etiology of DAT. Heavy-metal toxicity, specifically aluminum, is one of the theories that has received a great deal of attention as a possible cause of DAT. Conflicting studies have shown, however, that the association between aluminum and DAT is not clear. Some studies show that Alzheimer's brains have a greater amount of aluminum than the amount found in the brains of normal controls (Crapper, Krishnan & Dalton, 1973; Crapper, Krishnan & Quittkat, 1976). Other studies, however, suggest that geographic location plays a role in the amount of aluminum levels in the brain. Also, aluminum levels do not correlate with the amount of neurofibrillary tangles and neuritic plaques but rather with age (Bayles & Kaszniak, 1987). As has been demonstrated, the aluminum-Alzheimer's link is still in question and warrants further research.

A second theory held by Goudsmit, Marrow, Asher, Yanagihara, Masters, Gibs and Gajdusek (1980) is that of an infectious etiology or that DAT is caused by a virus and is transmittable. This theory, however, is not supported by their work. They attempted to transmit the disease from humans to primates and failed.

A third theory, that DAT has a genetic component, appears to have some validity due to the fact that 25-33 percent of DAT patients have affected relatives (Rousseau, 1987; American Psychiatric Association, 1987). First order relatives exhibit a three-to-five fold increased chance of acquiring DAT. The link between Down syndrome and DAT also supports the genetic theory. Those with Down syndrome who live into their 40's and 50's develop brain neuropathology similar to that seen in DAT (Bayles & Kaszniak, 1986; Rousseau, 1987).

Neuropathologic Changes

DAT appears to selectively effect specific areas of the brain. Typically the brains of DAT patients show marked cerebral atrophy and neuropathologic changes that are similar, though not identical, to those seen in normal aging but to a greater extent. In normal aging the brain is affected in the following ways: 1) a decrease in brain weight and converse increase in ventricular size is noted; 2) atrophy occurs in the cerebral cortex; 3) neuronal loss is found in the prefrontal cortex and hippocampus; and 5) neuritic plaques are found in the amygdala of the corpus striatum. Apparently spared in normal aging is the temporal lobe (Davis, 1984).

Some of the areas affected in the DAT brain are those same areas affected in the normal aging brain. Neuronal

loss, neuritic plaques and neurofibrillary tangles of commonly affected areas are in greater proportion in the DAT brain, however. The neuropathology continues onto other areas as well. The cortical areas most affected by DAT are the frontal, parietal and temporal lobes (Katzman, 1987; Perl & Pendlebury, 1986; Rousseau, 1987). These areas are affected by neuropathologic changes such as neurofibrillary tangles, neuritic plaques and granulovacuolar degeneration. The loss of neurons is predominant in the basal nucleus of Meynert, diagonal band of Broca, hippocampus, amygdala, locus ceruleus and temporal and parietal areas. Neurofibrillary tangles are found in the pyramidal cells of the hippocampus, the amygdala, the neocortex, and nucleus of Meynert and the locus ceruleus. Neuritic plaques are found in the frontal and parietal areas, hippocampus, amygdala, nucleus of Meynert and hypothalamus.

Effects of Neuropathologic Changes on Language Comprehension

The cortical areas most affected in DAT correlate with the cognitive and behavioral changes found in this disease. The cognitive and behavioral changes consist of impairment in memory, abstract thinking, judgement, higher cortical functions (i.e., language and visuospatial ability), and personality (American Psychiatric Association, 1987).

The area affected that is most relevant to this study, the temporal lobe, is involved in language comprehension. Wernicke's area located in the left mid-temporal lobe has been associated with the storage and retrieval of words and their comprehension. The visual cortex and visual association areas within the occipital lobes are associated with receiving printed language information. This information is sent via the angular gyrus to Wernicke's area to be comprehended. Comprehension of written material is impaired if the connections between the angular gyrus and Wernicke's area are interrupted (Brookshire, 1986; Davis, 1983).

Language Aspects of DAT

Specific language deficits which have been described in DAT are as follows: decreased auditory and reading comprehension, anomia, decreased vocabulary, difficulty with word associations, decreased ability to pantomime, breakdowns in referential operations and decreased ability to infer (Appell, et al., 1982; Bayles & Kaszniak, 1987; Bayles, 1982; Emery, 1985). Speech has been characterized as fluent, verbose, perseverative, empty, circuitous and nonsensical (Appell et al., 1982; Bayles, 1982).

There has long been a debate as to whether the language deterioration observed in DAT is similar to the types of linguistic dysfunction observed in focal lesions,

for example, the aphasias, or whether the language deficits associated with DAT are related to more generalized cognitive deterioration.

Wechsler (1977) described a case study of a 67-year-old man whose aphasia was an initial symptom of presenile dementia. The subject in question showed symptoms indicative of temporal lobe involvement. The findings upon EMI scan, however, were indicative of a diffuse degenerative process. Wechsler went on to state that perhaps the greater extent of cortical atrophy in the temporal region accounted for the aphasia.

A study by Appell et al. (1982) focused on the linguistic functioning of DAT patients. Their findings supported the view that language deterioration in DAT follows the pattern of loss of cellular connectivity in the tertiary association areas and the areas of the brain that deal specifically with memory. They stated that the communication abilities commonly affected by focal lesions (i.e., language initiation, articulation, phonemic competence, repetition and syntax) were spared in their DAT patients. Thus, their DAT patients were not similar to their non-fluent aphasic patients.

Schwartz, Marin and Saffran (1979) stated that what they referred to as "referential operations" (semantic knowledge or associating a word with its pictured referent)

are diffusely organized while syntactic and phonologic systems are focally organized. This would account for the preservation of syntax and phonology in the diffuse deterioration seen in dementia.

Kirshner, Webb, Kelly and Wells (1984) studied six patients who manifested progressive language disturbances similar to aphasia seen in a focal left-hemisphere lesion. Yet all but one of these patients appeared to be developing a generalized dementia. Their study indicated that the isolated or predominant aphasia, in the absence of a focal brain lesion, may be indicative of focal atrophy in the language areas and that, in some cases, language deficits can be an initial symptom of dementia.

A study of reading deterioration in DAT was done by Cummings et al. (1986). In their study, the general sparing of the ability to read aloud was confirmed; however, comprehension of read material declined with advancing dementia. The authors stated that the reading comprehension deficits in DAT were similar to those seen in transcortical sensory aphasia and that other cognitive abnormalities seen in DAT were also consistent with focal lesions of cortical areas crucial to specific intellectual skills.

The evidence presented suggests that while structurally the brain undergoes generalized atrophy and neuropathologic changes in DAT which negatively affect

overall cognitive functioning, these patients can exhibit language disturbances similar to those observed in patients with focal lesions.

The linguistic ability most pertinent to this study is that of reading comprehension. Studies have found that the ability to read aloud is spared in DAT though reading comprehension may be severely compromised (Cummings et al., 1985; Cummings et al., 1986; Schwartz et al., 1979). These studies, however, did not further differentiate the types of reading comprehension deficits observed in DAT.

Some researchers speculate the comprehension requires the understanding of factual or literal information and the understanding of inferred information. Understanding of factual information requires recognizing facts or details stated within the text. Retrieval of factual information is generally accomplished by direct access to the information stored in memory. Understanding inferential information requires a higher-level recognition of implied meaning or an extension of stored information (Bayles & Kaszniak, 1986; Camp, 1981).

Dementia affects what Bayles and Kaszniak (1987) call the semantic memory. The semantic memory, as a component of long-term memory, is considered a central processing system where facts and conceptual knowledge are represented and where conclusions and inferential reasoning are processed.

Inference is how one draws conclusions or analyzes relationships. Without the ability to infer a person's comprehension or ability to understand is impaired. Semantic memory deteriorates in DAT thus, comprehension is affected in DAT.

In a study of inferential processing in context with cognitively impaired subjects, LeDoux, Blum and Hirst (1983) found that demented patients were impaired on all tasks that required the subject to choose by inference the co-reference of a pronoun in contextually, syntactically or lexically constrained sentences. For example: "John stood watching, while Henry fell down the stairs. He ran for a doctor. (Choice of either John or Henry.)" They determined that the impairment in inferential processing of context was attributable to a general cognitive deficit.

Beeson, Bayles, Tomoeda and Slauson (1987) reported on a study of oral narrative discourse that examined the quality of verbal output of normal, aphasic and DAT subjects as they described two Norman Rockwell pictures. Their study found that the amount of inferred observations made by the subject groups progressively declined. The normals performed better than the fluent aphasic group, who in turn performed better than the mild DAT group. The mild DAT group performed better than the non-fluent aphasic group.

The moderate DAT group made the least amount of inferred observations overall.

There is evidence, then, that the comprehension and processing of inferred information is impaired in persons with DAT. But how does the level of this impairment compare with the comprehension of factual information or compare with the comprehension of factual and inferential information in the non-demented elderly?

COMPARISON POPULATION

Normal Elderly

Normal elderly people, as stated in Bayles and Kaszniak (1987), have preserved semantic memory and although semantic memory processes (i.e., ideation, inference and association) appear to decrease with increasing age, the effects do not noticeably change the ability to communicate.

Emery (1985) administered 13 diagnostic instruments to each of his subjects, pre-middle aged (30-42 years), normal elderly (75-93 years) and persons with DAT. These instruments included the Token Test, Test for Syntactic Complexity, Chomsky's Test of Syntax and the Wechsler Memory Scale. Emery's study revealed that significantly greater processing problems existed in the areas of linguistic abstractness, logicality and complexity for the normal elderly than for the normal pre-middle-aged subjects. The

performance of the normal elderly subjects, however, was significantly better than that of the DAT subjects. The DAT subjects' performance was both qualitatively and quantitatively inferior.

Cohen (1979) examined comprehension of spoken language in the elderly. He concluded that the elderly had more difficulty in making inference, detecting anomalies and determining the gist of a story than did younger subjects. He concluded that this was a result of limitations in processing capacity; there is decreased ability to perform simultaneous registration of concrete meaning and integrative processes with increasing age.

Camp's (1981) results contradicted those of Cohen (1979). He examined the relationship between age and utilization of fact retrieval versus inference. He asked normal elderly and young adults to read questions and answer true or false to four alternative answers following each question. The results revealed that older subjects engaged in more inferential processing (significant only in the reaction time task) than younger subjects. No significant age differences were found in the ability to process explicit versus implicit information.

Belmore (1981) compared the ability of younger and older adults to read a short passage, then verify the meaning of a test sentence which was either a paraphrase or

an inference. The results indicated that there were no significant age differences in accuracy of verification performance after immediate testing. When a delayed test was administered, however, the older subjects made significantly more errors. Thus, Belmore concluded that older subjects are more impaired in the ability to retain information over time. Also, the study indicated that the older subjects were more accurate in remembering implicit information than explicit information.

As discussed previously, the Beeson et al. (1987) oral discourse study found that the ability of normal elderly subjects to express inferential observations was superior to that of the fluent aphasic, mild DAT, non-fluent aphasic moderate DAT subject groups.

In summary, the evidence indicates that inference is indeed affected in DAT, but it is debatable as to whether it is affected in normal aging. There are no specific data on how it may be affected in mild and moderate DAT subjects and how this might relate to the comprehension of factual information. This study, therefore, attempted to provide these data by exploring the reading comprehension of factual versus inferential information in the two subject groups. It compared DAT subjects, mildly and moderately impaired, and non-demented controls.

CHAPTER III

METHODS AND PROCEDURES

SUBJECTS

Two groups of subjects were used in this study. One group consisted of patients who were diagnosed with probable dementia of the Alzheimer's type (DAT). This group was subdivided into mildly and moderately impaired subgroups. The second group consisted of individuals with no evidence of neurological damage (non-demented controls). All subjects used English as their primary language, had adequate vision to perceive typewritten material and could read three pre-test sentences aloud. Their pre-morbid reading skills were at least at the eighth grade level as assumed by educational and occupational history.

Demented Groups (DAT)

Eighteen male subjects were diagnosed by the Alzheimer's Disease Center of Oregon (ADCO). The diagnostic assessments included a medical history; neurologic, psychologic and clinical examinations; laboratory tests; CT or MRI scans; and EEG tests. Following these assessments the subjects were diagnosed by a panel of physicians, neuropsychologists and clinicians as having dementia of the

Alzheimer's type. The severity of dementia was assessed with the Mini-Mental State Examination (MMSE) (Folstein, Folstein, and McHugh, 1975). This group was subdivided into a mild group (N=9) and a moderate group (N=9) according to the MMSE guidelines. The mild group had a mean age of 66.4 years (SD, 5.8 years) and a mean education of 12.6 years (SD, 3.4 years). The moderate group had a mean age of 71 years (SD, 13.7 years) and a mean education of 11.2 years (SD, 3.2 years). The DAT groups are described in Table II.

Non-Demented Group

Twenty male subjects with a mean age of 70.4 years (SD, 3.8 years) and with no history or medical evidence of neurological damage were included in the control group. All subjects scored in the non-demented range (28 to 30) on the MMSE. None exhibited clinical evidence of aphasia or dementia. The mean education level for this group was 13.45 years (SD, 3.2 years). These subjects are described in Table III.

Group Homogeneity

A series of one-way analyses of variance which compared the three subject groups on the basis of age, education and MMSE score yielded the results displayed in Table IV and Figures 1, 2, and 3. There were no significant main effects between groups for age or education. As was

TABLE II

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
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

TABLE III

DESCRIPTIVE CHARACTERISTICS OF NON-DEMENTED
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

TABLE IV

SUMMARY OF THE ANALYSIS OF VARIANCE
FOR AGE, EDUCATION AND MMSE SCORE

	SS	DF	MS	F	Probability
AGE					
Between	120.057	2	60.028	1.029	.368
Within	2041.022	35	58.315		
EDUCATION					
Between	35.738	2	17.869	1.734	.191
Within	360.578	35	10.302		
MMSE SCORE					
Between	1001.189	2	500.594	164.807	.000*
Within	106.311	35	3.037		

SS = Sum of Squares

DF = Degrees of Freedom

MS = Mean Squares

* Significant

Figure 1. Comparison of study groups by age.

Figure 2. Comparison of study groups by education.

Figure 3. Comparison of study groups by MMSE score.

expected, a significant main effect ($p < .001$) was found between groups and MMSE score ($F = 164.81$; $df = 2.35$). Post-hoc analyses using the Tukey-Kramer test (adjusted for unequal N's) indicated that the non-demented group was significantly different from both the demented groups ($p < .001$). The mildly demented group was significantly different from the moderately demented group ($p < .001$) (Table V, Figure 3).

The DAT group was drawn from the Portland V.A. Medical Center; the V.A.'s associated care units (Dementia Clinic, Out Patient Clinic and Adult Day Care Health Program); Good Samaritan Hospital and its associated care units; and the Alzheimer's Disease and Related Disorders Association. Those whose medical diagnosis was unclear or who had multiple medical problems were excluded from the study. All members of the control group were volunteers associated with the V.A. Medical Center.

HUMAN SUBJECT CONCERNS

Permission to conduct this study was acquired from the Human Subject Committees of Portland State University, The V.A. Medical Center, Good Samaritan Medical Center and the Oregon Health Sciences University Hospital (see Appendix A).

All subjects and caregivers were informed of the nature of this study and asked to sign a consent form

TABLE V

TUKEY-KRAMER HSD MULTIPLE COMPARISONS
FOR MMSE SCORE BY GROUPS

Matrix of Pairwise Comparison Probabilities for MMSE Score

Group		1	2	3
r o u p	1	1.000		
	2	0.000*	1.000	
	3	0.000*	0.000*	1.000

1 = Non-demented elderly 2 = Mild DAT 3 = Moderate DAT
* Significant Difference

indicating their informed consent to participate (Appendix B).

The subjects were informed that they could terminate their participation at any time without consequence. If a subject appeared distressed by any of the tasks required, the test was subtly discontinued, the subject was graciously thanked and presented with a small token of appreciation for their time. Great pains were taken to preserve the dignity of all who participated in this study regardless of whether they were included within the final analysis.

INSTRUMENTATION

The MMSE (Folstein et al., 1975) is a brief screening protocol to assess mental status. The examination consists of 11 items that evaluate orientation, memory, the ability to follow verbal and written commands, name objects, write a spontaneous sentence and copy a geometric figure. The MMSE provides valid differentiation of dementia and normal aging and correlates significantly with the Wechsler Adult Intelligence Scale IQ scores (Folstein et al., 1975). This examination was used to identify severity of DAT and as a screening tool with the control group.

The Nelson Reading Skills Test (NRST) (Hanna, Schell & Schreiner, 1977) is a standardized test which assesses silent reading skills (reading vocabulary and comprehension) for grades three through nine. It consists of three levels of difficulty (A, B, & C) and requires the reader to answer three types of questions:

1. Literal questions require selecting answers that are explicitly stated in the text. These questions assess recall of specific information stated in a passage.
2. Translational questions require selecting answers that are paraphrased from the text. These questions assess the ability to make simple inferences.

3. Higher level questions require selecting answers that are implied from the text. These questions assess the ability to make higher level inferences.

Level B of the reading comprehension subtest assesses grades four to six and was the level administered to both of the subject groups in the present study. This subtest consisted of a total of five passages with five to eight questions following each passage (38 total questions). Five questions were excluded (1, 14, 15, 23, & 31) because they were part of the word meaning subtest and because they were found to be ambiguous in a study by Nicholas and Brookshire (1987).

The passages were retyped one passage per page in large print, double spaced, on 8½" x 11" paper (Appendix C). This was done to allow for ease of administration.

Nicholas, MacLennan and Brookshire (1986) examined the validity of the multiple-sentence reading comprehension subtests in five commonly used adult aphasia batteries. They assessed the passage-dependency of the questions to the text for each of the five subtests. Passage-dependency is the extent to which answering the questions accurately depends upon reading the text. The researchers found that all five tests examined had passage-dependency levels too low to be valid. They suggested that the NRST was a better

choice for assessing reading performance due to its acceptable levels of passage dependency. Nicholas and Brookshire (1987) examined error analysis and passage dependency of the NRST and confirmed their previous findings that it was a more valid measure of reading comprehension.

ADMINISTRATION

Special training is not required to administer the NRST, though familiarity with the test is desirable. Each subject was administered the NRST's reading comprehension subtest level B (Hanna et al, 1977). Each subject was requested to read each paragraph aloud, then read each question and point to the best answer. The elapsed time in minutes to complete the subtests was recorded. The subtest was administered in a quiet clinic room located at the V.A. Medical Center or at the subject's home. Average administration time for all three groups was 22.28 minutes.

SCORING AND DATA ANALYSIS

The results were scored as either right (+) or wrong (-) in accordance to the NRST manual by the administrator on-line. The number of elapsed minutes for each administration were recorded on the scoring sheet (Appendix D).

A series of one-way analyses of variance and post-hoc analyses (Tukey HSD Multiple Comparison Test) were performed to determine if significant differences existed between and within groups at all levels of performance: relative to total score, individual question type, and total time taken to complete the test. A series of Chi-Square tests were performed to determine the relationships of age, education and MMSE score on the total score achieved on the NRST.

CHAPTER IV

RESULTS AND DISCUSSION

RESULTS

The results of this study were analyzed using descriptive statistics, a series of one-way analyses of variance and post-hoc tests (Tukey-Kramer HSD Multiple Comparison adjusted for unequal N's), as well as Chi-Square tests.

Descriptive Results

A summary of the means, standard deviations and ranges for the total score, each question type score (literal, translation and high-level inference), and time needed to complete the test are indicated in Table VI.

Review of the Research Questions Posed

1. How does the reading comprehension performance of normal elderly subjects compare to the performance of DAT subjects in regard to accuracy and length of time required to take the test?

A series of one-way analyses of variance which compared the non-demented subject group to the demented elderly groups on the basis of total score on the NRST,

TABLE VI

SUMMARY OF THE DESCRIPTIVE STATISTICS FOR
PERFORMANCE SCORES: TOTAL SCORE,
QUESTION TYPE SCORE, TIME

Group	Measure	Total Score	Literal Score	Transl. Score	Hi-Lvl Score	Time
NON-DEM N = 20	$\bar{x}$	26.85	7.95	9.55	9.35	13.05
	SD	2.96	.99	1.10	1.75	5.36
	range	20 - 31	6 - 9	8 - 11	5 - 11	9 - 33
MILD DAT N = 9	$\bar{x}$	19.56	6.11	6.44	7.00	21.44
	SD	3.84	1.17	2.01	2.18	17.06
	range	13 - 24	4 - 8	3 - 9	4 - 10	11 - 66
MOD DAT N = 9	$\bar{x}$	14.33	4.44	5.11	4.78	32.67
	SD	4.12	1.59	2.03	1.92	20.56
	range	8 - 21	2 - 7	2 - 8	1 - 7	20 - 72

$\bar{x}$ = Mean SD = Standard Deviation

comparing their performance by type of question (literal, translational and high-level inference), as well as time needed to complete the test yielded the results displayed in Table VII.

Total NRST Score. There were significant main effects ($p < .001$) among groups for total NRST score ($F = 43.77$; $df = 2, 35$). Post-hoc analyses revealed that the non-demented group scored significantly higher than either of the demented groups ($p < .0001$) (Table VIII, Figure 4).

TABLE VII

SUMMARY OF THE ANALYSIS OF VARIANCE
FOR PERFORMANCE ON THE NRST

	SS	DF	MS	F	Probability
<hr/>					
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		
HIGH 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
* Significant

DF = Degrees of Freedom

MS = Mean Squares

Figure 4. Average total percentage correct on the NRST by group.

Performance by Level of Inference. There were significant main effects ($p < .001$) among groups for all question types (literal, translational, and high-level inference) ($F = 28.02, 28.38, 18.833$ respectively; $df = 2, 35$). Post-hoc analyses indicated that for the literal question score the non-demented performed significantly better than both demented groups (mild, $p = .007$; moderate, $p < .001$). This was also indicated for the translational scores (mild, $p = .001$; moderate, $p < .001$) and the high-level inference scores (mild, $p = .033$; moderate, $p < .001$). These results are summarized in Table VIII and Figure 5.

Performance by Time. There was a significant main effect ($p = .003$) between groups for the total time needed to complete the test ($F = 6.78$; $df = 2, 35$). Post-hoc analyses, indicated in Table VIII, revealed that the non-demented group did not require significantly less time than the mildly demented group to complete the test. The moderately demented group did, however, require significantly more time to complete the test than the non-demented group ($p = .002$) (Figure 6).

2. How does the reading comprehension of mildly demented subjects compare to the performance of the moderately demented subjects in regard to accuracy and length of time required to take the test?

TABLE VIII

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
r				
o	1	1.000		
u	2	0.000*	1.000	
p	3	0.000*	0.002*	1.000
LITERAL SCORE				
Group		1	2	3
r				
o	1	1.000		
u	2	0.007*	1.000	
p	3	0.000*	0.004*	1.000
TRANSLATIONAL SCORE				
Group		1	2	3
r				
o	1	1.000		
u	2	0.001*	1.000	
p	3	0.000*	0.106*	1.000
HIGH LEVEL SCORE				
Group		1	2	3
r				
o	1	1.000		
u	2	0.033*	1.000	
p	3	0.000*	0.017*	1.000
TIME				
Group		1	2	3
r				
o	1	1.000		
u	2	0.274*	1.000	
p	3	0.002*	0.191*	1.000

1 = Non-demented elderly

2 = Mild DAT

3 = Moderate DAT

* Significant Difference

Figure 5. Mean percentage correct scores on NRST by level of inference.

Figure 6. Average time to complete the NRST by group.

A series of one-way analyses of variance which compared the two demented groups on the basis of total score achieved on the NRST, performance by question type (literal, translational, high-level inference), and time needed to complete the test are summarized in Table VII.

Total NRST Score. As reported earlier, there were significant main effects ($p < .001$) between the groups for total NRST score ($F = 43.77$; $df = 2, 35$). Post-hoc analyses revealed that the mildly demented group had a significantly higher total NRST score than the moderately demented group ($p = .002$) (Table VIII, Figure 4).

Performance by Level of Inference. Post-hoc analyses indicated that the mildly demented group had significantly higher literal and high-level inference scores ($p = .004$; $p = .017$, respectively) than the moderately demented groups. There was no significant difference between the demented groups in translational scores (Table VIII, Figure 5).

Performance by Time. Post-hoc analyses revealed no significant difference between the mildly and moderately demented groups (Table VIII, Figure 6).

3. Is there a difference in performance between question type, literal, translational and high level inference, within the subject groups?

A series of one-way analyses of variance which compared the performance between the three question types

(literal, translational, high-level inference) of the NRST within groups is summarized in Table IX.

There were no significant main effects found between question type (literal, translational, high-level) within any of the groups. Performance on high-level inference questions was essentially equal to the performance on the literal and the translational questions for each of the groups. This indicated that none of the subject groups found a particular type of question more difficult than the other.

Analyses Of Other Performance Scores

The Total Passage Score within Groups. The results shown in Figure 7 reveal that there were no differences in performance within groups between the passages one through five. This indicated that the passages were equal in difficulty.

Affects of Age, Education and MMSE Score on Total Score. A Chi-Square analysis was done to determine if the total score could have been affected by age, education or MMSE score. The results of a Chi-Square test, shown in Table X, revealed that the total score was not affected by age. The total score, however, was affected to some degree by years of education ($p = .049$). It was not surprising that those with a higher level of education would tend to score higher on the NRST.

TABLE IX

SUMMARY OF THE ANALYSIS OF VARIANCE
BY QUESTION TYPE WITHIN GROUPS

	SS	DF	MS	F	Probability
NORM. ELD.					
Between	410.800	2	206.400	1.414	.251
Within	8281.600	57	145.290		
MILD DAT					
Between	485.852	2	242.930	.888	1.000
Within	6565.889	57	273.537		
MOD. DAT					
Between	16.222	2	8.111	.029	1.000
Within	6794.444	57	283.102		
SS = Sum of Squares DF = Degrees of Freedom MS = Mean Squares					

TABLE X

SUMMARY OF CHI-SQUARE TESTS FOR EFFECTS
OF AGE, EDUCATION AND MMSE SCORE
ON CORRECT TOTAL SCORE

Chi-Square Test of Independence of Total Score			
	Chi-Square	DF	Probability
Age	3E-03000	1	.959
Education	3.878	1	.049
MMSE	20.591	1	.001

Figure 7. Total percentage correct score of individual passages by group.

This analysis also revealed that the groups in this study were categorized appropriately according to MMSE scores.

DISCUSSION

Although the literature clearly indicates that those with dementia of the Alzheimer's type differ in comprehension ability from the normal elderly (Bayles & Kaszniak, 1987; Emery, 1985), it does not qualitatively describe the reading comprehension differences between them. This study attempted to provide insight into the qualitative differences among the elderly and Alzheimer's patients. The results of this study once again confirmed the above research indicating that the normal elderly perform quantitatively better than DAT subjects, although qualitative differences were not clearly revealed.

This study's data followed a predictable pattern of total score and question type performance for normal elderly who consistently performed significantly better than the demented groups. The pattern was not as predictable between the mild and moderate DAT groups. The mildly demented group performed significantly better than the moderately demented group as expected in total NRST scores, literal question type scores and high-level inference scores. The pattern was interrupted with no significant difference observed

between the demented groups in translational (simple inference) scores. Perhaps the reason there was no significant difference between the demented groups for simple inference questions was that the translational questions were not sensitive enough in difficulty to indicate a difference between severity of dementia. Perhaps the Alzheimer's subject's ability to make simple inferences does not deteriorate enough between the mild and moderate stages to indicate a difference.

The most surprising result was that none of the groups performed significantly better or worse on a specific question type. Nicholas and Brookshire's (1986) study reported that both the non-brain-damaged and aphasic groups found the higher level inference questions more difficult than the literal or translational questions. This study did not support their finding. The differences may be due to the population samples. Another reason may be that the NRST may not be sensitive enough to differentiate levels of complexity according to question type. Interestingly, Nicholas and Brookshire (1986) found that when analyzing passage dependence of the NRST, that the higher level inference questions were answered correctly more often than the other types of questions when the questions were presented without the subjects reading the accompanying text. This would indicate that the NRST may not be a good

measure of higher level inferential ability. This would lead to the speculation that the higher level inference questions are not more difficult than the other types of questions on the NRST, explaining why no differences were found between question type within each of the subject groups in the present study.

Could memory have played a role in the performance levels seen in the DAT subject groups? Memory impairment is certainly one of the criteria for the diagnosis of DAT (American Psychiatric Association, 1987). If a person's memory is impaired, then the ability to comprehend is impaired (Bayles & Kaszniak, 1987). This study attempted to control for the DAT subject's memory impairment by providing unlimited access to the passage while the subjects were answering the questions about the passage. The subjects were not explicitly told, however, that they could refer back to the passage if necessary.

Could the results of this data support either of the contentions that DAT clinically presents similarly to those with focal lesions (strokes) or an overall decline in cognitive ability? When considering the Nicholas and Brookshire (1987) data, the aphasic subjects performed very differently than the present study's DAT subjects did. The aphasic group exhibited a best to worst performance pattern across question types (literal, translational, high level

respectively). The DAT group in the present study exhibited no such pattern.

To support the contention that the deficits in DAT are consistent with an overall cognitive decline, a pattern would need to be seen. The pattern would consist of the best performance on those items that required the least amount of processing (factual comprehension) and worst performance on those items requiring a greater amount of processing (inference comprehension). Because there was no best-to-worst performance pattern seen in this study's DAT subjects, the contention that those with DAT present with deficits that indicate an overall cognitive decline cannot be supported either.

If there were a qualitative difference in the way inference was comprehended through reading, then differences would have been exhibited between the non-demented elderly and the DAT groups in performance by levels of inference (Figure 5). There was only a quantitative difference indicated between the non-demented and DAT groups, however. Therefore, the data in the present study continues to raise speculation as to whether the NRST is a valid instrument to measure levels of inference in the non-demented elderly and those with DAT.

In summary, this study supports the literature which states that the normal elderly's comprehension abilities are

significantly better than those with even mild dementia of the Alzheimer's type. It did not, however, provide more insight into how qualitatively comprehension is affected in normal elderly or DAT. The research data presented does question whether the NRST is a valid measure of multiple-sentence reading comprehension. The NRST may be able to differentiate levels of inferential ability in school-aged children who are acquiring inferential skills, it does not seem sensitive enough to establish levels of adult inferential ability.

CHAPTER V

SUMMARY AND IMPLICATIONS

SUMMARY

The purpose of this study was to investigate the reading comprehension abilities of those with mild and moderate dementia of the Alzheimer's type (DAT) and compare their performance to that of a sample of non-demented elderly. Thirty-eight male subjects were used, 20 non-demented elderly, nine mild DAT and nine moderate DAT. All were administered level B of the NRST. This test contains questions requiring three levels of inference: literal, translational, and high-level inference. Subjects were required to read aloud five passages and answer five to seven multiple choice questions following each passage. The amount of time taken to complete the test was noted.

Results indicated that the non-demented elderly subjects consistently performed significantly better than the mildly demented and the moderately demented in all areas of performance (total score, question type scores, time to complete the test). The mildly demented performed consistently better than the moderately demented across all levels of performance. The exception was that no

significant difference was seen between the demented groups in translational scores. The results did not indicate the predicted pattern of best performance on literal questions and worst performance on high inference questions for all subjects.

CLINICAL IMPLICATIONS

From a diagnostic standpoint, it is difficult to find a standardized test of reading comprehension appropriate for adults that will qualitatively differentiate levels of inference comprehended. The NRST was chosen for this study because of its passage dependent questions and it purported to differentiate literal, translational and high-level inference questions. Though the NRST does test reading comprehension, the results of this study do not support that this test is a good measure of inferential comprehension difficulty. Therefore, clinicians must continue to use their own best judgement regarding appropriate tools for assessing aspects of reading comprehension in adult clinical populations.

IMPLICATIONS FOR FURTHER RESEARCH

This study was limited in sample size and sample type. It would be useful to determine if the results of this study were due to the NRST's inability to differentiate qualitative comprehension information in adults because the

questions were too simple for the population or were the questions themselves not a good measurement of inferential ability for any age group. Did memory impairment play a role in the performance levels for the DAT population? When replicating this study, a suggestion to explicitly state that the person may refer to the passage when answering the question might help in controlling for any memory impairment. Is the NRST only qualitatively useful for certain age groups or clinical populations: 1) is there a ceiling age group where this test is no longer a measurement of inferential ability, high school, college age; 2) would different clinical populations, such as right-hemisphere damaged (RHD) or closed-head-injured (CHI) patients, perform differently on the test? A replication of this study using different sample groups (RHD, CHI), or different age groups (adolescents, college aged) may be useful to determine if subject sample affected this study's or Nicholas and Brookshire's (1987) results. Any sample comparison using this instrument would be helpful to determine if the NRST is a useful tool for some populations but not for others.

Possibilities for further research of reading comprehension in those with DAT might include evaluating reading with another instrument. The instrument would need to be of adequate length and complexity for adults, differentiate question type by level of inference and have

adequate passage dependency. A suggested reading test might be Form D of the Classroom Reading Inventory (Silvaroli, 1986). It has adequate length and complexity and it differentiates questions by inference level. The Classroom Reading Inventory does not report passage dependency levels, however, and would have to be evaluated for passage dependency prior to extensive use as a tool for testing adults. As it stands, a good qualitative measure to assess aspects of adult reading comprehension has not been confirmed.

REFERENCES

- Alzheimer's Disease and Related Disorders Association (1988). Alzheimer's disease fact sheet. Portland, OR: Alzheimer's Disease and Related Disorders Association.
- American Psychiatric Association (1987). Diagnostic and statistical manual of mental disorders (3rd ed. rev.). Washington, D.C.: American Psychiatric Association.
- Appell, J., A. Kertesz and M. Fisman (1982). A study of language functioning in Alzheimer patients. Brain and Language, 16, 265-280.
- Bayles, K.A. (1982). Language function in senile dementia. Brain and Language, 16, 265-280.
- Bales, K.A. and D.R. Boone (1982). The potential of language tasks for identifying senile dementia. JSHD, 47, 210-217.
- Bayles, K.A. and A.W. Kaszniak (1987). Communication and cognition in normal aging and dementia. Boston, MA: Little, Brown and Company.
- Beeson, P.M., K.A. Bayles, C.K. Tomoeda and T. Slauson (1987). Oral discourse in demented, aphasic, and elderly individuals: Content analysis. Paper presented at ASHA, 1987.
- Belmore, S.M. (1981). Age-related changes in processing explicit and implicit language. Journal of Gerontology, 36, 316-322.
- Brookshire, R.H. (1986). An introduction to aphasia. 3rd Ed. Minneapolis, MN: BRK Publishers.
- Burns, M.S., A.S. Halper and S.I. Mogil (1985). Clinical management of right hemisphere dysfunction. Gaithersburg, MD: Aspen Systems Corporation.
- Camp, C.J. (1981). The use of fact retrieval vs. inference in young and elderly adults. Journal of Gerontology, 36, 715-721.

- Cohen G. (1979). Language comprehension in old age. Cognitive Psychology, 11, 412-429.
- Coughlin, T.A. and K. Liu (1989). Health care costs of older persons with cognitive impairments. The Gerontological Society of America. Vol. 29, 2, 173-182.
- Crapper, D.R., S.S. Krishnan and A.J. Dalton (1973). Brain aluminum distribution in Alzheimer's disease and experimental neurofibrillary degeneration. Science, 180, 511-513.
- Crapper D.R., S.S. Krishnan and S. Quittkat (1976). Aluminum neurofibrillary degeneration and Alzheimer's disease. Brain, 99, 67-79.
- Cummings, J.L. and D.F. Benson (1983). Dementia: A clinical approach. Boston, MA: Butterworth.
- Cummings, J.L. J.P. Houlihan and M.A. Hill (1986). The pattern of reading deterioration in dementia of the Alzheimer type: Observations and Implications. Brain and Language, 29, 315-323.
- Darley, F.L. (1978). Aphasia. In F.L. Darley and D.C. Spriestersbach Diagnostic methods in speech pathology. New York, NY: Harper & Row Publishers, Inc.
- Davis, G.A. (1983). A survey of adult aphasia. Englewood Cliffs, NJ: Prentice-Hall, Inc.
- Emery, O.B. (1985). Language and aging. Experimental Aging Research, 11, 3-60.
- Folstein, M.F., S.E. Folstein and P.R. McHugh (1975). Minimal state. Journal of Psychiatric Research, 12, 189-198.
- Goudsmit, J., C.H. Marrow, D.M. Asher, R.T. Yanagihara, C.L. Masters, C.J. Gibbs, Jr. and D.C. Gajdusek (1980). Evidence for and against the transmissibility of Alzheimer's disease. Neurology, 30, 945-950.
- Hanna, G., L.M. Schell and R. Schreiner (1978). The Nelson reading skills test. Boston: Houghton-Mifflin.
- Heston, L.L. (1983). Dementia. New York, NY: W.H. Freeman & Co.

- Katzman, R. (1987). Alzheimer's disease advances and opportunities. Journal of the American Geriatrics Society, 35, 69-73.
- Kirshner, H.S., W.G. Webb, M.P. Kelly and C.E. Wells (1984). Language disturbance: An initial symptom of cortical degeneration and dementia. Archives of Neurology, 41, 491-496.
- La Pointe, L.L. and J. Horner (1979). Reading comprehension battery for aphasia. Tigard, OR: CC Publications, Inc.
- Ledoux, J.F., C. Blum and W. Hirst (1983). Inferential processing of context: Studies of cognitively impaired subjects. Brain and Language, 19, 216-224.
- McKhann, G., D. Drachman, M. Folstein, R. Katzman, D. Price, and E.M. Stadlan (1984). Clinical diagnosis of Alzheimer's disease. Neurology, 34, 939-944.
- Meyers, P.S. (1983). Treatment of right hemisphere communication disorders. In W.H. Perkins (Ed.), Current therapy of communication disorders: Language handicaps in adults. New York, NY: Thieme-Stratton, Inc.
- Nicholas, L.E. and R.H. Brookshire (1987). Error analysis and passage dependency of test items from a standardized test of multiple-sentence reading comprehension for aphasic and non-brain-damaged adults. Journal of Speech and Hearing Disorders, 52, 366-368.
- Nicholas, L.E., D.L. MacLennan and R.H. Brookshire (1986). Validity of multiple-sentence reading comprehension tests for aphasic adults. Journal of Speech and Hearing Disorders, 51, 82-87.
- Perl, D.P. and W.W. Pendlebury (1986). Neuropathology of dementia. Neurologic Clinics, 4(2), 355-368.
- Porch, B.E. (1981). Porch index of communicative ability. Palo Alto, CA: Consulting Psychologists Press.
- Rousseau, P.C. (1987). Alzheimer's Disease: An age-old problem. Hospital Practice, Feb. 15, 59-68.

- Schwartz, M.F., O.S. Marin and E.M. Saffran (1979).
Dissociations of language function in dementia: A case
study. Brain and Language, 7, 277-306.
- Shames, G.H. and E.H. Wiig (1982). Human communication
disorders. Columbus, OH: Merrill Publishing Company.
- Silvaroli, N.J. (1988). Classroom reading inventory.
Dubuque IA: William C. Brown Company.
- Tierney, M.C., R.H. Fisher, A.J. Lewis, M.L. Zoritto, W.G.
Snow, D.W. Reid and P. Nieuwstraten (1988). The
NINCDS-ADRDS work group criteria for the clinical
diagnosis of probable Alzheimer's disease. Neurology,
38, 359-364.
- Van Demark, A.A., E.C. Lemmer and J.L. Drake (1982).
Measurement of reading comprehension in aphasia with
the RCBA. JSHD, 47, 288-291.
- Wechsler, A.F. (1977). Presenile dementia presenting as
aphasia. Journal of Neurology, Neurosurgery, and
Psychiatry, 40, 303-305.

APPENDIX A

HUMAN SUBJECT COMMITTEE APPROVAL

Portland State University

MEMORANDUM

HUMAN SUBJECTS RESEARCH REVIEW COMMITTEE
1987-88

DATE: 15 June 1988

TO: Donna Graville, SP

FROM: Robert C. Holloway, Chairperson
Human Subjects Research Review Committee (HSRRC)

RE: HSRRC Approval

In accordance with your request, the Human Subjects Research Review Committee has reviewed your proposal entitled Reading Comprehension in Dementia of the Alzheimer's type: Factual vs. Inferential for compliance with DHHS policies and regulations on the protection of human subjects.

The committee is satisfied that your provisions for protecting the rights and welfare of all subjects participating in the research are adequate and therefore the project is approved.

c: Office of Grants and Contracts

RCH:asm

THE OREGON HEALTH SCIENCES UNIVERSITY

3181 S.W. Sam Jackson Park Road, L106, Portland, Oregon 97201 (503) 279-7784/7887

Research Services

DATE: November 29, 1988

TO: Donna J. Graville, B.S.
Senior Investigator: Marie T. Rau, Ph.D.

FROM: Nancy White, Administrative Assistant *N White*
Committee on Human Research, L-106

SUBJECT: Project Title: Reading Comprehension in Dementia of the
Alzheimer's Type: Factual versus Inferential

The above-entitled study falls under category #2 and is considered to be exempt from review by the Committee on Human Research. Therefore, this study has been put into our exempt files, and you will receive no further communication from the Committee concerning this study. If possible, please notify the Committee when this project has been completed.

If the involvement of human subjects in this study changes you should contact the Committee on Human Research to find out whether or not these changes should be reviewed.

If you have further questions regarding the status of this study, please call Nancy White at ext. 7887.

Schools:
Schools of Dentistry, Medicine, Nursing

Clinical Facilities
University Hospital
Doernbecher Memorial Hospital for Children
Crippled Children's Division
Outpatient Clinics

Special Research Division
Villum Institute for
Advanced Biomedical Research

REPORT OF SUBCOMMITTEE ON HUMAN STUDIES		PROJECT OR PROGRAM TITLE Reading Comprehension in Dementia of the Alzheimer's Type: Factual vs Inferential	NUMBER
PRINCIPAL INVESTIGATOR'S NAME Marie T. Rau, Ph.D., SLP-CCC		VA FACILITY VA Medical Center, Portland, Oregon	
INSTITUTION OF SUBCOMMITTEE (or the equivalent body) Veterans Administration Medical Center, Portland, Oregon		DATE OF REVIEW May 10, 1988	
This subcommittee has reviewed the above described project with respect to the rights and safety of the human subjects. The following are our findings:			
1. RISKS (Check one)			
☒ The planned research involves little foreseeable risk and the subjects safety is adequately protected unless the plan is modified. ☐ The foreseeable risk is justified by the potential benefit to the subjects or by the anticipated benefit to society and the plans include adequate and appropriate measures to reduce the risk insofar as feasible. ☐ The risk is justified but further measures seem advisable to protect the subject, including _____ ☐ The risk seems greater than can be justified by the research as planned and the project or program is not approved as presented.			
2. INFORMATION FOR THE SUBJECT (Check one)			
☒ The information to be given the subjects (or their legal representatives) is complete and accurate enough for them to reach a valid decision concerning participation in the research. ☐ The information for the subjects as presented is incomplete or defective in that _____ 			
3. CONSENT METHOD (Check one)			
☒ The format and manner of obtaining informed consent from the subjects (or their legal representatives) is satisfactory. ☐ The method of obtaining informed consent is defective in that _____ 			
4. FURTHER COMMENTS			
5. RECOMMENDATION (Check one)		SIGNATURE OF CHAIRMAN	
☒ The project or program be approved as submitted. ☐ The plan or protocol be revised in keeping with our comments and resubmitted. ☐ The proposal as described be rejected.

November 14, 1988

Donna Graville, B.S.
Speech Language Pathology
Portland VA Medical Center
Portland, Oregon 97207

Dear Ms. Graville:

The Institutional Review Board of Good Samaritan Hospital & Medical Center has by expedited review approved your study entitled "Reading Comprehension in Dementia of the Alzheimer's Type: Factual versus Inferential". The consent forms for use with subjects drawn from Good Samaritan Hospital and Medical Center have been revised. Copies of the revised forms are enclosed.

You are free to begin your study at any time. Please be advised that you should inform the IRB of any changes in your protocol or if any problems emerge or serious or unexpected adverse patient experiences have been observed.

Sincerely,

H. M. Hieronimus
Coordinator,
Research Administration

APPENDIX B

CONSENT FORMS USED FOR BOTH SUBJECT GROUPS

Donna Graville, B.S.
 Marie T. Rau, Ph.D., CCC-SLP
 Speech Language Pathology
 Portland VA Medical Center
 Portland, OR 97207
 (503) 220-8262 x5711

Reading Comprehension in Dementia of the
Alzheimer's Type: Factual versus Inferential

Consent Form (DAT)

1. The purpose of this study is to gather information on the reading comprehension of normal elderly subjects and those with dementia of the Alzheimer's type. I understand that I/my spouse/ward was selected for this study because I/he/she has been diagnosed with probable dementia of the Alzheimer's type (DAT).

Donna Graville has explained the details of the study. The procedure involves reading aloud, five passages, and answering the questions following each passage by pointing to the correct answer.

I understand that I will be informed of any changes in the nature of the study or in the procedures, as described above, as they may occur. Donna Graville will answer any and all questions that I have.

2. I understand that there is no risk or discomfort involved.

I understand that there is no benefit of this procedure to me/my spouse/ward, but that the study may help to better understand how reading comprehension is affected in normal elderly and those with DAT.

3. I consent to the use of the results of this study for publication for scientific purposes, excluding my/my spouse/ward's identity.

4. I understand I/my spouse/ward may leave the study at any time without prejudice or without any effect upon VA benefits, my relationship with Portland State University or Good Samaritan Hospital.

5. Therefore having given consideration to the above information, I voluntarily consent to participate in this study as described.

 Volunteer/Guardian's Signature

 Date

 Witness's Signature

 Date

If you experience problems that are the result of your participation in this study, please contact the secretary of the Human Subjects Research and Review Committee, Office of Grants and Contracts, 303 Cramer hall, Portland State University, 464-3417.

Donna Graville, B.S.
Marie T. Rau, Ph.D., CCC-SLP
Speech Language Pathology
Portland VA Medical Center
Portland, OR 97207
(503) 220-8262 x5711

Reading Comprehension in Dementia of the
Alzheimer's Type: Factual versus Inferential

Consent Form (Normal Volunteers)

1. The purpose of this study is to gather information on the reading comprehension of normal elderly subjects and those with dementia of the Alzheimer's type (DAT). I understand that I was selected for this study because I have no history of head trauma or neurological damage.

Donna Graville has explained the details of the study. The procedure involves reading aloud five passages and answering the five to seven questions following each passage by pointing to the correct answer.

I understand I will be informed of any changes in the nature of the study or in the procedures, as described above, as they may occur. Donna Graville will answer any and all questions that I have.

2. I understand that there is no known risk or discomfort involved.

I understand that there is no benefit of this procedure to me, but that the study may help to better understand how reading comprehension is affected in normal elderly subjects and DAT subjects.

3. I consent to the use of the results of this study for publication for scientific purposes, excluding my identity.

4. I understand I may leave this study at any time without prejudice or without any effect upon VA benefits, my relationship with Portland State University or Good Samaritan Hospital.

5. Therefore having given consideration to the above information, I voluntarily consent to participate in this study as described.

Volunteer's Signature

Date

Witness's Signature

Date

If you experience problems that are the result of your participation in this study, please contact the secretary of the Human Subjects Research and Review Committee, Office of Grants and Contracts, 303 Cramer Hall, Portland State University, 464-3417.

APPENDIX C

EXAMPLE OF NRST PASSAGES AND QUESTIONS

Each spring Adelie penguins return to a nesting ground that has many small stones. This place is called a rookery. Here each pair of mates builds a nest of stones. The male and female alternate collecting stones because if the nest isn't guarded, other penguins will steal the stones.

The female lays the eggs. Then her mate sits on them while she goes to the sea to eat and get fat. In about two weeks the female returns and the famished male goes to feed. She sits on the eggs for two more weeks until they hatch.

13. While the male sits on the eggs, the female

A. gets hungry. B. steals stones.

C. goes to the sea to eat. D. builds a new nest.

14. About how long does it take penguin eggs to hatch?

A. 1 week B. 4 weeks C. 7 weeks D. 10 weeks

15. After the eggs are laid, the male and female

A. collect food for each other. B. take turns sitting on them.

C. leave them alone to hatch. D. return together to the sea.

APPENDIX D

REVISED NELSON SCORE SHEET

REVISED NELSON SCORE SHEET

#	ANS	CA	TYPE	+/-
1		A	H	
2		B	H	
3		D	H	
4		B	L	
5		B	L	
6		D	H	
7		A	T	
8		C	T	
9		D	T	
10		A	L	
11		A	L	
12		B	H	
13		C	L	
14		B	T	
15		B	T	
16		A	T	
17		D	H	
18		C	T	
19		B	H	
20		C	L	
21		D	H	
22		A	H	

SUBJ. INT.:

TOTAL MINS:

LA CORRECT: /10

TA CORRECT: /12

HA CORRECT: /11

CORRECT: /33

MMSE SCORE: /

#	ANS	CA	TYPE	+/-
23		A	T	
24		D	H	
25		C	T	
26		C	T	
27		A	L	
28		B	L	
29		D	T	
30		D	L	
31		D	T	
32		A	L	
33		C	H	