

INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

U·M·I

University Microfilms International
A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
313/761-4700 800/521-0600

Order Number 9315456

Formulaic language in aging and Alzheimer's disease

De Santi, Susan M., Ph.D.

City University of New York, 1993

Copyright ©1993 by De Santi, Susan M. All rights reserved.

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

A

FORMULAIC LANGUAGE IN AGING

AND

ALZHEIMER'S DISEASE

by

SUSAN DE SANTI

A dissertation submitted to the Graduate Faculty in Speech and Hearing Sciences
in partial fulfillment of the requirements for the degree of Doctor of Philosophy,
The City University of New York.

1993

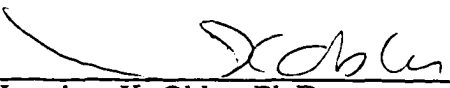
c 1993

SUSAN DE SANTI

All Rights Reserved

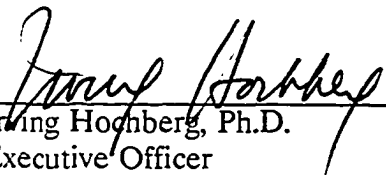
This manuscript has been read and accepted for the Graduate Faculty in Speech and Hearing Sciences in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

25 Jan. 1993
Date



Loraine, K. Obler, Ph.D.
Chair of the Examining Committee

Jan. 27, 1993
Date



Irving Hochberg, Ph.D.
Executive Officer

Wilma Rosen, Ph.D.

Lynne Clark, Ph.D.

Supervisory Committee

The City University of New York

ABSTRACT

FORMULAIC LANGUAGE IN AGING AND ALZHEIMER'S DISEASE.

by

Susan De Santi

Advisor: Distinguished Professor Loraine K. Obler

Formulaic and novel language was studied in normal aging and Alzheimer's disease. Two schools of thought regarding formulaic language have arisen in the literature on language in Alzheimer's disease. One hypothesis is that processing formulaic language is more difficult than processing novel (propositional) language. However, descriptive studies indicate that formulaic language production is more abundant than novel language in the speech of those with AD. Four experiments were administered to explore this controversy, as well as normal aging effects. Both types of language were tested with respect to various types of processing using a comprehension task, a grammaticality judgment task, a sentence completion task and a sentence repetition task. Results support a dissociation between comprehension and the other language abilities tested in Alzheimer's disease; comprehension of formulaic language is more compromised by the disease process and production (repetition, grammaticality judgment, and sentence completion) is relatively preserved. In normal aging this dissociation was not seen. Age related decline was noted, however, on those tasks which required complex processing and increased memory load.

DEDICATION

This dissertation is dedicated to Dr. Louis Gerstman, whose death on March 17, 1992 made it impossible for him to be here for the completion of this project. I will always remember his dedication to his students, his unending availability, and his genius with data. His illness forced me to find a measure of that "genius within myself" and I believe I have done well. Lou and I shared a saying "strive to be a builder" which meant that noble accomplishments are not easily attained. When we applied this to research we meant, that research demanded the fullest dedication of our capacities and time and that we never compromised ourselves, our efforts or our accomplishments with indolence.

So "cheers" to you Lou, thanks for being a part of my life. You'll be proud to know that with your help I am on my way to being a builder.

ACKNOWLEDGEMENTS

The undertaking of a Ph.D. was a commitment that involved many years of my life. There are many people who enabled me to take this path and encouraged me along the way. I wish to take this opportunity to thank them for their support.

T. James Matthews, Ph.D who introduced me to research, was convinced that I should pursue a Ph.D. and assisted me whenever I needed his help. Robert Goldfarb, Ph.D. who also believed I was Ph.D. material and helped whenever I called. Ms. Loretta Walker who simplified my life at CUNY in many ways. Fred Hornowski who was not only a friend but someone who helped me focus my thoughts and find the words that lay buried in my brain. To Jeanie, Marianne, Ellen, Gina and Carol, my friends, who were there whenever I called, in any capacity and with any aid I needed. To my brother, Michael, sisters, Denise and Yvonne, and my nephew and neice, Daniel and Kaitlin, whose encouragement, support and love surrounded me every step of the way.

To the students/faculty in dissertation seminar, especially Drs. Hochberg, Boothroyd, and Harris, who listened and helped develop the design of this project. Mark Weiss, Ph.D. who taught me about computer speech analysis. Mr. Cecil Redmond who was a wizard with equipment and with technical support. David Swinney, Ph.D. who generously shared his computer equipment and software for this project. Carol Torrosian, Chiam Tarshish and Elia Sinaiko who assisted with statistics and taught me how to do it. They sat beside me for hours as I learned SPSS and struggled with the data. Angela Genovese, Anita Haravon and Laura

Koenig who helped in data input and measurements and who made a tedious task enjoyable. Mony de Leon, Ph.D. who gave me the opportunity to work at NYUMC and provided a supportive work environment. I look forward to the future research we will produce. Kerry Kilborn, Ph.D. who proffered friendly support and thoughtful comments on the drafts of this dissertation. Richard Schwartz, Ph.D. who encouraged me when I was frustrated, assured me that dissertation problems do get resolved, provided true support and helped me smile. Wilma Rosen, Ph.D. who taught me about research design and whose guidance was greatly appreciated. Lynne Clark, Ph.D. who stepped in at a moment's notice and helped perfect this project. Loraine K. Obler who is a great example to a professional women. She is a true mentor who has taught me how to do research and how to be a person while doing it all. I hope she will be proud of my work, in the present and future and remember that she is a part of it all. Those people in the Wednesday night group that provided an open ear and emotional support. To my family, especially Mary and Daniel De Santi, my parents, who assisted me in every aspect of my life, and made this accomplishment possible. John Gaeta, my husband, without whose love and support many of these accomplishments would have been denied me, and complications might have overwhelmed me.

To all the people who participated in this project and their families; thank you for your contribution to our ultimate victory over Alzheimer's disease.

TABLE OF CONTENTS

	page
CHAPTER 1	1
INTRODUCTION	1
Terminology	1
Language of Alzheimer's disease	5
Lexical Organization of Formulaic Language	10
Normal Aging	14
Summary	15
RESEARCH ISSUES AND HYPOTHESIS	16
CHAPTER 2	18
SUBJECTS	18
EXPERIMENTS	25
EXPERIMENT 1	25
Introduction	25
Rationale	26
Hypotheses	27
Procedure	28
Stimuli	29
Analysis of Data and Results	30
Discussion	35
EXPERIMENT 2	40

	page
Introduction	40
Rationale	41
Hypotheses	42
Procedure	43
Stimuli	45
Calculation of Correctness Score	47
Calculation of Reaction Time and Reading Time	48
Analysis of Data and Results	50
Correctness Score	50
Reaction Time	57
Reading Time	61
Discussion	65
EXPERIMENT 3	74
Introduction	74
Rationale	75
Hypotheses	76
Procedure	77
Stimuli	79
Calculation of Response Type Score	80
Calculation of Reaction Time	82
Analysis of Data and Results	85

	page
Response Type Score	85
Reaction Time Prior to Key Word	99
Discussion	118
EXPERIMENT 4	125
Introduction	125
Rationale	127
Hypotheses	127
Procedure	127
Stimuli	128
Calculation of Correctness Score	128
Analysis of Data and Results	129
Discussion	137
CHAPTER 3	142
GENERAL DISCUSSION	142
Alzheimer's Disease	142
Lexical Organization and Processing	153
Normal Aging	158
Comprehension Versus Other Language Skills	166
Is Alzheimer's disease and exaggeration of normal aging	170
FUTURE RESEARCH	170
Appendix 1: Questionnaire	175

	page
Appendix 2: Informed Consent Form	178
Appendix 3: Individual Subject Characteristics	180
Appendix 4: Stimuli for Experiments 1 and 4	183
Appendix 5: Individual Scores for Percent Correct - Comprehension	186
Appendix 6: Stimuli for Experiment 2	189
Appendix 7: Individual Score for Mean Percent Correct	193
- Grammaticality Judgments	
Appendix 8: Individual Scores, Reaction Time	196
- Grammaticality Judgment	
Appendix 9: Individual Scores, Reading Time	199
- Grammaticality Judgment	
Appendix 10: Stimuli for Experiment 3	202
Appendix 11: Correctness Scores for Individual Subjects	204
- Appropriate and Inappropriate Responses	
Appendix 12: Correctness Scores for Individual Subjects	207
Appropriate - Predicted and Appropriate Not Predicted Responses	
Appendix 13: Reaction Time Scores for Individual Subjects	210
Appropriate and Inappropriate Responses	
Appendix 14: Reaction Time Scores for Individual Subjects	213
Appropriate - Predicted and Appropriate Not Predicted Responses	

page

Appendix 15: Individual Scores, Mean Percent Correct	216
- Sentence Repetition	
References	221

LIST OF TABLES

	page
SUBJECTS	
Table 1: Mean Group Characteristics	20
Table 2: ANOVA (Group x Education), (Group x SES)	24
EXPERIMENT 1	
Table 1.1: Mean Correct Scores	31
Table 1.2: Repeated Measures ANOVA	33
EXPERIMENT 2	
Table 2.1: Mean Percent of Correct Grammatical Judgments	51
Table 2.2: ANOVA: Grammaticality Judgment of Formulaic Sentences	53
Table 2.3: Repeated Measures ANOVA: Grammaticality Judgment for Novel and Ungrammatical Sentences	55
Table 2.4: Mean Reaction Time for Grammaticality Judgments	58
Table 2.5: Mean Reading Time for Grammaticality Judgments	62
Table 2.6: Mean Reaction Time for Grammaticality Judgments Idioms and Small Talk Phrases	71
EXPERIMENT 3	
Table 3.1: Mean Percent of Appropriate and Inappropriate Responses for Sentence Completion	86
Table 3.2: Repeated Measures ANOVA - Appropriate Responses	88
Table 3.3: ANOVA - Inappropriate Responses for Formulaic Sentences	90

	page
Table 3.4: ANOVA - Inappropriate Responses for Novel Sentences	90
Table 3.5: Mean Percent of Appropriate - Predicted and Appropriate - Not Predicted Responses for Sentence Completion	92
Table 3.6: Repeated Measures ANOVA: Appropriate - Predicted Responses	94
Table 3.7: Repeated Measures ANOVA: Appropriate - Not Predicted Responses	97
Table 3.8: Mean Reaction Time for Appropriate and Inappropriate Responses	100
Table 3.9: Repeated Measures ANOVA: Appropriate Responses	102
Table 3.10: ANOVA: Inappropriate Responses for Formulaic Sentences	104
Table 3.11: ANOVA: Inappropriate Responses for Novel Sentences	105
Table 3.12: Mean Reaction Time of Appropriate - Predicted And Appropriate - Not Predicted Responses	106
Table 3.13: Repeated Measures ANOVA: Appropriate - Not Predicted Responses	110
Table 3.14: Mean Reaction Time for Appropriate-Predicted, Appropriate - Not Predicted Responses for Idioms and Small Talk Phrases	114
Table 3.15: Mean Percent of Appropriate - Predicted, Appropriate - Not Predicted Responses for Idioms and Small Talk Phrases	116

EXPERIMENT 4

Table 4.1: Mean Percent of Sentence Repetitions	130
Table 4.2: Repeated Measures ANOVA Sentence Repetitions	132
Table 4.3: Mean Error Scores of Novel Sentence Repetitions	134
Table 4.4: Number of Occurrences of Error Type for Novel Sentence Repetitions	136

DISCUSSION

Table 5.1: Results of AD and Normal Elderly Control Groups on 4 Experiments	144
Table 5.2: Results of AD Group on Formulaic and Novel Sentences	149
Table 5.3: Results of Normal Elderly Control and Normal Young Control Groups: Comparison of 4 Experiments	160
Table 5.4: Results of Normal Elderly Control and Normal Young Control Groups: Comparison of Formulaic and Novel Sentences	163
Table 5.5: Results of Normal Elderly Control and AD Groups: Comparison of Formulaic and Novel Sentences	167

LIST OF FIGURES

	page
Figure 1. Key Phrase Measurement for Experiment 3	219
Figure 2. Key Phrase Measurement for Experiment 4	220

CHAPTER I

INTRODUCTION

The major question this dissertation seeks to answer is: Does formulaic language remain intact relative to propositional language in persons with Alzheimer's disease? There are two secondary questions. One addresses the organization of the lexicon for formulaic language and the other explores the possibility that formulaic language may change with normal aging.

The following sections first define terminology and then present historical and contemporary views of the concepts of automatic/formulaic language and propositional/novel language. This is followed by a discussion of language changes of Alzheimer's disease. Last evidence will be provided that leads to the formulation of the three questions of this dissertation.

Terminology

Theorists and researchers have applied various categorization systems to characterize the differences in language usage and processing. One distinction is between language strings that function as a large unanalyzed unit such as idioms (e.g., He has his head in the clouds.) or social everyday phrases (e.g., How are you?) and language that has the potential to be generated or parsed in normal usage (e.g., The boy is under the chair.). This categorization system focuses on a dichotomy between formulaic language (e.g., idioms, social phrases) and

propositional language (i.e., phrases and sentences that need to be generated) (Van Lancker, 1987).

Historically, formulaic language was labeled automatic language (Jackson, 1878). The term automatic has been used extensively in the normal language and brain damaged literature. Automaticity or automatic behavior was first introduced by Jackson (1878) who discussed the nature of brain function concerning speech/language abilities and brain damage associated with aphasia. He characterized automatic aspects of behavior as the unconscious use of language, the automatic structure of language, automatic verbal utterances, automatic processes, automatic movements, automatic muscles, degrees of automaticity and words being produced or retrieved automatically.

Emotional language, oaths, interjections, swearing, recurrent utterances, and certain over-learned phrases were included in the category of automatic speech. Additionally Jackson contrasted automatic language with propositional language. Propositions were viewed as linguistic symbols that expressed some mental representation or thought. By implication, conscious consideration was needed for propositions to be produced. Although an automatic phrase could have the same syntactic structure as a propositional phrase, the two phrases function differently and require different resources. Jackson provided an example of an aphasic patient who used several phrases (e.g., "Come on to me") in an automatic fashion. The phrases were automatic in that they were uttered whenever he tried to speak, but they carried no meaning in the given context.

Another example of automatic speech was utterances spoken appropriately in predictable and common circumstances (e.g., saying "Goodbye" when leaving). These same phrases could not be produced on command by some patients. Thus, these patients displayed conservation of automatic language use with loss of voluntary language use. Because the context elicited the production of the phrase, these phrases were considered highly organized in the nervous system.

In his theory of language loss in aphasia, Henry Head (1926) maintained the distinction between automatic speech and speech involving conscious thought. For Head, automatic speech included meaningless phrases, emotional phrases, oaths and familiar phrases including slang expressions. According to Head, these types of phrases did not involve conscious thought or culminate in an action. Head suggested that the expressions or cliches that are used to begin and maintain conversation during normal discourse add emotional tone and color to the conversation. Slang fits under the category of automatic language for Head.

Head raised questions about the definition of propositional language proposed by Jackson. He believed the criterion for what constituted a proposition was unclear. Head felt the term propositional language, as described by Jackson, was too restrictive concerning language behavior seen in aphasia. Rather Head viewed aphasia not just as an impairment in the mental representation of expressions but also in the symbolic formulation of those expressions. While Head broadened the category of what consisted of the automatic speech produced by aphasic patients, he did not explicitly define this term.

Goldstein (1948) distinguished between two types of language following a dichotomized categorization system using the terms abstract and concrete language for automatic and propositional language. Abstract language was viewed as a reflection of an abstract mental attitude including the volitional, propositional, and rational (logical) aspects of language. Concrete language, by contrast, consisted of the use of automatic speech, production of emotional language and the understanding of language in familiar or conditioned or context bound situations. Goldstein maintained Head's belief that everyday language use and understanding consisted of both abstract and concrete aspects of language combining both types of language. He proposed that automatic speech first occurred during a conversation and then is followed by more abstract language usage when people express their wants, desires or thoughts.

Luria (1970) maintained the notion of automatic language and propositional language when he discussed his classification of aphasia. In efferent motor aphasia, especially in the most severe cases, propositional abilities suffer, where the patient may be unable to formulate a proposition but would produce familiar phrases, emotional phrases and overlearned or practiced phrases.

Contemporary theorists dichotomize language using different terms from those used historically. In the current psycholinguistic literature the term formulaic language has been used to denote the concept of automaticity. Formulaic language, according to Peters (1983), "consist[s] of multimorphemic phrases or sentences . . . that have become available to a speaker as

prefabricated items in his or her lexicon" (p. 2). Van Lancker (1987) who agreed concurred with Peter's definition contrasted formulaic language with propositional language, stating that propositional language is created on-line according to grammatical rules. According to Van Lancker, speech formulae include: memorized phrases, swear words, exclamations, greetings and leave rituals, social control phrases, idioms, and small talk. More recently the terms familiar and novel language have been relabeled by psycholinguists as formulaic and propositional language respectively (Van Lancker and Kempler, 1987; Kempler, Van Lancker and Read, 1988). A third term, idiomatic language, yet to be defined, is often seen in the literature. According to Jackson (1874) Peters (1983) and Van Lancker (1987) idiomatic language is a type or subcategory of automatic/formulaic language. Idioms, according to the Dictionary of American Idioms (Boatner, Gates & Makkai, 1975) are phrases which have both literal and non-literal meanings. A review of the literature reveals that the terms automatic speech, formulaic language and idiomatic language have been used interchangeably. This dissertation will use the words formulaic language (used by Van Lancker, 1987) in describing overlearned language behavior that is under study and contrast it with novel language.

Language of Alzheimer's Disease

Dementia of the Alzheimer's type is a degenerative neurologic disease process affecting both linguistic (language comprehension and language

production) and metalinguistic aspects of language. The most obvious change in language functioning in persons with Alzheimer's disease occurs at the semantic level, specifically affecting lexical conceptual information. For example, impairment in naming objects has been detected in mild stages of AD (Appell, Kertesz, & Fisman, 1982; Obler, 1983; Huff, Corkin, & Growdon, 1986) and becomes more severe as the disease progresses in moderate dementia (Bayles & Tomoeda, 1983). As noted in the literature in a variety of naming tasks, lexical semantic problems manifest themselves as a reduced size of vocabulary (Schwartz, Marin, & Saffran, 1979; Bayles, Boone, Tomoeda, & Slauson, 1989), reduced verbal fluency (Rosen, 1980; Appell et al., 1982; Gerwirth, Shindler, & Hier, 1984), and empty speech during discourse (Obler & Albert, 1981, 1984; Obler, 1983; Nicholas, Obler, Albert, & Helm-Estabrooks, 1985). Impaired word association abilities (Gerwirth et al., 1984; Santo Pietro & Goldfarb, 1985; Abeysinghe, Bayles, & Trosset, 1990), impaired non-verbal or pantomimed production of words (Kempler, 1988), and recognition of pantomimed words (Kempler, 1988; Huff, Mack, Mahlmann, & Greenberg, 1988) have been exhibited by persons with AD.

Other aspects of language and language use have been described as impaired in Alzheimer's disease. Verbal discourse has been characterized as circumlocutory, restricted in definite references (Obler, 1983), possessing a limited variety of vocabulary (Bayles, 1986), producing less information (Beeson, Bayles, Tomoeda & Slauson, 1987), and reintroducing topics inappropriately (Curtiss,

Kempler, & La Rue, 1983). Discourse during topic directed interviews was characterized as having short conversational turns with missing information which was classified by listeners as incoherent (Ripich and Terrell, 1988). A longitudinal study of conversational discourse in a moderately staged AD patient showed a steady decrease of the patient's request for clarification (Hamilton, in preparation), indicating a loss of knowledge of one's own conversational abilities and needs.

Interestingly, not all aspects of language are impaired with Alzheimer's disease. The partial preservation of language abilities in Alzheimer's disease has been of particular interest in attempts to understand both the disease process and the relationship among the components of language such as lexical - semantics versus syntax, morphology, phonology (Whitaker, 1976; Schwartz et al., 1979; Nebes, Martin, & Horn, 1984; Nebes, Boller, & Holland, 1986; Ober & Shenaut, 1988). Causino, Obler, Knoefel, and Albert (in preparation) observed some aspects of pragmatic abilities such as topic control, turn-taking, presupposition and directives were spared for some late-stage demented subjects they studied. Bilingual patients with AD could translate and correct the examiner's speech (De Santi, Obler, Sabo-Abramson and Goldberger, 1990).

Syntactic and phonological skills such as the ability to correct sentences containing grammatical or phonological errors (Schwartz, et al., 1979; Bayles et al., 1989), have also been observed to be relatively intact in AD patients.

Phonological abilities as reported by Bayles, Tomoeda, & Caffrey (1982) appear

the most resistant to the disease process. Sentence structure of AD patients during discourse was observed as complex, containing similar sentence structures to those seen in normal age-matched controls (Appell et al., 1982; Kempler, Curtiss, & Jackson, 1987). Nebes et al. (1984, 1986) showed intact semantic priming skills during word pronunciation and lexical decision tasks. Finally, repetition priming (i.e., repeated exposure of the stimulus sentence) affects AD patients and normal adults similarly (Ober and Shenaut, 1988).

As some investigators (Schwartz, et al, 1979; Whitaker, 1976; Obler, 1980) proposed, the preserved syntactic and phonological abilities in production tasks may reflect the more automatic rule-governed aspects of language . Automatic aspects of language, which do not require conscious control, may remain functional in dementia (Schwartz et al., 1979; Bayles, 1982). The fact that semantic priming effects during word naming are grossly intact in moderate dementia, suggests that information in the semantic memory can be automatically activated and used in memory encoding (Nebes, Martin and Horn, 1984).

Collectively clinical findings reveal that even in final stages of Alzheimer's disease, patients demonstrate preserved use of formulaic language including conversational phrases (e.g., greeting and leave rituals). In contrast with anecdotal reports and clinical observations, the only published experimental investigation (Kempler, et al. 1988) of formulaic phrase comprehension (e.g., idioms and proverbs) actually revealed a deficit. Kempler, Van Lancker and Read (1988) studied the ability of mild, moderate and late staged Alzheimer's

patients to comprehend idioms using the Familiar and Novel Language Comprehension Test (FNLC). The FNLC tests comprehension of proverbs and idioms with newly generated or novel sentences. In the experiment AD and normal control subjects who listened to the stimulus sentence, were provided with a four-picture array in which they were to point to the picture that best described the stimulus. Results revealed that the Alzheimer's patients, unlike normal controls, performed better on the novel sentences than they did on the formulaic sentences. This pattern was maintained in all stages of AD.

Kempler and colleagues (1988) stressed that formulaic language is harder for the demented subject to process than is propositional language. As mentioned in the descriptive clinical literature on language in Alzheimer's disease, on the other hand, suggests that formulaic language is more likely to be produced by AD patients than propositional language. Because of these two viewpoints and the lack of experimental literature to resolve them, the primary question of this study was motivated, namely: What is the effect of Alzheimer's disease on formulaic and propositional language?

In a set of four experiments I will investigate whether a dissociation exists between formulaic and propositional language in AD patients. This study will experimentally compare the abilities of AD patients (mild - moderate staged) to comprehend and produce formulaic and propositional language.

Lexical Organization of Formulaic Language

Formulaic language has been studied in both normal and brain damaged adults. Because empirical research on formulaic language in Alzheimer's disease is sparse, it may be useful to review the literature of other neurologically impaired language populations in their use of formulaic language.

I will first present two hypothetical views of formulaic and novel language. and then describe a theory of lexical organization of formulaic language.

There are two theoretical perspectives that describe formulaic and novel language. The first proposes a dichotomy between formulaic and novel language, whereas the second suggests a continuum of language. The dichotomy has been erroneously attributed to Jackson (1874; 1978) by aphasiologists. The theories about language function in aphasia developed by Head (1926), Goldstein (1948), and Luria (1970) support this schema. As previously stated, these aphasiologists viewed these two types of language as mutually exclusive. Clinical evidence of language behavior following focal brain damage (i.e., loss of novel language with preservation of formulaic language) supports this dichotomy.

Jackson (1874, 1978) did not propose a dichotomy between these two language types. Careful reading of his theory reveals that he proposed a continuum of language constructions gradated from automatic or formulaic use of words to propositional word use. At the automatic end of the continuum, simple and compound interjections and conversational phrases occur whereas at the propositional end of the continuum, phrases which expressed relational meanings

occur (Jackson, 1974). Van Lancker (1987) also proposed a continuum of language, however more extensive gradations of formulaic language were provided including exclamations, greetings, idioms, conversational phrases and cliches.

Idioms, one type of formulaic language (Peters, 1983; Van Lancker, 1987) is midway on the continuum of language. Use of this language form has been studied extensively in the normal young aging (Gibbs, 1980; Gibbs, Nayak, Bolton, Keppel, 1989; Gibbs, Nayak and Cutting, 1989; Nayak and Gibbs, 1990) and in brain damaged populations (Van Lancker and Kempler, 1987; Kempler et al, 1988; Dronkers, in preparation). In the English language, idioms have a special status where some are considered frozen (i.e., they cannot undergo any grammatical transformations without losing their idiomatic meaning), and others are considered productive (i.e., they can undergo some but not all transformations) (Chafe, 1968; Fraser, 1970; Weinrich, 1969; Gibbs, 1980). For example the phrase, "Kick the bucket," is a frozen idiom that can be idiomatically interpreted as "to die." The idiomatic meaning is lost when the passive "the bucket was kicked by Jane" is made. On the other hand, an idiom such as, "John laid down the law," is syntactically productive in that the passive "the law was laid down by John" does not change the figurative meaning of this idiom. As discussed next, syntactically frozen idioms suggests that some idioms may not be subject to morphological level operations but processed as single lexical items.

Some theories of normal lexical organization offer an account of the differences regarding lexical storage and processing between formulaic and

propositional language. One such theory proposes that formulaic language is stored and processed in the lexicon as whole chunks and not as individual morphemes which characterize propositional language (Dronkers, in preparation; Van Lancker, 1987). Formulaic language does not follow the rules of combination that characterize propositional language. Formulae are processed like single lexical items without syntactic analysis (Dronkers, 1984). Peters (1983) argued that formulaic language is structurally fixed and contextually conditioned.

The results of experimental studies of normal adult and aphasic populations language performance partially support this latter theoretical perspective. To test the unitary nature of formulaic language, non-fluent aphasic patients made grammatical decisions about formulaic phrases faster than propositional phrases (Dronkers, in preparation). Further, these same subjects made lexical decisions about formulae as fast as they made decisions about single words. Collectively these results suggested that formulaic language may be processed as single lexical items not requiring syntactic operations.

The notion that some lexical items in an idiom can be changed without altering its figurative meaning is termed lexical flexibility (Gibbs, Nayak, Bolton, and Keppel, 1989). Lexical flexibility is different from the syntactic flexibility described above. A productive idiom may be, "Button the lip," which when changed to, "Fasten the mouth," can still maintain its figurative meaning. Other idioms as, "Kick the bucket," do not have this lexical flexibility and when changed to "Punt the pail" lose their idiomatic meaning. In a series of experiments, Gibbs

et al. (1989) showed that all idioms cannot be viewed as possessing the same lexical characteristics. They showed that some idioms maintain their figurative meaning even when a noun or verb gets substituted, where other idioms could not maintain their figurative meaning when such changes occurred (Gibbs, et al., 1989). Normal subjects have an intuition about the decomposability of idioms which can be separated from knowledge of the lexical and/or syntactic flexibility of the idiom. This study points to the possibility that some forms of formulaic language (those that are inflexible) may be single lexical items stored and processed as whole units.

Swinney and Cutler, (1979) investigated idiomatic understanding in normal college aged adults to determine if the literal meaning of the idioms was activated prior to the figurative meaning. Using reaction time studies, they determined that the figurative meaning of the idiom was accessed faster than the literal meaning. Their research further supports the first hypothesis that idioms are lexically stored and accessed as whole units, similar to that of single words. If these results hold true for the stimuli developed for the present investigation, then comprehension of formulaic language should exceed that of novel.

Comprehension of literal and figurative meanings of idioms in normal college age adults was studied by Gibbs (1980). Reaction times for comprehension of figurative meanings of idioms were significantly less than for literal meaning of the idioms despite the amount of available contextual information. Gibbs suggested the literal interpretation of the idiom doesn't need

to be retrieved before the figurative interpretation can be derived. According to Gibbs, the fact that idioms are used in everyday language is the most important influence on comprehension or processing idioms. Again Gibbs' data supports a single lexical item theory concerning storage and processing.

One piece of contradictory evidence to the discussion of idioms and other types of formulae being processed and stored as single lexical items, is derived from clinical observations noted in subjects with Alzheimer's disease (De Santi, personal communication). AD patients were observed making errors in their production of idioms (e.g., She's getting under my chin), while singing songs and when reciting rhymes. This later evidence raises the question of whether formulaic language is processed like single lexical units. Because there is no literature on AD versus normal aging exists, it raises the issue whether the problems with production of formulae are due solely to Alzheimer's disease and/or the normal aging process.

Normal Aging

The final question that is unclear at this point is whether the problems with production of formulae are due to Alzheimer's disease *per se* or to normal aging. By the very fact that the incidence of Alzheimer's disease increases with age, most persons with Alzheimer's disease are by nature older individuals. The appropriate control group for this patient population is healthy elderly persons. Most of the investigations reviewed here about comprehension of formulaic language

employed college students. Some theoretical frameworks (Obler, Albert, Goodglass and Benson, 1978; Brown and Jaffe, 1975) suggest language may become more automatic with age, yet no empirical evidence is available. For example, in a speculative paper Brown and Jaffe (1975) in discussing the increase in lateralization of language as a function of age, suggest there may also be an increase in its automaticity.

As stated above in the study of AD, healthy elderly persons usually serve as the control group. Reports of changes in language function specifically with regard to formulaic language in the healthy control subjects are not found in these studies. Further these studies do not have healthy young groups to serve as controls for the normal elderly. Therefore while there is an abundance of data on language in healthy aging, there is little or none from the AD literature that speaks directly to the question of language change in healthy aging. The normal aging language literature, on the other hand, reports that production of serial speech, one type of formulaic language, has been shown not to change with aging (Obler, 1980). Since healthy elderly adults were included in the present study, an important question was raised: What is the effect of normal aging on formulaic language relative to novel language?

Summary

As illustrated, the literature on Alzheimer's disease and normal aging concerning formulaic language is sparse; therefore no definitive conclusions can

be drawn for either population. Further limited tasks (i.e., comprehension and serial speech) were employed using formulaic language; therefore limited conclusions can be drawn. Additionally the same sentence (especially in comprehension studies with young normals) served as the formulaic stimulus and the novel counterpart; therefore other cognitive processes (i.e., facilitation and inhibition effects) might account for performance. What remains uninvestigated is an examination of formulaic and novel language across multiple modalities in various populations. The investigation proposed here will explore four linguistic processes in three populations using distinct formulaic and novel sentences.

RESEARCH ISSUES AND HYPOTHESIS

The main issue this dissertation seeks to clarify is the effect of Alzheimer's disease on formulaic language as compared to novel language. Only one study has examined comprehension abilities of these two aspects of language in patients with Alzheimer's disease. Furthermore, there is an apparent discrepancy (as discussed above) between the descriptive literature and the experimental study with regard to the disturbance of formulaic language. The specific question that will be addressed is whether and how AD affects performance of each of the two types of language. On the basis of a review of the literature regarding Alzheimer's disease, it is hypothesized that novel language performance will be more negatively affected by Alzheimer's disease than will formulaic language performance with regard to grammaticality judgment, sentence completion and

repetition tasks. On the other hand, comprehension of formulaic language will be more negatively affected by Alzheimer's disease than comprehension of novel language.

A second theoretical issue that this investigation addresses is how normal aging impacts formulaic and novel language performance. The possibility that language becomes more automatic as one ages has been suggested by Opler, Albert, Goodglass, & Benson, (1978), and Brown & Jaffe, (1975). The results of the experiments of this present investigation will provide further evidence regarding this issue since both young and older normal adults will be tested. It is hypothesized that older normal subjects will show a slight reaction time advantage over the younger normal subjects in their responses to formulaic language relative to novel language.

The final issue of this investigation is related directly to the lexicon, namely, do formulaic phrases have the same lexical status as novel phrases? In particular, are formulaic phrases processed, stored and treated the same (during comprehension, metalinguistic tasks and production tasks) as novel sentences? It is hypothesized that formulaic phrases will be processed differently than novel sentences for all tasks across all groups.

CHAPTER II

METHODS

SUBJECTS

Subjects were 12 persons with a diagnosis of probable Alzheimer's disease (ages 68-80), 12 healthy elderly (ages 69-81), and 12 healthy young (ages 21-34) persons (Table 1). All subjects were native monolingual American English speakers with normal vision with or without corrective lenses. Subjects with a history of hearing impairment, with or without a corrective device, were excluded from the study. All subjects had a minimum educational level of completion of the eighth grade.

A questionnaire was filled out by each subject (or guardian) providing information regarding medical, language and work histories (Appendix 1). All subjects (or guardians) gave informed consent to participate in the study (Appendix 2).

Alzheimer's subjects were recruited from The Aging and Dementia Research Center of The Millhauser Laboratories at New York University Medical Center (n = 11) and Peninsula Counseling Center, Lynbrook, N.Y (n = 1). For Group characteristics refer to Table 1. For individual characteristics refer to Appendix 3. Selection of subjects with Alzheimer's disease was based on the diagnosis of probable Alzheimer's disease according to the criteria set by NINCDS-ADRDA (McKhann, Drachman, Folstein, Katzman, Price & Stadler, 1984). Medical history, neurological examination, X-ray computed tomographic

brain scan, magnetic resonance imaging, blood tests, urine tests, and other medical procedures were reviewed to rule out the presence of other types of dementia, other neurological or medical conditions. Subjects with non-Alzheimer's dementing pathology (e.g., multiple infarcts, subcortical dementias, prior head trauma with loss of consciousness, infectious processes and drug and alcohol abuse) were excluded from this study. Those with a history of psychiatric problems, language learning disorders, visual acuity problems that were uncorrected with glasses and reading problems other than those resulting from Alzheimer's disease were also excluded from the study.

The normal elderly control subjects were recruited from The Aging and Dementia Research Center of NYUMC (n = 3) and from communities in Long Island (n = 6), New Jersey (n = 2) and New Hampshire (n = 1). The normal young control subjects were recruited from communities in Queens (n = 6), Long Island (n = 2), New Jersey (n = 1) and New Hampshire (n = 3). (See Appendix 3.)

Table 1

Group Mean Characteristics

Group	Age	Ed.	MMS	SES
Young				
\bar{X}	27	13.7	29.6	43.3
SD	(3.2)	(2.34)	(0.88)	(9.7)
Elderly				
\bar{X}	74	13.1	28.9	44.0
SD	(4.0)	(2.84)	(1.3)	(14.3)
A. D.				
\bar{X}	74	12.8	21.2	43.8
SD	(4.2)	(2.85)	(2.85)	(13.5)

Note.

Ed. = Education

MMS = Mini-Mental Status score (Folstein et al., 1975)

SES = Socio-economic Status (Hollingshead, 1977)

Normal control subjects (young and elderly) with a history of the following were excluded from this study: psychiatric problems, neurological disorders, language learning disorders, visual problems that are uncorrected with glasses, illiteracy and history of bilingualism (beyond the age of 4).

All subjects received the Mini Mental Status Examination (MMS) (Folstein, Folstein & McHugh, 1975). This exam documents the presence of cognitive impairment. A score of 24 or below (out of a possible 30 points) indicates a cognitive impairment. The following severity rating scale based on Kempler et al. (1988) was employed: Within Normal limits: 25-30; Mild dementia: 20-24; Moderate dementia: 15-19; and Severe dementia: 14 and below.

Among the AD patients, nine had a mild degree of dementia and three had a moderate degree.

The Global Deterioration Scale (GDS) (Reisberg, Ferris, de Leon and Cook, 1982) was administered to 10 of the 12 Alzheimer's disease subjects who were patients in the Aging and Dementia Research Center of New York University Medical Center. This instrument is a seven-point rating scale that assesses the cognitive and functional capacity of the elderly and provides a staging scale. The 7 stages of the Global Deterioration Scale include:

GDS 1 - no cognitive decline.

GDS 2 - very mild cognitive decline.

GDS 3 - mild cognitive decline.

GDS 4 - moderate cognitive decline.

GDS 5 - moderately severe cognitive decline.

GDS 6 - severe cognitive decline.

GDS 7 - very severe cognitive decline.

A GDS of 4 or more indicates dementia according to Reisberg et al. (1982). Additionally a GDS of 3 with a mini-mental score of 23 or below is indicative of dementia (Folstein, 1983). Subjects in this study with Alzheimer's disease were characterized as either GDS 3 (n = 2), GDS 4 (n = 5) or GDS 5 (n = 4), and were required to meet the criterion for dementia using one or both of the two staging scales; Mini-Mental Status Scale or the Global Deterioration Scale. The Mini-Mental Status examination was administered by this examiner on the same day that the experimental testing for this project was undertaken. The Global Deterioration Scale was administered to those subjects seen at the Aging and Dementia Research Center of New York University Medical Center by a physician the first day of admission to that Clinic.

All subjects received a socio-economic score (SES) from the Four Factor Index of Social Status (Hollingshead, 1977). This index was derived from information obtained from the questionnaire completed on all subjects. Scores were compiled from type of occupation, education, marital status and sex. A weight of 5 was multiplied to the occupation score and a weight of 3 was multiplied to the score given for education (Hollingshead, 1977). These two scores were combined and an SES score was obtained. This procedure is slightly different from the one used by Hollingshead (1977) who included the occupation

and education scores of the spouse of the subject (when subjects were married or widowed) and then averaged the subject and spouse's scores together to derive the SES score for that subject. The spouse's information was not available for many subjects in this project; therefore, it was not included in the analysis.

The AD and normal elderly groups were matched for age, education level, and socio-economic status. The normal young group was matched to the other groups based on educational level and socio-economic status. Analysis of variance revealed no significant differences among groups for years of education and SES (Table 2).

Table 2

Analysis of Variance: Group by Education Level

Source	SS	df	MS	F	p
Between Group	4.4	2	2.1	.3027	.7409
Within Group	239.25	33	7.3		

Analysis of Variance: Group by Socio-economic Status

Source	SS	df	MS	F	p
Between Group	2.8	2	1.4	.0090	.9911
Within Group	5308.35	33	160.8		

The ages of the normal elderly group and Alzheimer's disease groups were not significantly different ($t(22) = .54, p > .10$).

EXPERIMENTS

Four separate experiments were conducted in the same order for all subjects. Subjects were tested individually in a single one-hour session. Though 54 subjects were initially tested, data from only 36 were retained for analysis. Subjects were excluded because of technical problems ($n = 10$) or an inability to perform the experimental tasks ($n = 8$). All data from these subjects were excluded.

EXPERIMENT 1

INTRODUCTION

In general, language comprehension skills deteriorate with the progression of Alzheimer's disease (Appell et al., 1982; Au Obler & Albert, 1988; Bayles and Kaszniak, 1987; Emery, 1985; Faber-Langendoen, Morris, Knesevich, La Barge, Miller & Berg, 1988; Bates, Wulfeck, Marchman, Kritchevsky, 1991). Not all aspects of comprehension are equally compromised. Additionally, problems with comprehension of abstract items as opposed to concrete items were noted (Appell et al., 1982).

The present experiment was undertaken to replicate Kempler et al. (1988). They administered a comprehension task to AD patients to compare their understanding of formulaic utterances and novel utterances. The formulaic language that was tested included idioms and social phrases. Idioms cannot be comprehended by analyzing the meanings of the individual words that make up

the sentence or by using word order strategies (Frazer, 1970; Chomsky, 1980). It is often assumed that idioms are represented as single unanalyzed items in the mental lexicon (Swinney and Cutler, 1979). It is believed that comprehension of idiomatic language requires abstract reasoning skills because it necessitates going beyond the actual words in the phrase (Lezak, 1983; Gibbs, 1980).

Social phrases (e.g., "How are you?"), though not identical to idioms, are similar to them in several ways. They have a single meaning and thus may function as a single lexical unit (Frazer, 1970). Because they occur frequently in daily conversations they are highly familiar. By their usage social phrases may become fixed in form to the point where alterations do not occur. By contrast to idioms and social phrases, novel phrases are sentences generated from individual lexical items, requiring at a minimum, syntactic and lexical processing and analysis for comprehension.

RATIONALE

Kempler et al. (1988) found that subjects with Alzheimer's disease showed better comprehension of novel sentences than formulaic sentences and that normal elderly controls comprehended the two sentence types equally well. They also found (Kempler et al., 1988; Van Lancker and Kempler, 1987) that normal elderly subjects were more accurate than the subjects with Alzheimer's disease in comprehending both formulaic and novel sentences. A pilot project (De Santi, Obler, Gerstman, & Rosen, 1992) supported these findings. In addition, De Santi

et al. (1992) extended the study to include normal young control subjects and found no significant difference between the normal young and elderly groups in comprehension of both formulaic and novel sentences.

In order to accurately interpret and discuss the findings from experiments two, three and four of this investigation, a replication of Kempler et al's (1988) experiment was needed. Further a comparison of performance on comprehension with performance on other language tasks (grammaticality judgment, sentence completion and repetition) involving these two language types would lead to a more complete understanding of formulaic and novel language.

HYPOTHESES

The hypotheses were:

1. Subjects with Alzheimer's disease will perform significantly worse than the normal elderly and normal young control groups in comprehension of both formulaic and novel sentences while the two control groups will perform equally well irrespective of the type of sentence.
2. Comprehension of formulaic utterances will be poorer than comprehension of novel utterances for subjects with Alzheimer's disease. The normal young and normal elderly control groups will comprehend both types of sentences equally well.

PROCEDURE

Subjects were seated at a table and presented a booklet with four pictures. Two pictures were on each page. The experimenter read a stimulus sentence aloud and then the subject pointed to the picture that best depicted the sentence.

The subject was given the following instructions during the training period: "I'm going to say a sentence and I'd like you to match one of these pictures to the sentence that I say. Some sentences are kind of funny. They're idioms. Do you know what an idiom is? For example 'He has his head in the clouds'" (Kempler et al., 1988). The subject then pointed to the picture that described that sentence. If the response was correct the examiner said, "Yes, that is correct" and explained why. If the response was incorrect, the examiner said "No, that is not correct," and explained why, indicating the correct response. Another practice picture was given to the subject, using the same procedure. If the subject understood the task and correctly responded to the trials, the test began; if not, the two trials were repeated.

Formulaic phrases were always presented first. This procedure avoided a response set where subjects would take a lexico-syntactic analytic approach to comprehending formulaic items. Comprehension of formulaic utterances (which requires abstracting the overall concept of all the words) is a more linguistically challenging task than comprehension of novel sentences (which relies on word meanings and word order strategies). The linguistically challenging task was given first (i.e., comprehension of formulaic sentences), followed by the easier one (i.e.,

comprehension of novel sentences).

The examiner marked the response for each stimulus sentence on a response sheet. A correct response was scored as a 1. An incorrect response was scored as 0.

STIMULI

The stimuli were twenty formulaic phrases and twenty novel phrases (Appendix 4). Ten formulaic items and response cards comprised the first version of the Familiar and Novel Language Comprehension Test (Kempler et al., 1988). The other ten formulaic sentences and the twenty novel sentences were taken directly from the revised version of this test (Kempler and Van Lancker, in preparation).

A picture pointing task was used which minimized the auditory memory component of this comprehension task was utilized. The response array for both types of stimulus phrases consisted of three foils and one correct response. The response array for the formulaic sentences included: 1) a concrete response with a "referential representation of one word in the stimulus," 2) a response whose "meaning was opposite or related to the idiomatic meaning of the stimulus," 3) an "irrelevant choice," and, 4) the correct response. The response for the novel phrases included "three foils with grammatical misreadings such as adjective misassignment or subject-object reversal and the correct response" (Kempler et al., 1988).

ANALYSIS OF DATA AND RESULTS

The results of all test items (10 from the first version and 30 from the revised version) were analyzed first. The two versions were separately analyzed in the post hoc analysis.

The mean score of correct responses for formulaic and novel sentences which was derived for each group is shown in Table 1.1. The individual scores for each subject are in Appendix 5.

Table 1.1

Mean Correct Scores - Experiment 1

Group	Formulaic Phrases	Novel Phrases
Young		
\bar{X}	19.2	19.0
(SD)	(0.7)	(1.5)
Elderly		
\bar{X}	17.0	18.5
(SD)	(3.3)	(1.9)
A. D.		
\bar{X}	13.7*	15.3*+
(SD)	(4.3)	(2.9)

Note.

A.D. = subjects with Alzheimer's disease

* score significantly lower than the normal young control group.

+ score significantly lower than the normal elderly control group.

Each group's performance on each sentence type was compared using a repeated measures ANOVA. Using the data from all subjects in all groups violated the assumptions of the ANOVA, as a non-homogeneity of variance was noted for comprehension of formulaic sentences (Cochrans $C(11,3) = .61815$, $p < .05$) and for comprehension of novel sentences (Cochrans $C(11,3) = .59794$, $p < .05$). The repeated measures ANOVA with the data from two outliers (subject 31 and 34) in the AD group removed from the analysis was performed. The assumptions of homogeneity of variance were satisfied (formulaic sentences: Cochrans $C(10,3) = .569$, $p = .09$, novel sentences: Cochrans $C(10,3) = .391$, $p = .908$). The results from this analysis confirmed the previous results, indicating a significant between group effect and an effect of sentence type. These results are shown in Table 1.2.

Table 1.2

Repeated Measures Anova

Between-Subject Effect

Source	SS	df	MS	F	p
Within Cells	265.78	31	8.57		
Group	137.35	2	68.67	8.01	.002

Within-Subject Effect

Source	SS	df	MS	F	p
Within Cells	93.38	31	3.01		
Group	17.25	1	17.25	5.73	.023

Interaction Effect

Source	SS	df	MS	F	p
Within Cells	93.38	31	3.01		
Group X Stype	12.10	2	6.05	2.01	.151

Note. Stype = sentence type

Post hoc analysis of the significant groups effect used a Fisher LSD test. The results indicated that the normal young group was significantly more accurate at comprehending formulaic sentences than the subjects with Alzheimer's disease ($t(31) = 3.57, p = .001$). The normal young group did not perform significantly better than the normal elderly group ($t(31) = 1.82, p = .07$) but a trend was noted in that direction. Further the normal elderly group did not comprehend formulaic sentences significantly better than subjects with Alzheimer's disease ($t(31) = 1.83, p = .07$) but a trend was noted.

The results of comprehension of novel sentences showed a somewhat different outcome. The normal young ($t(31) = 3.50, p = .001$) and normal elderly groups ($t(31) = 2.83, p < .01$) were significantly more accurate than the subjects with Alzheimer's disease for comprehending novel sentences. The normal young and normal elderly groups did not differ from each other for comprehending novel sentences ($t(31) = .71, p = .48$).

To further analyze the significant within group effects, post hoc Fisher LSD tests were performed. The subjects with Alzheimer's disease performed significantly differently for each of the stimulus sentence types ($t(31) = -2.19, p < .05$), whereby comprehension of novel utterances was better than comprehension of formulaic utterances. The normal elderly control group was also significantly better on comprehension of novel sentences relative to formulaic sentences ($t(31) = -2.12, p < .05$). The normal young control group comprehended these two types of sentences equally well ($t(31) = .24, p = .81$).

Thus normal young and normal elderly control groups performed similarly for comprehension of novel utterances, and subjects with Alzheimer's disease performed significantly worse. Performance on comprehension of formulaic sentences was more complex in that the normal elderly group did not perform significantly worse than the normal young group and they did not perform significantly better than the subjects with Alzheimer's disease.

DISCUSSION

Hypothesis 1, which stated that the AD group would perform significantly worse than both control groups on both sentence types, while the normal elderly and young groups would perform equally well, was not fully confirmed. As expected the AD group made significantly more errors than both control groups for comprehension of novel sentences and significantly more errors than the normal young group for comprehension of formulaic sentences. Further the control groups did not differ from each other on their comprehension of formulaic and novel sentences. The unexpected result was that the normal elderly control group did not perform significantly better than the AD group for comprehension of formulaic sentences, although there was a trend in the expected direction. This finding may indicate that comprehension of formulaic language is becoming compromised with aging. The normal young control subjects' scores indicated a ceiling effect for both sentence types and, thus, we cannot know for certain if there is any difference in the comprehension of these different sentence types for

this group.

Hypothesis 2, which stated that the control groups would show no difference between the sentence types but the subjects with Alzheimer's disease would show a difference between the two sentence types, was partially confirmed. The subjects with Alzheimer's disease performed significantly worse on comprehension of formulaic sentences as compared to comprehension of novel sentences. The fact that the normal elderly control group also showed this same differential was a surprise.

The findings with the AD group replicate those obtained by Kempler et al. (1988). While comprehension of these novel phrases was easier than comprehension of these formulaic phrases for subjects with Alzheimer's disease, one should note that comprehension of both kinds of sentences was impaired, albeit novel less so. These results support the notion that comprehension in general is impaired in Alzheimer's disease (Appell et al., 1982; Emery, 1985; Bayles and Kaszniak, 1987; Au et al., 1988).

The results obtained with the normal elderly group did not replicate the findings of Kempler et al. (1988) or Van Lancker and Kempler (1987). In those studies (1987, 1988) normal elderly controls performed at ceiling for both formulaic and novel utterances. The normal elderly group studied here did not, but their comprehension of novel sentences was better than their comprehension of formulaic sentences ($p < .05$). Only the normal young group studied here performed at ceiling. The difference in performance of the normal elderly

subjects tested here and those tested by Kempler et al. (1988) and Van Lancker and Kempler (1987) may be accounted for, in part, in terms of age. Since the subjects in the current study were older ($\bar{X} = 74$ years) than Van Lancker and Kempler's subjects (1987) ($\bar{X} = 68$ years), perhaps comprehension of formulaic utterances begins to become compromised in the eighth decade of life. This notion is consistent with other research in language competencies in the elderly, which found that discourse parameters do not evidence age-related change until age 75 (Bayles, Rao, Trosset, Tomoeda, 1992) and naming abilities in subjects aged 70 and above began to deteriorate significantly (Nicholas et al., 1985).

The differences in results between the current study and those of Kempler et al. (1988) may also be a function of the differences in stimulus materials. The subjects tested by Van Lancker and Kempler (1987) were administered the first version of the Familiar and Novel Language Comprehension Test, whereas the subjects studied here were given the revised Test (in preparation). As mentioned previously, the revised Familiar and Novel Language Comprehension Test (in preparation) incorporated the formulaic test items from the first version and added 10 more. None of the novel sentences from the first version were used in the revised version. Perhaps the newer formulaic sentences were more difficult than the formulaic sentences in the original (1987, 1988) version. To determine if that could account for the differences between the results of the normal elderly subjects tested here and those tested by Van Lancker and Kempler (1987), an ANOVA was performed on those formulaic phrases tested by Van Lancker and

Kempler (1987). The results show that the normal elderly group tested here on the formulaic phrases used in the 1988 version of the Familiar and Novel Language Comprehension Test still did not perform at ceiling. Their mean percentage score of correct responses was 79%. This should be compared to the normal elderly group studied by Van Lancker and Kempler (1987) whose mean percent of correct responses was 97.3% for formulaic sentences.

A final concern which must be discussed is the picturability of idioms. It is possible that the connection one makes between an idiom and the pictorial depiction of that idiom was more difficult than the connection made for novel sentences. Anecdotally, some normal elderly control subjects reported that some pictures within a stimulus set were confusing or that there was more than one possible choice for that sentence. This concern was never voiced for the novel sentences by these subjects, so one might assume that confusion did not occur for the novel pictorial response choices.

The results of the two elderly groups (normal elderly and subjects with Alzheimer's disease) support the notion that formulaic and novel sentences are processed and comprehended differently within the semantic system. The fact that both these groups performed better on comprehension of novel sentences suggests that the processing of formulaic and novel sentences is not identical, a consistent finding in psycholinguistic research. The study of formulaic language in the psycholinguistic literature usually contrasts the idiomatic meaning of a sentence with the literal meaning of that same sentence (Gibbs, 1979, 1980;

Swinney and Cutler, 1979). The task administered here did not provide that contrast but rather explored comprehension of novel sentences that were not literal interpretations of idioms so that the idiomatic meaning would not interfere with processing novel stimuli.

The results of this experiment indicate that comprehension of these formulaic sentences but not these novel sentences is compromised with aging, whereas Alzheimer's disease affects comprehension of both formulaic and novel sentences but not to the same degree (formulaic sentence comprehension appeared more affected than novel sentences). Only the latter result confirms the findings of Kempler et al. (1988), who suggested that comprehension of formulaic language is more severely impaired (than novel language) in Alzheimer's disease.

EXPERIMENT 2

INTRODUCTION

Grammaticality judgment is a traditional psycholinguistic task which tests knowledge of the rules of language. On such a task one must reflect about knowledge of word order, morphological markers and agreement. Grammaticality judgment tasks have been used in studies in aphasia (Luria, 1977; Gardner, Denes and Zurif, 1975; Linebarger, Schwartz and Saffron, 1983; Friederici, 1982; Dronkers, in preparation) and child language (Gleitman, Gleitman and Shipley, 1972; de Villiers and de Villiers, 1973) to examine metalinguistic skills. Although certain metalinguistic skills have been studied, grammaticality judgment has not been experimentally investigated in persons with Alzheimer's disease. While the grammaticality task appears on the surface to be an easy task, the underlying skills needed may be compromised by the disease process. The issues at hand are: 1. Do subjects with Alzheimer's disease have access to their grammatical knowledge and 2. can they use this knowledge to make grammatical decisions about formulaic and novel sentences?

Given what has been hypothesized (in the first chapter) about formulaic language, that it is not generated by the rules of the language but, rather, processed and produced as chunks, this task may provide a clearer understanding about the differences between formulaic and novel sentence types. The question raised is: Are formulae subject to word-level operations and relatively impervious

to syntactic operations such as parsing? Naturally syntactic parsing characterizes processing of novel forms.

This experiment also explores the effect of age on the way formulaic and novel language are judged and the speed at which these judgments occur. The expectation is that speed of response will decline with age and Alzheimer's disease.

RATIONALE

This task was chosen because on some tasks (e.g., correcting syntactically aberrant sentences) syntactic abilities have been shown to be relatively spared in Alzheimer's disease (Whitaker, 1976; Schwartz et al., 1979; Appell et al., 1982), however on others (e.g., acting out responses to syntactically complex sentences without using semantic information - Emery, 1985) syntactic decline can be evidenced. This experiment explored one aspect of syntactic ability in aging and Alzheimer's disease, namely the ability to make grammaticality judgments for formulaic and novel sentences.

The hypotheses proposed are based in part on pilot work (De Santi et al., 1992) undertaken prior to this project. In that study, four normal elderly controls, four normal young control and four persons with Alzheimer's disease were tested on a grammaticality judgment task of formulaic, novel and ungrammatical sentences. High correctness scores for accurate grammatical decisions were achieved by all groups. Control groups were not differentiated from each other

nor from the subjects with Alzheimer's disease. The results from the subjects with Alzheimer's disease must be interpreted with caution since the number of subjects in the group was so small. In terms of reaction time, each group was fastest in making grammaticality decisions about formulaic phrases, then novel phrases and slowest for ungrammatical phrases. Sentence processing time did not differentiate the control groups from each other but the control groups responded faster than the subjects with Alzheimer's disease. The finding that the normal elderly control group was not slower than the normal young control group is contrary to expectation. Therefore, caution should be taken when interpreting their reaction time results and in proposing expectations.

HYPOTHESES

1. Subjects with Alzheimer's disease will perform significantly worse than the normal young and normal elderly control groups in grammaticality judgment for formulaic, novel and ungrammatical sentences, while normal elderly and normal young control groups will perform equally well for these three sentence types.
2. All groups will make more grammatical judgment errors for ungrammatical sentences than for formulaic and novel sentences, while they will not show a difference in the accuracy of judgments between formulaic and novel sentences.
3. All groups will be faster at making grammatical judgments and reading formulaic sentences than novel and ungrammatical sentences.
4. The normal elderly control group will be slower than the normal young control

group at making grammaticality judgments. The subjects with Alzheimer's disease will perform significantly slower than the normal young and normal elderly control groups for all stimulus sentence types.

PROCEDURES

The subject was seated in front of a portable Commodore 64 computer. The software package which ran this experiment was a C64 Psycholinguistic Lab developed by Dr. David Swinney from the Linguistics Department at the Graduate School of CUNY.

Subjects were asked to consider some verbal strings and make a decision about them using a two choice response mode. Oral instructions given by the examiner were "You will see some words on the screen. Some words will make a real sentence and some will not. Read each sentence aloud and press the "GOOD SENTENCE" button if what you read is a real sentence in English and the "BAD SENTENCE" button if what you read is not a real sentence in English. Do not press the button until you finish reading the sentence."

Each stimulus remained on the screen until the response was made (i.e., the subject pressed a button). A response box consisting of two buttons with the words "GOOD SENTENCE" and "BAD SENTENCE" written above each of the two buttons were the only keys available to the subject. When a response was made, the screen cleared and a fixation cross appeared on the screen. As necessary, the directions were restated and the subjects were asked if they were

ready to continue. When the subject was ready, the examiner pressed a button for the next stimulus presentation.

If the subject did not read the sentence aloud, the directions were repeated. If the subject did not press the button and only gave a verbal response, the instructions were repeated. In both cases that stimulus sentence was eliminated from the subject's data pool and the reaction time, read time and accuracy score were deleted. Of the 36 subjects that were included in the study only one had two incidents of missing reaction time data as that subject hit the response key prior to reading any portion of the sentence. Of the 2160 sentences analyzed for reading time, data were missing from 30 sentences (1.4%).

The stimuli consisted of 60 sentence trials composed of twenty trials of three sentence types; formulaic sentences, novel sentences and ungrammatical sentences. Ten practice sentences which included the three sentence types were administered first to make certain that the subject understood the task and could perform it appropriately. The training period was repeated once if the subject required further training. Stimuli were presented in large capital letters in green on a black background for ease of reading. Correctness scores for making the grammaticality decision, amount of time needed to read the sentence, and reaction time for making decisions about the sentence were calculated for each stimulus sentence. These procedures will be explained below.

Each stimulus remained on the screen until a response was made. If no response was made after one minute of stimulus presentation, the screen cleared

and no reaction time was recorded for that stimulus. A fixation "cross" was presented in the same spot as the first word in the stimulus phrase prior to presentation of each stimulus. The examiner had external control of the stimulus presentation so that the subjects did not feel rushed. After the fixation cross appeared on the screen the examiner repeated the directions if necessary, then said "ready" and pressed the button. If no directions were needed, the examiner said "ready" and then pressed the button for the stimulus presentation. When the examiner pressed the button to present the stimulus on the screen, a 1000 Hz. tone was sent to one channel on a tape recorder. The second channel on the tape recorded the subject's reading of the stimulus sentence.

To avoid order effects, three versions of the experimental sentences were created from the 60 stimuli sentences. Sentences were pseudo-randomized so that there were no more than three consecutive occurrences of one sentence type. An experimental protocol which included the three versions of this experiment was developed for each subject group. Consecutive subjects within each group were given consecutive versions of the protocol (i.e., Subject 1 received version 1, subject 2 received version 2, subject 3 received version 3, subject 4 received version 1, etc.).

STIMULI

Twenty pairs of sentences were developed. Each pair consisted of a formulaic sentence and a novel sentence. Two categories of formulaic sentences were used:

idioms (e.g., I smell a rat) and small talk phrases (e.g., It's my pleasure). There were equal numbers of the two categories (10 idioms and 10 small talk phrases). Small talk phrases were included because this is the type of language used in everyday speech and has been reported anecdotally to be preserved in AD. Peters (1983) and Van Lancker (1987) included small talk phrases (also known as conversational phrases) as one type of formulaic language.

The pairs of formulaic and novel sentences were matched for surface syntactic structure, likeliness of occurrence of the words, and sentence length in words. Nine ungrammatical sentences were developed by altering nine of the formulaic sentences (e.g., It my pleasure.) and seven were developed by altering seven propositional sentences (The couch is on floor the.). Four additional ungrammatical sentences did not match the formulaic or novel sentences. All ungrammatical sentences were altered from grammatical sentences by one change. The alterations consisted of changing verb tense, word order, part of speech or morphological markers (e.g., You knowed what I want.).

Formulaic sentences were developed using informal idioms (Boatner, Gates, & Makkai, 1984) and small talk phrases (sentences chosen from conversational speech). Novel sentences were developed by changing either the last content word or the first content word in the formula and did not contain any formulae. This included the following examples; first item changed (There's no end to our problems was changed to There's no solution to our problems), or last item changed (It's my pleasure was changed to It's my book). All sentences were

appropriately punctuated.

A concern in developing the novel (propositional) phrases was that the words forming the proposition should occur with the same likelihood as those words which formed the formula. Likelihood of occurrence for words within the propositional sentences was determined from a fill-in-the-blank task given to undergraduate students. Fifteen students were given 100 formulaic utterances with either the first or last content word eliminated. The students were instructed to fill-in-the-blank with the word that is most likely to occur without forming an idiom. All responses were written and tallied. The words chosen to produce the propositional phrases were the most frequently used word by this group. For example: given the idiom "The joke went over his head" and the sentence "the _____ went over his head," 90% of those participating in the task responded with "ball." Therefore, "The ball went over his head" was the propositional phrase matched with the formulaic phrase "The joke went over his head." The stimuli for this experiment are found in Appendix 6.

CALCULATION OF CORRECTNESS SCORES

Forty of the 60 trials for this experiment were GOOD SENTENCES the remaining were ungrammatical and therefore, BAD SENTENCES. When the subject correctly identified a sentence as GOOD a score of 1 was given for that sentence. When the subject correctly identified a sentence as BAD a score of 1 was given for that sentence. When a subject incorrectly identified a Good

sentence as Bad or a Bad sentence as Good a score of 0 was given for that sentence. The total number of correct responses was calculated as the correctness score.

CALCULATION OF REACTION TIME AND READING TIME

Two response times were calculated: 1) the time to read the sentence aloud, and 2) the time to make the grammaticality decision and press the button (reaction time). When a stimulus appeared on the computer screen, the computer's stopwatch function began to calculate the time. When the subject pressed the button the stopwatch stopped and that time was stored alongside the response (GOOD or BAD sentence) for that sentence. The time between stimulus presentation and button press was the reaction time (REACT TIME) for that stimulus presentation. The stopwatch reset and when the next stimulus appeared the procedure repeated itself and continued to do so for all stimulus presentations.

As stated previously, when the examiner pressed the button to present the stimulus on the screen, a beep was sent to a tape recorder. The tape recorder recorded the subject's reading of the stimulus. The period between the onset of the beep and the completion of reading the sentence was calculated as the reading time (READ TIME). The read time score was calculated off-line using the Kay Sonograph machine. The following equipment was used in the calculation of reading time:

- Kay Sonograph machine model DSP Sonograph 5500: digitized the analogue signal and displayed as a wave form.
- Zenith monitor ZCM-1492: displayed the digitized signal.
- Marantz Tape Recorder: presented the analogue signal.
- Sennheiser HD 414 headphones: enabled the examiner to auditorily monitor the digitized signal and determine the critical point for measurement of reaction time.
- Speaker JBL PRO III: enabled the examiner to listen to the digitized signal in a sound field.

All audio tapes were digitized using a wave form analysis program developed by the Kay Corporation to be used with the Kay DSP Sonograph machine. Each stimulus sentence was measured individually. The digitized signal was pictorially displayed on a video monitor. It included the 1000 Hz beep tone (indicating when the stimulus sentence was presented to the subject on the computer) and the stimulus sentence (read aloud by the subject). Please refer to Figure 1 as you are reading the following description.

The experimenter measured the interval between the onset of the beep (1) and the completion of the last phoneme of the last word in the sentence (2). The left cursor (A) was placed at the onset of the beep, the right cursor (B) was placed at the point where the subject finished producing the last phoneme of the last word and the waveform returned to baseline. The interval between the two cursors was measured and was considered the read time.

The read time score (READ TIME) and the reaction time (REACT TIME) score for each stimulus sentence were never compared to each other. This decision was made during sentence analysis of this data set as it was determined that the accuracy of the timing measurement using the Kay machine was at least , but not consistently, 100 msec. more precise than the stop watch function on the Commodore computer. Therefore, these two measures could not be compared to each other in any meaningful way.

ANALYSIS OF DATA AND RESULTS

1. Correctness Score

The mean percentage of correct responses for grammaticality judgments is shown below in Table 2.1 for all groups. Individual subject data can be found in Appendix 7.

Table 2.1

Mean Percent of Correct Grammatical Judgments

Group	Formulaic Phrase	Novel Phrases	Ungrammatical Phrases
Young			
\bar{X}	99.6#	92.1	93.3
(SD)	(1.4)	(10.7)	(4.4)
Elderly			
\bar{X}	96.7	92.5	86.7
(SD)	(5.8)	(07.2)	(7.2)
A. D.			
\bar{X}	92.1	85.8	78.3*
(SD)	(11.9)	(8.4)	(16.0)

Note.

= not analyzed due to ceiling effects

* score significantly lower than the normal young control group.

+ score significantly lower than the normal elderly control group.

The normal young group performed at ceiling level on grammaticality judgment of formulaic sentences. Because their performance with this type of sentence led to a violation on a test for homogeneity of variance, the young group was omitted from the repeated measures ANOVA. This analysis then revealed no significant difference between the normal elderly control group and the AD group on grammaticality judgment of formulaic sentences (Table 2.2).

Table 2.2

Analysis of Variance: Grammaticality Judgment of Formulaic Sentences

Source	SS	df	MS	F	p
Between Group	126.1	1	126.04	1.4296	.244
Within Group	1939.58	22	88.16		

Thus the AD group was as accurate as the normal elderly control group in grammaticality decisions about formulaic sentences.

A repeated measures ANOVA was performed to analyze the results for all three groups on accuracy of grammaticality judgments for novel and ungrammatical sentences. When all subjects' scores were included in the analysis, a violation of homogeneity of variance (using Cochran's test) was noted for ungrammatical sentences (Cochran's $C(11,3) = .782$, $p = < .001$) but not for novel sentences ($C(11,3) = .482$, $p = .310$). To equalize the variance, the data from subject 35, an AD patient who performed particularly poorly, were removed from the analysis. Homogeneity of variance was met for novel sentences ($C(11,3) = .468$, $p = .37$) but not for ungrammatical sentences ($C(11,3) = .630$, $p = .02$). The violation of homogeneity of variance noted for ungrammatical sentences was a result of the broad distribution of scores for the subjects with Alzheimer's disease and a narrow distribution of scores for the healthy control groups. Since the distributions of scores formed normal curves, no further analysis was undertaken to reduce the heterogeneity of variance for the ungrammatical sentences.

Results from the repeated measures ANOVA for grammaticality judgment of novel and ungrammatical sentences indicated a significant group effect, nonsignificant effects for type of sentence (within subject) and group X sentence interaction (Table 2.3).

Table 2.3

Repeated Measures Anova: Grammaticality Judgment - Novel andUngrammatical Sentences

Between-Subject Effect

Source	SS	df	MS	F	p
Within Cells	3553.13	33	107.67		
Group	1431.25	2	715.63	6.65	.004

Within-Subject Effect

Source	SS	df	MS	F	p
Within Cells	2686.46	33	81.41		
Group	292.01	1	292.01	3.59	.067

Interaction Effect

Source	SS	df	MS	F	p
Within Cells	2686.46	33	81.41		
Group X Stype	259.03	2	129.51	1.59	.219

Note. Stype = Sentence type

To determine where the differences between the groups lay in their percentage of correct responses for novel and ungrammatical sentences, post hoc analysis was performed using a Fisher LSD test. Comparing groups on the percentage of correct responses for novel sentences showed no significant group differences [normal young versus normal elderly ($t(33) = .115$, $p = .91$); normal elderly versus AD ($t(33) = 1.82$, $p = .07$); normal young subjects versus AD ($t(33) = 1.71$, $p = .09$)].

It was only for decisions about ungrammatical sentences that significant results were obtained. Although the control groups performed equally well ($t(33) = 1.56$, $p = .127$), and the AD group did not differ from the normal elderly control group ($t(31) = 1.95$, $p = .06$), the AD group was significantly less accurate than the normal young control group ($t(33) = 3.51$, $p = .001$).

A within group analysis examining the three stimulus sentences types was undertaken for the normal elderly control and AD groups using a Fisher LSD analysis. The results indicated that the normal elderly control group responded to formulaic sentences with greater accuracy than novel sentences ($t(40) = 1.97$, $p = .05$) or ungrammatical sentences ($t(40) = 3.95$, $p < .001$) and responded to novel sentences with greater accuracy than ungrammatical sentences ($t(40) = 1.97$, $p = .05$). The subjects with Alzheimer's disease judged more formulaic sentences accurately than novel ($t(40) = 2.28$, $p < .05$) and ungrammatical sentences ($t(40) = 3.65$, $p < .001$).

In summary the groups performed equally accurately in grammaticality

judgments for formulaic and novel sentences. For ungrammatical sentences, the AD group differed only from the young normal control group.

2. Reaction Time

The mean reaction time score for each group for each stimulus type, correctly identified as a Good or Bad sentence can be found in Table 2.4.

Individual subject data are found in Appendix 8.

Table 2.4

Mean Reaction Time (msec.) for Grammaticality Judgments

Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
Young			
\bar{X}	2372	2405	2641
(SD)	(414)	(526)	(447)
Elderly			
\bar{X}	2606	2754	2791
(SD)	(511)	(698)	(496)
A. D.			
\bar{X}	4620*+	4604*+	5259*+
(SD)	(1661)	(1797)	(2249)

Note.

A.D. = subjects with Alzheimer's disease

* score significantly lower than the normal young control group.

+ score significantly lower than the normal elderly control group.

The mean reaction times for all groups for each sentence type were initially analyzed using a repeated measures ANOVA. Violations of homogeneity of variance were noted, as determined by Cochran's test, for reaction time of formulaic sentences ($C(11,3) = .864$, $p < .001$), novel sentences ($C(11,3) = .808$, $p < .001$) and ungrammatical sentences ($C(11,3) = .918$, $p < .001$).

In order to counter this heterogeneity, median scores were derived for each subject for each sentence type. A repeated measures ANOVA was performed. However, the assumptions of homogeneity of variance were violated within this measure of central tendency as well.

In an attempt to eliminate heterogeneity of variance, the data were transformed using square roots and natural logs. Neither transformation resulted in homogeneous variances. Consequently, a nonparametric statistical procedure, Kruskal-Wallis one-way ANOVA test, was applied for each sentence type, followed by Mann-Whitney U tests for group comparisons. The comparison of reaction time for grammaticality judgments of formulaic sentences indicated a significant difference across groups ($X^2(2) = 16.28$, $p < .001$). The AD group was significantly slower than the normal young group ($z = -3.58$, $p < .001$) and the normal elderly group ($z = -3.23$, $p = .001$), but the two control groups were not significantly different ($z = .98$, $p = .32$).

Reaction time measures for grammaticality judgment of novel sentences showed a main effect of group ($X^2(2) = 13.39$, $p = .001$). The AD group was significantly slower than normal young group ($z = -3.29$, $p = .001$) and normal

elderly group ($z = -2.77$, $p < .01$), and the two control groups were not significantly different from each other ($z = -1.21$, $p = .22$).

Analyzing reaction time for ungrammatical sentences for all groups showed a main effect of group ($X^2(2) = 11.51$, $p < .01$). The AD group was significantly slower than the normal young ($z = -3.29$, $p < .01$) and the normal elderly control groups ($z = -2.77$, $p < .01$). Again the two control groups performed equally fast ($z = -.63$, $p = .53$).

Wilcoxon matched-pairs tests were performed to determine if each group's reaction times were significantly different for sentence types. The normal young group performed significantly faster on their decisions about formulaic sentences than for ungrammatical sentences ($z = -2.82$, $p < .01$). They were also faster at making decisions about novel sentences than ungrammatical sentences ($z = -2.43$, $p < .05$). There was no difference in the time it took normal young subjects to make grammaticality judgments for formulaic or novel sentences ($z = -.63$, $p = .53$).

The normal elderly control group was faster only at making decisions about formulaic sentences as compared to ungrammatical sentences ($z = -2.43$, $p < .05$). Although the absolute reaction time measure for formulaic sentences was faster than it was for novel sentences, no significance was noted ($z = -1.26$, $p = .20$). Novel sentences were not significant compared to ungrammatical sentences ($z = .000$, $p = 1$).

The subjects with Alzheimer's disease showed a different pattern. They

were not significantly faster for judging formulaic sentences as compared to novel sentences ($z = -.08$, $p = .93$) or as compared to ungrammatical sentences ($z = -1.41$, $p = .15$). A trend was noted for faster responding to novel sentences than to ungrammatical sentences ($z = -1.88$, $p = .06$).

In summary the normal young and normal elderly control groups responded equally quickly to making grammaticality judgments for formulaic, novel and ungrammatical sentences. The subjects with Alzheimer's disease were slower than the normal control groups in making grammaticality judgments for all sentence types. Only the normal control groups showed a differential pattern in reaction times to types of sentences. The control groups were faster for making decisions about formulaic utterances than they were at making decisions about ungrammatical utterances but not novel utterances. Only the normal young subjects were faster at making decisions about novel utterances than for ungrammatical utterances. The subjects with Alzheimer's disease did not show this pattern. Their response times for formulaic, novel and ungrammatical sentences were statistically equivalent.

3. Reading Time

Reading time was measured to rule out this performance factor's influence on the reaction time measurement. The mean reading time for each group for each sentence type is shown in Table 2.5. Appendix 9 contains the individual subject data scores.

Table 2.5

Mean Reading Time for Grammaticality Judgments

Group	Formulaic Phrase	Novel Phrase	Ungrammatical Phrase
Young			
\bar{X}	2230	2168	2511
(SD)	(261)	(389)	(275)
Elderly			
\bar{X}	2360	2375	2653
(SD)	(322)	(340)	(316)
A. D.			
\bar{X}	2913*+	2826	3426*+
(SD)	(504)	(665)	(1093)

Note.

A.D. = subjects with Alzheimer's disease

* score significantly lower than the normal young control group.

+ score significantly lower than the normal elderly control group.

To determine if each group performed differently from each other and to determine if there were differences of the sentence types a repeated measures ANOVA was performed. Violations of homogeneity of variance, determined using Cochran's test were noted for formulaic sentences ($C(11,3) = .612, p = .03$), novel sentences ($C(11,3) = .611, p = .03$) and ungrammatical sentences ($C(11,3) = .86, p < .001$). The procedures to counter the variance problems used with the reaction time data outlined in the section above were attempted with the reading time data. Neither using the median read time scores nor transforming the data with square roots or natural log adjusted the variance. The Kruskal-Wallis one-way ANOVA test, a nonparametric statistical method, was used to determine if reading scores differed for each sentence type. This was followed by Mann-Whitney U tests for group comparisons.

Reading time for formulaic sentences showed a significant group effect ($X^2(2) = 13.27, p = .001$). The AD group was significantly slower than the normal young group ($z = -3.34, p < .001$) and normal elderly group ($z = -2.65, p < .01$). Novel sentence reading time did not differ significantly among the groups ($X^2(2) = 5.15, p = .08$). Analysis of reading time for ungrammatical sentences revealed a significant main effect of group ($X^2(2) = 8.81, p = .01$). The AD group was significantly slower than the normal young ($z = -2.71, p < .01$) and normal elderly ($-2.14, p < .05$) control groups.

Wilcoxon matched-pairs tests were performed to determine if each group performed significantly differently for the three sentence types. The pattern of

performance was identical for all groups. The normal young group read formulaic and novel sentences equally quickly ($z = -.147, p = .88$). Ungrammatical sentences were read slower than formulaic sentences ($z = -4.63, p < .001$) and novel sentences ($z = -4.38, p < .001$). The normal elderly control group read formulaic and novel sentences equally quickly ($z = -.147, p = .88$) but read ungrammatical sentences slower than formulaic sentences ($z = -4.63, p = .001$) and novel sentences ($z = -4.63, p < .001$). The AD group, like the normal young group, read formulaic and novel sentences equally fast ($z = .147, p = .88$) but were slower at reading ungrammatical sentences than formulaic sentences ($z = -4.63, p < .001$) and novel sentences ($z = -4.38, p < .001$).

In summary, there was no main effect of sentence type and no interaction of sentence type by group. A main effect of group was obtained, however. Differences in reading time between the normal young and normal elderly control groups for all sentence types were not noted. The normal young and normal elderly control groups were significantly faster than the subjects with Alzheimer's disease at reading time for any sentence types.

When examining the performance for reading formulaic and novel sentences, all groups showed no reading time difference for these two sentence types. All groups were slower at reading ungrammatical utterances than they were at reading formulaic and novel sentences.

DISCUSSION

Taken together the results from the grammaticality judgment task confirmed some but not all of our hypotheses. Regarding Hypothesis 1, which stated that the two control groups would be equally proficient in terms of the number of accurate grammaticality judgments they made regardless of sentence type but that both groups would be more accurate than the subjects with Alzheimer's disease for all sentence types, we were partially correct. As predicted, there was no difference in the performance of the two control groups for all sentence types. The performance of the subjects with Alzheimer's disease did not support the hypothesis. They were as accurate as the control groups at making grammaticality judgments for formulaic and novel sentences and as accurate as the normal elderly control group at making judgments about ungrammatical sentences.

The second hypothesis proposed, that no groups would show a difference in the accuracy of grammaticality judgment for formulaic or novel sentences but both sentence types would be more accurately judged than ungrammatical sentences, was partially borne out.

The normal young control groups' performance could not be statistically evaluated as they reached a ceiling effect on judgments of formulaic sentences. Their performance on novel and ungrammatical sentences did show errors, although it is unlikely that these scores were different from formulaic sentences. The normal elderly control group was more accurate at judging formulaic and

novel sentences than ungrammatical. The Alzheimer's group was only more accurate at judging formulaic compared to ungrammatical. An unanticipated result for both control groups was that their performance on formulaic sentences was better than on novel sentences.

Hypothesis 3 for this experiment addressed reaction time and reading time measurements. It was hypothesized that judgments and reading times for formulaic sentences would be faster than judgments for novel sentences for all groups, and that reading and responding to both formulaic and novel sentences would be faster than for ungrammatical sentences. Some of our predictions were confirmed. The pattern of results was different for reaction time and reading time and each will be discussed separately.

All groups read formulaic and novel sentences faster than ungrammatical sentences which confirmed our hypothesis. All groups showed no reading time difference between formulaic and novel sentences, contrary to our prediction.

When we examined reaction time to formulaic and novel sentences compared to ungrammatical sentences, the normal young control group performed as expected. They were faster at making decisions about formulaic and novel sentences than ungrammatical sentences. The normal elderly control group was faster at making decisions about formulaic sentences than ungrammatical sentences, which supported our hypothesis.

All subject groups did not show a faster reaction time to formulaic sentences than to novel sentences. The subjects with Alzheimer's disease did not

support our hypothesis for reaction time comparisons of any stimulus sentence pair. The normal elderly control group did not react to novel sentences faster than ungrammatical sentences.

The last hypothesis postulated that the normal young control group would respond and read the fastest, followed by the normal elderly control group and then the subjects with Alzheimer's disease who would be the slowest. The normal elderly control group was as fast as the normal young control group at reading and making judgments for all sentence types, an unexpected finding. The AD group was slower for all sentence types for both reading and reaction time with one exception. They were not differentiated from the control groups for reading novel sentences.

The first question posed for this experiment concerned whether subjects with AD have access to grammatical knowledge that can be used to make grammaticality judgments for formulaic and novel sentences. The results from this experiment suggest that Alzheimer's disease does not affect grammaticality judgment abilities for types of sentences used in this study. The subjects with Alzheimer's disease were able to make accurate grammaticality judgments, however, they were slower at making these decisions than were the control groups.

There are a few things to consider when addressing these results. While there was an equal amount of stimuli for each sentence type (20 formulaic, 20 novel and 20 ungrammatical), there were more good stimuli (40 sentences) than

bad stimuli (20 sentences). In retrospect, this was a flaw in the design of the study and that using an equal number of grammatical and ungrammatical sentences would have prevented questions from being raised of subjects developing a bias toward good responses. Perhaps the results of the AD group who were as accurate as the control groups at deciding about formulaic and novel sentences, can be explained as a bias toward providing an affirmative response rather than a negative one. While this is possible, the fact that subjects with Alzheimer's disease did make errors on grammatical formulaic and novel sentences, saying they were bad suggests that they did not have a bias. Further, it was noted that when the subjects with Alzheimer's disease read the ungrammatical sentences, they often spontaneously and, apparently unwittingly, corrected them, and said that these corrected sentences were good sentences. Therefore, many of their errors on ungrammatical sentences were a result of reading errors rather than having difficulty switching response mode.

One should note also, that the subjects with Alzheimer's disease read both formulaic and novel sentences significantly faster than they read ungrammatical sentences, but we did not see this advantage in the reaction time measure. This fact suggests that it was the "deciding" aspect of the task that stressed the processing system of the subjects with Alzheimer's disease.

The results from the subjects with Alzheimer's disease provide supportive evidence that at least some aspects of syntactic processing are preserved with the disease. Those investigators (Emery, 1985; Bates, Wulfeck, Marchman,

Kritchevsky, 1991) who report syntactic deficits in Alzheimer's disease used relatively complex sentence structures. The experiment presented here used relatively simple syntactic structure. Further research where grammaticality judgments are tested on sentences with a variety of simple and complex syntactic structures could test whether the complexity factor influences syntactic judgments in AD.

The second issue that this experiment addressed was related to the lexicon. The syntactic processing of formulaic and novel sentences was examined to determine if formulae underwent syntactic processing operations during grammaticality judgments. One would expect formulaic sentences to be processed faster than novel sentences if they were not syntactically parsed. The fact that there was no difference in response time and reading time of formulaic and novel sentences suggests that these two types of sentences are equivalent with regard to syntactic processing. The fact that errors occurred, although admittedly infrequently, for all groups when making decisions about formulaic sentences, suggests that formulaic phrases are not processed as single lexical units, but that some syntactic processing occurs during grammaticality judgment.

The fact that the formulaic language employed included both idioms and small talk phrases may account for the reaction time findings. It is possible that these two types of formulae are sufficiently different from each other that they masked any potential difference between formulae and novel sentences. To test this concern each group's performance on these two types of formulae were

compared (See Table 2.6.)

Table 2.6

Mean Reaction Time (msec.): Grammaticality Judgments - Idioms and Small TalkPhrases

Group	Idioms	Small Talk Phrases
Young		
\bar{X}	2555	2189
(SD)	(519)	(355)
Elderly		
\bar{X}	2670	2541
(SD)	(519)	(573)
A.D.		
\bar{X}	5013	4227
(SD)	(2579)	(1879)

Note.

Idiom: N = 10.

Small Talk Phrases: N = 10.

The normal young control group responded to small talk phrases faster than idioms ($t(11) = 3.88, p < .01$). The normal elderly control group and the subjects with Alzheimer's disease did not show this pattern. There were no differences in reaction time for idioms and small talk phrases (normal elderly ($t(11) = 1.15, p > .10$); AD subjects ($t(11) = .89, p > .10$). It is possible that the normal young control group was less familiar with the idioms than the elderly groups, took a longer time to process this information, and eliminated any processing difference between formulaic and novel sentences. The performance of the elderly groups (normal elderly and AD) suggests that at least for the sentences examined here, formulae and novel sentences are not processed differently with respect to syntactic operations.

The third question this experiment addressed, examined age and its affect on grammaticality judgment. There was no aging effect noted in terms of response time. The normal elderly control group was as fast as the normal young control group at making grammaticality judgments. This result does not support the literature about reaction time slowing in normal elderly (e.g., Bromley, 1966; Salthouse, 1985; Botwinick and Storandt, 1974). The slowing effect accompanying aging was not seen with this task. Nebes et al. (1989, 1991) similarly noted that their normal elderly control group did not show a reduced reaction time measure for a sentence completion task. While that was a different task, it is consistent with the results found here that slowing is not a universal result of aging and that performance on some tasks will show this reduction while performance on other

tasks will not. The methodological limitations imposed by the AD subjects did not allow the use of modern chronometric methods used in many psycholinguistic studies. The fact that subjects were required to read each sentence aloud probably obscured any reaction time advantage the young group might have obtained.

EXPERIMENT 3

INTRODUCTION

In Experiments 1 and 2, there was conflicting evidence regarding formulaic and novel language. Comprehension (Exp. 1) of formulaic language was compromised with age and Alzheimer's disease, whereas comprehension of novel language was affected by Alzheimer's dementia only. Further, a dissociation was noted between the two types of language, whereby comprehension of formulaic language was more affected by dementia and age than comprehension of novel language. By contrast, grammaticality judgments (Exp. 2) for formulaic and novel language were not differentially influenced by age or Alzheimer's disease. Dementia, however, resulted in longer latencies for these decisions. None of the groups exhibited latencies shorter for formulaic language than for novel language. These results prompt further questioning about formulaic and novel language abilities in AD with regard to other language tasks, specifically: Do subjects with Alzheimer's disease have a differential ability to complete formulaic and novel sentences?

The findings from Experiment 2 do not provide support for the notion that formulaic language, in general, is treated differently from novel language (Kempler et al., 1988), as far as grammaticality judgment is concerned. Questions that remain are: Will formulaic sentences be completed faster than novel sentences; will the response types differentiate these two sentence types? The

answer to these questions may provide insight into how formulaic and novel units are represented in the mental lexicon.

The third area that requires further exploration is related to healthy aging. The lack of response time slowing for the normal elderly control group might have been a reflection of the task in Experiment 2. The question to be answered in this experiment is: Does aging affect the speed with which formulaic and novel sentences can be completed?

RATIONALE

Recently, sentence completion tasks have been used to study the language of subjects with Alzheimer's disease (Nebes, Boller and Holland, 1986; Nebes and Brady, 1991). These studies indicate that some aspects of semantic abilities are spared in Alzheimer's disease, in particular those aspects that are related to priming and completion of highly constrained sentences. The task administered here addressed a related question by comparing the ability of patients with AD to complete formulaic and novel sentences. It may be that formulaic sentences operate like the highly constrained sentences of Nebes et al.'s (1991) and AD patients will show no deficit on this task.

This experiment had two dependent measures. One was the appropriateness of the responses. This measure should permit us to assess the degree to which Alzheimer's patients retain control over lexico-semantic relations among constituents of formulaic and novel language. Thus, the appropriateness

measure was designed to assess aspects of lexical representation. The other measure was the amount of time required to locate, select and produce the response which completed the sentence was measured. The response latency measures were intended to evaluate the relative difficulty of processing formulaic and novel language. Both measures will be explained in greater detail below.

The hypotheses proposed are based in part on a pilot study (De Santi et al., 1992). Subjects with mild to moderate Alzheimer's disease (n=4) produced more inappropriate responses than the control groups for both formulaic and novel sentences. The normal young control group was not faster than the normal elderly control group at completing formulaic and novel sentences, contrary to expectation. The subjects with Alzheimer's disease were slower than the normal groups.

Taken together, response latency and appropriateness should provide a more comprehensive picture of aspects of lexical representation and processing than would be possible with either measure in isolation. Also, if the sentence completion task provides more support for the processing and/or representational differences between novel and formulaic language, we can be more confident that such differences are real and generalizable outside the narrow task domains used so far.

HYPOTHESES

1. The subjects with Alzheimer's disease will produce fewer **APPROPRIATE**

responses than the control group. The number of INAPPROPRIATE responses should be greater for novel sentences than for formulaic sentences.

2. The normal young control group will be faster at completing formulaic and novel sentences than the normal elderly control group.
3. The normal elderly control group will respond faster than the subjects with Alzheimer's disease when completing both formulaic and novel sentences.
4. All groups will be faster at responding to formulaic sentences than novel sentences.

PROCEDURE

This experiment used a cloze procedure in which the subject completed the sentence with a single, "best" word. Phrases and sentences were visually presented to the subject on a Commodore 64 computer. All words in the sentence except the last one were presented simultaneously. In place of the last word was a blank. A Marantz model PMD 201 tape recorder with a Sony model ECM - 155 microphone was used to record all responses. A tone generator that produced a 1000 Hz tone to the tape recorder was used to indicate to the examiner post hoc when the sentence was presented on the screen.

The directions the subjects received were as follows. "A sentence will come up on the screen. The last word will be omitted. Read the sentence aloud and complete it as quickly as possible. Only use ONE word to complete the sentence."

The stimulus was presented in large font size in green on a black background for clarity. Each stimulus remained on the screen until a verbal response was given by the subject, permitting a maximum response latency of 60 seconds. After the subject responded or if no response was made after one minute had elapsed, the examiner pressed a button that cleared the screen for 100ms. This was followed by a fixation cross that appeared at the location where the first letter of the sentence would be seen. The next stimulus sentence did not appear until the examiner pressed an external control button when the examiner judged that the subject was paying attention. When the external control button was pressed, the stimulus sentence appeared on the screen and simultaneously, the 1000 Hz tone was sent to the tape recorder. The synchronized time allowed calculation of a reaction time measurement directly from the recording.

A five-item training period was presented first, followed by the experiment. The training trial was repeated if the subject appeared to require further training. The training trial was repeated when the subject did not accurately complete more than three training sentences. If the subject did not understand the task or perform it incorrectly after two training trials, the subject was removed from the subject pool.

STIMULI

Twenty pairs of sentences were developed. Each pair was composed of a formulaic sentence and a novel sentence. Ten of the formulaic sentences were

idioms, 10 sentences were small talk phrases. The sentences were designed so that a single word could complete each pair of sentences although other words could also be appropriate. For example, the word "mouth" could complete the following sentences. "She took the words right out of my _____" (formulaic sentence), "I spit the food right out of my _____" (novel sentence).

Pairs of sentences were matched for surface syntactic structure and sentence length in words. Formulaic sentences were developed using informal idioms (Boatner, Gates, & Makkai, 1984); conversational small talk phrases were chosen from an English phrase book. Novel sentences were developed from the formulaic sentences by retaining the final element and changing as few elements from the formulaic phrase as possible so that the idiom was no longer recognizable. A verb and noun could be changed to yield the desired result (e.g., I love that dress you're wearing was changed to I want that hat you're wearing). Similarly, the pronoun and verb were changed in this example (It's raining cats and dogs to get the novel phrase He's petting cats and dogs). All novel sentences did not contain formulae and were judged for this constraint by two linguists.

For each pair of stimulus sentences the same target response (key word) was possible. For example: (formulaic phrase) It's raining cats and _____, (novel phrase) He's petting cats and _____. The word "dogs" that was considered the key word could occur in each of the two sentences. In this way, responses for the paired formulaic and novel sentences were matched. Consequently, simply to keep responses matched and scoring consistent, this word was considered the

desired or "predicted" response. A complete list of the stimuli for this experiment is found in Appendix F.

Two dependent measures, appropriateness score and reaction time, were taken. We will discuss each measure separately.

CALCULATION OF APPROPRIATENESS SCORE

Since one cannot derive a correctness score from this task because many different responses may be "correct," particularly for the novel stimulus sentences, measures of response appropriateness were obtained for each subject for each stimulus type. A response was considered appropriate if it was a single word that was syntactically and semantically possible as a completion of the stimulus sentence. An example of an appropriate response was "We made circles and triangles." An inappropriate response included multi-word responses and those which were not semantically or syntactically possible. An example of an inappropriate multi-word response was "Where are the books."

On the first review of the data, appropriateness of response was determined by the experimenter. The experimenter scored each response with an "A" (Appropriate) for a syntactically and semantically appropriate response and "I" (Inappropriate) for a syntactically or semantically inappropriate response or a multi-word response. Of the 1440 sentences that were scored, 32 (2%) responses were not easily categorized as "A" or "I." These responses were discussed with a linguist and the following conclusions drawn: if the response clearly violated

linguistic rules (syntactic or semantic) it was categorized as inappropriate. An example of this is in the sentence "You drove my car astray." Because "astray" is appropriately attributed only to animate objects and cars are inanimate objects, this response was categorized as inappropriate. The other decision regarding the odd use of words was: if the meaning of the sentence was clear and the word did not violate linguistic rules, the response was categorized as appropriate. An example of this is in the sentence "We won fair and even." The word "even" appears to be used here to indicate to equalize or to be level. The meaning of the sentence was relatively clear and there was no clear-cut violation of linguistic rules. This sentence was categorized as Appropriate.

In the next analysis appropriate responses were coded as Appropriate - predicted or Appropriate - not predicted. Appropriate - predicted responses were the ones used by the experimenter in the development of the stimulus sentences. Appropriate - not predicted responses were not chosen by the experimenter in the development of the stimuli.

Appropriate - predicted responses received a score of 3, Appropriate - not predicted responses a score of 2, and Inappropriate responses a score of 1. Two raters scored the sentences. The first rater scored all sentences using the 1, 2 or 3 scoring system. The second rater scored all sentences from 25% of the subjects (six subjects) that were randomly chosen. The scores from the two raters for responses other than those receiving a score of 3 were compared and an inter-rater reliability measure of $r = .90$ ($p < .001$) was obtained. Disagreements of

response scores between the raters were discussed and a consensus for these sentences was obtained.

CALCULATION OF REACTION TIMES

The reaction time measure was the amount of time from initiation of the stimulus to the time of response. It excluded the time needed to say the response. The reaction time for the key word should provide some insight into access and utilization of semantic information.

The stimulus presentation was controlled by the examiner. As mentioned previously, the examiner pressed a button that simultaneously presented the stimulus sentence on the computer screen and sent a 1000 Hz tone to a tape recorder. All sentences (and beeps) were recorded. Each reaction time was calculated in the laboratory after the experiment was completed.

All audio tapes were digitized using a waveform analysis program developed by the Kay Corporation to be used with the Kay DSP Sonograph machine (model 5500). Each stimulus sentence was measured individually. The digitized signal was pictorially displayed on a Zenith video monitor (model ZCM-1492). The digitized signal included the 1000 Hz beep tone (indicating when the stimulus sentence was presented to the subject on the computer), the stimulus sentence (read aloud by the subject) and the response produced by the subject. Please refer to "reaction time for key phrase" measure in Figure 2 while reading the following description.

The experimenter measured the time interval between the beep (A) and the point just prior to the initial sound of the response (B). The point just prior to the initial sound of the response or "key word" was obtained as follows. The experimenter listened (via Sennheiser HD 414 headphones) to the entire sentence including beep, stimulus sentence and response after it was digitized and displayed by the Kay machine on the monitor in a waveform display. Two cursors were available for the experimenter to move and block the displayed signal. The right cursor was placed at the end of the response (C). This point (the end of the response) was determined using visual and auditory feedback (via sound field using JBL PRO III speakers). Visually, the end of the response was noted as the point where the signal ceased and the pictorial display returned to baseline. Auditorily, the end of the response was noted as the point where the subject no longer produced the last phoneme in the response. The left cursor was placed at the point just before the onset of the key word (B) as noted using visual feedback. The experimenter simultaneously viewed the waveform and listened to the signal to determine the onset and end of the key word.

An example of the above procedure follows. If the sentence produced by the subject was "He's a snake in the grass," the experimenter isolated the word "grass." When the key word was isolated, the phrase before the key word was measured. This was calculated as the point where the beep signal began (A) to the point just before the key word (B). The experimenter listened to the signal marked within the cursors. This time the examiner heard the beep and the

stimulus phrase with the key word omitted. For example in the sentence "He's a snake in the grass," the examiner now heard "[beep] He's a snake in the." The time between the two cursors was noted at the bottom on the video display screen. This time was calculated as the reaction time prior to the key word for that stimulus sentence.

If the subject had a long pause before the key word, the response time was calculated from the beep to the point just prior to the first sound of the key word. The reaction time included the pause time. If the subject completed the sentence with one word and then changed to another word, the time from the beep to the second word was calculated as the reaction time. If the subject responded with more than one word (a phrase and therefore an Inappropriate response), the time from the beep to just before the first sound of the response phrase was calculated as the reaction time. If the subject conversed between the sentence presentation and response, the reaction time was measured from the beep to the point just prior to the response word. These sentences were not coded as Inappropriate responses as the conversations were usually semantic search strategies. For example when given the stimulus "How are ____?" After reading the stimulus, the subject said "question, question, question." Apparently this subject was using the syntactic structure of the sentence and the question mark as a strategy while searching his semantic network. In the rare instance where reaction time could not be calculated because of technical difficulty (e.g., telephone rang and masked the subject's voice), response time for that stimulus sentence was eliminated from

the data.

ANALYSIS OF DATA AND RESULTS

1. Response type score

As noted above, the response types for this task were categorized as Appropriate - predicted, Appropriate - not predicted and Inappropriate. An Appropriate - predicted response was one that was semantically and syntactically possible and was preassigned by the experimenter as the most likely response to complete the phrase. An Appropriate - not predicted response was one that was semantically and syntactically possible but not preassigned by the experimenter. Responses that were unacceptable for this category were multi-word responses or words that did not fit syntactically or semantically into the stimulus sentence.

The first analysis examined the mean percentage score for Appropriate responses and Inappropriate responses for formulaic and novel sentences. The results are found in Table 3.1. The Appropriate response category included both Appropriate - predicted and Appropriate - not predicted responses.

Table 3.1

Mean Percent of Appropriate and Inappropriate Responses for Sentence Completion.

Group	Appropriate		Inappropriate	
	formulaic	novel	formulaic	novel
Young				
\bar{X}	49.4	49.2	0.60 (#)	0.80 (#)
(SD)	(1.1)	(1.2)	(1.13)	(1.23)
Elderly				
\bar{X}	48.1	48.1	1.90	1.90
(SD)	(1.6)	(2.1)	(1.55)	(2.2)
A.D.				
\bar{X}	45.0*+	44.4*+	5.00+	5.60+
(SD)	(4.8)	(3.3)	(1.60)	(3.70)

Note.

= not analyzed due to rare occurrence.

* score significantly lower than the normal young control group.

+ score significantly lower than the normal elderly control group.

To determine if the mean percentage for each sentence type for Appropriate and Inappropriate responses differed, further analysis was undertaken. A repeated measures ANOVA was not possible for all response types as a heterogeneity of variance for Inappropriate responses was noted (variance was nonexistent for Inappropriate responses for normal young subjects as they made virtually none.) and the assumptions of this analysis were violated. Rather, two one-way ANOVAs were performed for Inappropriate responses (for normal elderly and AD groups) and a repeated measures ANOVA was used for Appropriate responses.

The repeated measures ANOVA examined the groups' performance on Appropriate responses to formulaic and novel sentences. When all subjects were included in this analysis, violations of the homogeneity of variance assumptions were seen. Using the Cochran's test for homogeneity of variance, significant results for formulaic sentences ($C(11,3) = .86, p < .001$) and novel sentences ($C(11,3) = .689, p < .01$) were obtained. To balance the homogeneity of variance, the data from five outliers in the AD groups were removed. The assumptions of the homogeneity of variance were satisfied (formulaic sentences: $C(9,3) = .511, p = .261$), novel sentences: ($C(9,3) = .489, p = .343$) with this procedure. The results seen in Table 3.2 show a between group effect but no within group or interaction effects.

Table 3.2.

Repeated Measures Anova: Appropriate Responses

Between-Subject Effect

Source	SS	df	MS	F	p
Within Cells	74.74	28	2.67		
Group	80.70	2	40.35	15.12	.000

Within-Subject Effect

Source	SS	df	MS	F	p
Within Cells	93.04	28	3.32		
Group	.52	1	.52	.16	.698

Interaction Effect

Source	SS	df	MS	F	p
Within Cells	93.04	28	3.32		
Group X Stype	.30	2	.15	.05 -	.955

Note. Stype = Sentence type

Post hoc testing using Fisher LSD indicated that the normal young control group did not complete significantly more formulaic sentences with Appropriate responses than did the normal elderly control group ($t(28) = 1.87, p = .07$), but did so compared to the AD group ($t(28) = 3.79, p < .001$). The normal elderly control group responded to formulaic sentences with a greater number of Appropriate responses than did the subjects with Alzheimer's disease ($t(28) = 3.76, p < .05$).

Post hoc Fisher LSD testing for novel phrases showed that the normal young control group made more Appropriate responses than the subjects with Alzheimer's disease ($t(28) = 3.98, p < .001$) as did the normal elderly control group ($t(28) = 2.64, p = .01$).

The next analysis examined the percentage of Inappropriate responses for formulaic sentences. The normal young control group was not included in this analysis as they made very few Inappropriate responses (9 out of 12 subjects had perfect scores). A one-way ANOVA was performed on the Inappropriate responses of the normal elderly and AD groups. Heterogeneity of variance, using the Cochran's test, was noted for formulaic sentences ($C = .904, p = .04$) but not novel sentences ($C = .74, p = .09$). Subject 36, an AD patient, was an outlier. With the results of that subject removed from the analysis, the assumptions of the homogeneity of variance were met for formulaic sentences ($C = .767, p = .06$) and for novel sentences ($C = .763, p = .07$). The results of this ANOVA showed that the normal elderly control group made significantly fewer Inappropriate

responses than the subjects with Alzheimer's disease (See Table 3.3).

Table 3.3

Analysis of Variance: Inappropriate Responses for Formulaic Sentences

Source	SS	df	MS	F	p
Between Group	22.69	1	22.69	4.491	.05
Within Group	106.10	21	5.05		

In Table 3.4 below note the results of the ANOVA for novel sentences completed with Inappropriate responses for the normal elderly control group and subjects with Alzheimer's disease.

Table 3.4

Analysis of Variance: Inappropriate Responses for Novel Sentences

Source	SS	df	MS	F	p
Between Group	83.17	1	83.17	8.61	.007
Within Group	202.69	21	9.65		

Again the normal elderly group produced fewer Inappropriate responses to novel sentences than did the subjects with Alzheimer's disease.

In the next analysis the percent score for Appropriate responses was separated into Appropriate - predicted and Appropriate - not predicted for formulaic and novel sentences. These mean response scores along with the Inappropriate responses for formulaic and novel sentences were derived for each group and are shown in Table 3.5.

Table 3.5

Mean Percent of Appropriate - Predicted and Appropriate - not Predicted Responses for Sentence Completion.

Group	Appropriate		Appropriate	
Group	Predicted		Not-Predicted	
	formulaic	novel	formulaic	novel
Young	38.9 (3.7)	25.2 (4.2)	10.4 (3.3)	23.9 (3.9)
Elderly	37.7 (3.6)	22.7 (4.6)	10.4 (2.8)	25.4 (3.2)
A.D.	33.8*+ (4.8)	18.1*+ (4.8)	11.3 (4.8)	26.3 (5.4)

Note.

* score significantly lower than the normal young control group.

+ score significantly lower than the normal elderly control group.

The mean percentage of responses for formulaic and novel sentences according to response type was further analyzed to determine if groups significantly differed from each other and if each group's response type differed for the two sentence types.

A1. Appropriate - Predicted Responses

A repeated measures ANOVA was performed to determine if the groups were significantly different from each other for their production of appropriate - predicted responses for formulaic and novel sentences. The results as seen in Table 3.6 indicated a significant effect of group and type of sentence. There was no interaction effect noted. (The assumptions of homogeneity of variance were met for this analysis using Cochran's test for formulaic ($C(11,3) = .543, p = .12$) and for novel sentences ($C(11,3) = .372, p = .10$)).

Table 3.6

ANOVA: Appropriate - Predicted Responses

Between-Subject Effect

Source	SS	df	MS	F	p
Within Cells	1058.07	33	32.06		
Group	476.22	2	238.11	7.43	.002

Within-Subject Effect

Source	SS	df	MS	F	p
Within Cells	272.66	33	8.26		
Group	3938.28	1	3938.28	476.66	.000

Interaction Effect

Source	SS	df	MS	F	p
Within Cells	272.66	33	8.26		
Group X Stype	10.94	2	5.47	.66	.523

Note. Stype = sentence type

Post hoc analysis using a Fisher LSD test was performed to determine where the significance lay for the between group effect. The results indicated that the normal young and elderly control groups did not differ from each other in the number of formulaic sentences they completed with Appropriate - predicted responses ($t(33) = .687, p = .49$). Both control groups produced significantly more Appropriate - predicted responses than did the AD group [$t(33) = 2.86, p < .01$] - AD versus normal young controls; ($t(33) = 2.17, p < .05$) - AD versus normal elderly controls].

The post hoc analysis of novel sentences using the Fisher LSD test indicated that the normal control groups did not differ from each other in the amount of Appropriate - predicted responses they produced ($t(33) = 1.35, p = .185$). The healthy young subjects produced significantly more Appropriate - predicted responses to novel sentences than did the subjects with Alzheimer's disease ($t(33) = 3.83, p < .001$). The normal elderly control group also produced significantly more Appropriate - predicted responses to novel sentences than did the subjects with Alzheimer's disease ($t(33) = 2.48, p = .01$).

The within subjects effect was analyzed using the Fisher LSD test. The results showed that all groups produced more Appropriate - predicted responses to formulaic sentences than to novel sentences (normal young: ($t(33) = 11.71, p < .001$), normal elderly ($t(33) = 12.78, p < .001$), AD subjects: ($t(33) = 13.31, p < .001$).

A2. Appropriate - Not Predicted Responses

The results of the repeated measures ANOVA comparing the percentage of formulaic utterances and novel utterances responded to with Appropriate - not predicted responses are found in Table 3.7. There was no significant effect for group and no significant interaction, but a significant difference between sentence types was noted. All groups produced more Appropriate - not predicted responses to novel sentences than to formulaic sentences (normal young: $t(33) = -8.19, p < .001$), normal elderly: $t(33) = -6.65, p < .001$, AD group: $t(33) = -9.09, p < .001$).

Table 3.7

ANOVA: Appropriate - Not Predicted Responses

Between-Subject Effect

Source	SS	df	MS	F	p
Within Cells	540.36	33	16.37		
Group	29.34	2	14.67	.903	.418

Within-Subject Effect

Source	SS	df	MS	F	p
Within Cells	384.11	33	11.64		
Group	3791.75	1	3791.75	325.76	.000

Interaction Effect

Source	SS	df	MS	F	p
Within Cells	384.11	33	11.26		
Group X stype	8.51	2	4.25	.37	.697

Note. stype = sentence type

Summary

In summary the results from the percentage of sentence completions for each group for each sentence type for each response type show that the normal young control group and the normal elderly control group did not differ from each other in the percent of responses to formulaic or novel sentences that were completed with Appropriate - predicted, or Appropriate - not predicted words. Both the normal young group and the normal elderly group provided more Appropriate - predicted responses than did the AD group for both formulaic and novel sentences. All groups did not differ in the number of Appropriate - not predicted responses made for formulaic and novel sentences. The normal elderly group made fewer Inappropriate responses for formulaic and novel sentences than did the subjects with Alzheimer's disease.

Examination of the percentage of response types within each group reveals identical response patterns. All groups produced significantly more Appropriate - predicted responses for formulaic sentences than for novel sentences and significantly more Appropriate - not predicted responses for novel sentences than for formulaic sentences. There were no differences within the groups for the amount of Inappropriate responses they made for either formulaic or novel utterances.

Looking at the interaction effect, one realizes that with age, the ability to respond as quickly to novel sentences as formulaic sentences becomes compromised. This ability is further compromised when one has Alzheimer's

disease.

2. Reaction Time Prior To The Key Word

The "prior to key word" reaction time measure incorporated the time needed to read, process the phrase and select the key word. This analysis was undertaken in part to get a better measure of the processing time needed to "find" the key word in one's lexical network. It was not possible to separate the time needed to read the sentence from the time needed to select the key word because both occurred simultaneously. While each subject read the sentence aloud, there appeared to be silent reading occurring in anticipation of what was to come next. This was evidenced by the position and duration of pauses during sentence reading.

A. Analysis using Appropriate and Inappropriate Responses

This analysis compared reaction time measures for all groups for formulaic and novel sentences according to response type (Appropriate versus Inappropriate). The Appropriate responses included Appropriate - predicted and Appropriate - not predicted words. Mean reaction time in msec. is in Table 3.8.

Table 3.8

Mean Reaction Time (msec.) for Appropriate and Inappropriate Responses.

Group	Appropriate		Inappropriate	
	formulaic	novel	formulaic	novel
Young	2030 (180)	2548 (689)	1950# (221)	2928# (1186)
Elderly	2222 (254)	2906 (719)	2559 (1691)	2240 (513)
A.D.	3236* (1321)	4469*+ (2028)	5748 (5181)	5199+ (2519)

Note.

data not analyzed due to rare occurrence of response.

* score significantly lower than the normal young control group.

+ score significantly lower than the normal elderly control group.

To determine if the mean reaction time measures were different, a repeated measures ANOVA was run for Appropriate responses and a series of ANOVAs was performed for Inappropriate responses. This procedure was utilized because the number of Inappropriate responses for each group varied for each sentence type (e.g., three normal young subjects made a total of three Inappropriate responses for formulaic sentences and four for novel sentences; Ten AD subjects made a total of 23 Inappropriate responses for formulaic sentences and 27 for novel sentences). Since the normal young subjects made virtually no Inappropriate responses, their data was excluded from the analysis.

A1. Appropriate Responses

The results of the repeated measures ANOVA that compared the mean reaction time scores for formulaic and novel sentences when the data from all groups was examined yielded a significant homogeneity of variance as determined by Cochran's test for formulaic sentences ($C(11,3) = .947, p < .001$) and novel sentences ($C(11,3) = .806, p < .001$). Data from 4 AD subjects (25, 29, 30, 34) were excluded. The homogeneity of variance problem was resolved for formulaic sentences ($C(10,3) = .602, p = .06$) and novel sentences ($C(10,3) = .555, p = .117$). Results indicate a main effect of group and sentence type as shown in Table 3.9.

Table 3.9

Repeated Measures ANOVA: Appropriate Responses.

Between-Subject Effect

Source	SS	df	MS	F	p
Within Cells	14277032.51	29	492311.47		
Group	7613693.96	2	3806847.0	7.73	.002

Within-Subject Effect

Source	SS	df	MS	F	p
Within Cells	7395535.57	29	255018.47		
Group	7904890.01	1	7904890.0	31.00	.000

Interaction Effect

Source	SS	df	MS	F	p
Within Cells	7395535.57	29	255018.47		
Group X Style	435000.34	2	217500.17	.85	.437

Note. style = sentence type

Post hoc Fisher LSD testing indicated that the subjects with Alzheimer's disease were slower than the normal young group ($t(29) = -2.099$, $p < .05$) at providing Appropriate responses to formulaic sentences. There was no difference between the Alzheimer's disease and normal elderly control groups ($t(29) = -1.49$, $p = .14$) or between the normal elderly and young control groups ($t(29) = -.67$, $p = .50$) in responding to formulaic sentences with an Appropriate response.

Fisher LSD testing indicated that the subjects with Alzheimer's disease were slower than the normal young ($t(29) = -3.43$, $p < .001$) and normal elderly control groups ($t(29) = -2.31$, $p < .05$) when providing an Appropriate response to novel sentences. Again the normal young control group was not significantly different from the normal elderly control group ($t(29) = -1.25$, $p = .22$).

Fisher LSD test revealed that all groups were faster when providing an Appropriate response for formulaic sentences than they were for novel sentences (normal young subjects: $t(29) = -2.51$, $p < .05$); normal elderly subjects: $t(29) = -3.32$, $p < .01$); AD subjects: $t(29) = -3.74$, $p < .001$).

A2. Inappropriate Responses

The next analysis examined the reaction time differences between the normal elderly and AD groups for inappropriate responses to formulaic sentences (Table 3.10). Recall that the normal young subjects were excluded from this analysis because they produced little Inappropriate responses. The results of this ANOVA showed no significant between group effect.

Table 3.10

Analysis of Variance: Inappropriate Responses for Formulaic Sentences

Source	SS	df	MS	F	p
Between Group	369814351.8	1	36814351.8	2.1539	.16
Within Group	256385048.7	15	170092336.5		

When the responses to novel sentences were examined using an ANOVA and data from all normal elderly and AD subjects were included, a significant homogeneity of variance was obtained ($C = .9658$, $p < .001$). The data from the outliers (subjects 25 and 29 of the AD group) were removed and the homogeneity of variance problem was solved ($C = .8008$, $p = .08$). A significant between group effect was noted (Table 3.11). Note that the normal elderly control group was faster than the subjects with Alzheimer's disease in providing Inappropriate responses to novel sentences.

Table 3.11

Analysis of Variance: Inappropriate Responses for Novel Sentences.

Source	SS	df	MS	F	p
Between Group	24960354.38	1	24960354.38	4.1957	.04
Within Group	57648821.60	12	4804068.46		

B. Analysis using Appropriate - Predicted, Appropriate - not - Predicted

Responses

The next analysis performed examined the reaction time for the production of the key word for Appropriate responses that were subcategorized as Appropriate - predicted, Appropriate - not predicted. The following table (Table 3.12) shows the mean reaction times for each group for each sentence type according to the type of response produced.

Table 3.12

Mean Reaction time (msec.): Appropriate - Predicted, Appropriate - Not Predicted Responses for Sentence Completion.

Group	Appropriate		Appropriate	
	Predicted		Not-Predicted	
	formulaic	novel	formulaic	novel
Young	2007 (153)	2385 (277)	2298 (746)	2695 (1116)
Elderly	2205* (249)	2637 (458)	2253 (534)	3170 (1089)
A.D.	3031*+ (804)	4033* (2548)	3690 (2810)	4796*+ (2147)

Note.

* score significantly lower than the normal young control group.

+ score significantly lower than the normal elderly control group.

Each group's mean reaction time for producing the key word for each stimulus sentence type was compared using a repeated measures ANOVA. Each response type was analyzed separately.

B1. Appropriate - Predicted Responses

The mean reaction time of Appropriate - predicted responses for all groups for each sentence type were initially analyzed using a repeated measures ANOVA. Violations of homogeneity of variance were noted, as determined by Cochran's test, for reaction time of formulaic sentences ($C(11,3) = .882$, $p < .001$) and novel sentences ($C(11,3) = .957$, $p < .001$). When the outliers (AD subjects 25 and 29) were removed from the analysis the homogeneity of variance problem did not change (formulaic sentences: ($C(10,3) = .659$, $p = .01$); novel sentences: ($C(10,3) = .653$, $p < .05$).

In order to counter this heterogeneity, median scores were derived for each subject for each sentence type. The repeated measures ANOVA was performed. However the assumptions of homogeneity of variance were violated within this measure of central tendency as well.

In an attempt to eliminate heterogeneity of variance, the data were transformed using square roots and natural logs. Neither transformation resulted in homogeneous variances. Consequently, a non parametric Kruskal-Wallis one-way ANOVA test was applied for each sentence type, followed by Mann-Whitney U tests for group comparisons. The comparison of reaction time for

Appropriate -predicted responses to formulaic sentences for the three groups indicated a significant difference across groups ($X^2(2) = 18.99, p < .001$). The AD group was significantly slower than the normal young control group ($z = -3.75, p < .001$) and the normal elderly control group ($z = -3.06, p < .01$). The normal young group was faster than the normal elderly group for this response type ($z = -2.36, p < .05$)

Reaction time measures for Appropriate - predicted responses to novel sentences using a Kruskal-Wallis one-way ANOVA showed a main effect of group ($X^2(2) = 7.09, p < .05$). The AD group was significantly slower than normal young ($z = -2.45, p = .01$) but not the normal elderly control group ($z = -1.67, p = .09$). The two normal control groups did not differ from each other in responding to novel sentences with Appropriate - predicted responses ($z = -1.33, p = .18$).

Wilcoxon matched-pairs tests were performed to determine if each group's reaction times were significantly different for sentence types. The normal young control group performed significantly faster on their completion of formulaic sentences than of novel sentences ($z = -3.06; p < .01$). A similar pattern was seen with the normal elderly control group who was only faster at completing formulaic sentences as compared to novel ($z = -2.98; p < .01$). The subjects with Alzheimer's disease did not show a reaction time advantage for formulaic sentences as compared to novel sentences ($z = -1.57, p = .11$).

B2. Appropriate - Not Predicted Responses

A repeated measures ANOVA was used to determine if there were any effects for producing an Appropriate - not predicted response as the key word for completion of the stimulus sentences. When data from all subjects were used in the analysis, significant homogeneity of variance using Cochran's test was noted for formulaic sentences ($C(11,3) = .903, p < .001$) and novel sentences ($C(11,3) = .655, p < .001$). When the outliers (AD subjects 25 and 29) were removed from the analysis the homogeneity of variance problem was resolved (formulaic sentences: $C(10,3) = .562, p = .18$); novel sentences: $C(10,3) = .487, p = .32$). The results of this ANOVA are listed in Table 3.13 and show a between group effect, a within group effect and an interaction effect.

Table 3.13

Repeated Measures ANOVA: Appropriate - Not Predicted Responses.

Between-Subject Effect

Source	SS	df	MS	F	p
Within Cells	45677659.97	31	1473481.9		
Group	10165267.86	2	5082633.9	3.45	.044

Within-Subject Effect

Source	SS	df	MS	F	p
Within Cells	1950802.93	31	629291.00		
Group	16162483.73	1	16162484	25.68	.000

Interaction Effect

Source	SS	df	MS	F	p
Within Cells	1950802.93	31	629291.00		
Group X Stype	4098087.97	2	2049044.0	3.268	.052

Note. stype = sentence type

To determine where significance lay between the groups, Fisher LSD testing was run. The results indicated that the subjects with Alzheimer's disease were not significantly slower than the normal young control group ($t(31) = .616$, $p = .54$) nor the normal elderly control group ($t(31) = -.702$, $p = .49$) at completing formulaic sentences with Appropriate - not predicted responses. The normal groups did not show a reaction time difference either ($t(31) = .091$, $p = .92$).

The normal groups' reaction times for completing Appropriate - not predicted response for novel sentences did not differ ($t(31) = -.958$, $p = .34$). Both normal young and normal elderly subjects were, however, significantly faster than the AD group for producing an Appropriate - not predicted response for a novel sentence (normal young: ($t(31) = -2.97$, $p < .01$); normal elderly ($t(31) = -2.06$, $p < .05$).

The within subject effect was analyzed using a Fisher LSD test. The elderly groups performed similarly to each other. The normal elderly control group was faster at producing an Appropriate - not predicted response for completing formulaic sentences than they were for producing an Appropriate - not predicted response for completing novel sentences ($t(31) = -2.83$, $p < .01$). The AD group showed the same pattern as the normal elderly control group in that they were faster for producing an Appropriate- not predicted word for completing a formulaic sentence than they were for producing an Appropriate - not predicted response for novel sentences ($t(31) = -4.57$, $p < .001$). The normal young control

group did not show this pattern. They were equally fast at producing the Appropriate - not predicted response for formulaic sentences and novel sentences ($t(31) = -1.23, p = .22$).

Summary

The results of the reaction time measures for producing an Appropriate - predicted lexical item for completion of formulaic sentences show that both normal groups were faster at producing a lexical item than were the subjects with Alzheimer's disease. The normal young control group was also faster than the normal elderly control group for this sentence type. When novel sentences were completed with an Appropriate - predicted response, only the normal young subjects were faster than the subjects with Alzheimer's disease.

Reaction time to complete formulaic sentences with Appropriate - not predicted responses does not show differences between the groups. When the stimulus sentence is novel and the response is Appropriate - not predicted, however, the normal young and normal elderly control groups were faster than the subjects with Alzheimer's disease. No group differences were found for completing formulaic or novel sentences with inappropriate responses.

Idioms and Small Talk Phrases

Idioms and small talk phrases constituted the formulaic stimuli for this experiment. It was thought, post hoc, that the results obtained (i.e., the older

group's slower performance than the younger group's when completing a formula with an Appropriate - predicted response) might in fact reflect differences in these formulae. Reaction times for each of these subtypes are shown in Table 3.14.

Table 3.14

Mean Reaction Time (msec.): Appropriate - Predicted, Appropriate - Not
Predicted Responses for Idioms and Small Talk Phrases

Group	Appropriate		Appropriate	
	Predicted		Not-Predicted	
	Idiom	Small Talk	Idiom	Small Talk
Young				
\bar{X}	2700	1507	2283	4278
(SD)	(459)	(417)	(3172)	(2434)
Elderly				
\bar{X}	3134	1570	1521	4941
(SD)	(650)	(341)	(1125)	(2658)
A.D.				
\bar{X}	5568	1900	2256	10074
(SD)	(4354)	(775)	(3790)	(9105)

Note.

Idiom: N = 10.

Small Talk Phrases: N = 10.

Reaction times were analyzed using paired t-tests. The results showed that all groups were faster at responding to small talk phrases than idioms when they gave Appropriate - predicted responses [(t(11) = 4.91, $p < .001$) - normal young controls; (t(11) = 6.42, $p < .001$) - normal elderly controls; (t(11) = 2.71, $p < .05$) - AD group]. The elderly groups were slower at producing Appropriate - not predicted responses to small talk phrases than to idioms [(t(11) = -3.21, $p < .01$) - normal elderly controls; (t(11) = -2.68, $p < .05$) - AD group)]. These results suggest that idioms and small talk phrases are not equivalent types of formulae.

Examining the percentage of responses to idioms and small talk phrases proved that these formulae were different. Groups responded differently to each category. Scores for each category are shown in Table 3.15.

Table 3.15

Mean Percent of Appropriate - Predicted, Appropriate - Not PredictedResponses for Idioms and Small Talk Phrases

Group	Appropriate		Appropriate	
	Predicted		Not-Predicted	
	Idiom	Small Talk	Idiom	Small Talk
Young				
\bar{X}	17.7	21.3	06.7	03.8
(SD)	(3.4)	(1.7)	(3.0)	(1.7)
Elderly				
\bar{X}	16.1	21.7	07.5	02.9
(SD)	(2.9)	(1.6)	(2.3)	(1.4)
A.D.				
\bar{X}	14.2	19.6	08.1	03.1
(SD)	(4.6)	(2.8)	(2.8)	(1.5)

Note.

Idiom: N = 10.

Small Talk Phrases: N = 10.

Paired t-tests were performed on response types to small talk phrases and idioms. All groups gave more Appropriate - not predicted responses to idioms than to small talk phrases [(t(11) = 2.76, $p < .05$) - normal young controls; (t(11) = 5.70, $p < .001$) - normal elderly controls; (t(11) = 5.42, $p < .001$) - AD group]. Moreover, all groups produced more Appropriate - predicted responses to small talk phrases than to idioms [(t(11) = -3.14, $p < .01$) - normal young controls; (t(11) = -6.41, $p < .001$) - normal elderly controls; (t(11) = -3.77, $p < .01$) - AD group]. These results suggest that knowledge of small talk phrases was better than knowledge of idioms for all subjects. It is important to note that the AD group did not show less knowledge of idioms than did the control groups.

DISCUSSION

Some hypotheses were supported by the results of this experiment and some were not. Moreover, it was often the case that only a portion of a hypothesis was supported, since three groups were being compared on two different sentence types, with three possible response categories. Hypothesis will be discussed separately.

Hypothesis 1 had two parts. The first part stated that subjects with Alzheimer's disease would produce fewer Appropriate and more Inappropriate responses than the control groups. This hypothesis was supported for both sentence types. Subjects with Alzheimer's disease produced more Inappropriate than the normal control groups. The second part of Hypothesis 1, that the AD group would produce more Inappropriate responses for novel than formulaic sentences was not supported. Multiple words were the typical (60%) Inappropriate response made for both sentence types.

Hypothesis 2 predicted that the normal young control group would complete both sentence types faster than the normal elderly control group. This hypothesis was confirmed for formulaic sentences when an Appropriate - predicted response was given. However, the normal elderly control group was as fast as the normal young control group for completing formulaic sentences with Appropriate - not predicted responses and novel sentences with Appropriate - predicted and Appropriate - not predicted responses.

Hypothesis 3 anticipated that the normal elderly control group would

respond faster than the subjects with Alzheimer's disease for completing both formulaic and novel sentences. Portions of this hypothesis were supported. The normal elderly control group was faster than the subjects with Alzheimer's disease at responding to formulaic sentences with Appropriate - predicted responses and at responding to novel sentences with Appropriate - not predicted responses. The normal elderly control group was not faster than the subjects with Alzheimer's disease for producing Appropriate - predicted responses for novel sentences or for producing Appropriate - not predicted responses for formulaic sentences.

The 4th hypothesis postulated that all groups would respond faster to formulaic sentences than they would to novel sentences. Again only a part of this hypothesis was supported. When the response was Appropriate - predicted, the normal control groups were faster at responding to formulaic than novel sentences. The subjects with Alzheimer's disease did not show this differential pattern. When the sentence was completed with an Appropriate - not predicted response, the older groups showed a reaction time difference for sentence type; formulaic sentences were responded to faster than novel sentences. The normal young control group responded equally fast to formulaic and novel sentences.

Three questions were posed at the beginning of this experiment which will now be addressed. In the first question the ability of subjects with Alzheimer's disease to complete formulaic and novel sentences was considered. Subjects with Alzheimer's disease did not show a performance differential ability to complete

formulaic and novel sentences. They do show poorer performance as compared to the normal elderly control group and this suggests that disease affects sentence completion abilities in general. Recall that the AD subjects produced more Inappropriate responses than the normal control group for all response types (though note the number was minimal: 5% of all responses). Moreover their pattern of Inappropriate responses was different from that of the control groups. AD patients had a higher percentage of Inappropriate responses that were semantically or syntactically problematic compared to the control groups (40% AD group; 17% normal elderly control group; 17% normal young control group). The AD group was slower than control groups when producing Appropriate - predicted responses. Further, the differential pattern seen between formulaic sentences and novel sentences in the normal control groups was inconsistent for the AD group. Together these results suggest that language abilities needed to complete sentences (regardless of sentence type) begin to become compromised with AD. The problems are found in word selection and reaction time. The reaction time advantage that formulaic language provides to the normal control groups does not appear available to the subjects with Alzheimer's disease. The fact that subjects with Alzheimer's disease fail to show a differential pattern between formulaic and novel sentences, suggests that with Alzheimer's disease there is a cognitive slowing (i.e., a loss of the reaction time advantage) affecting formulaic language. Alternatively, it is possible that the AD patients may be stymied by the formulaic sentences because they have a sense of what word

completes the sentence. The failure of the reaction time advantage for formulaic sentences may indicate a rigidity in thinking and reflect the AD's difficulty with realizing that there more than one solution to the problem. The results found here do not fully support the reports (Nebes et al., 1984; Nebes et al., 1986; Ober at al., 1986; Nebes et al., 1991) of no performance difference between AD subjects and elderly controls for some lexical tasks (e.g., completing highly constrained sentences). One difference between the stimuli of Nebes et al. (1991) and those used here, was that at least half the formulae (i.e., the idioms) in this study were metaphorical, whereas Nebes et al.'s stimuli were highly predictable, very constrained and not metaphorical.

The second issue of this experiment addressed differences in response type and time between formulaic and novel sentences in order to address lexical differences between these sentence types. All groups' data support, in part, the notion that these two types of sentences are processed differently in the lexicon. The normal elderly control group shows this regardless of response type produced, that is, they are faster at completing formulaic sentences than novel sentences. The normal young control group is faster at completing formulaic sentences than novel sentences when producing Appropriate - predicted responses and equally fast at both sentence types when producing an Appropriate - not predicted response. The subjects with Alzheimer's disease are faster for formulaic sentences when producing Appropriate - not predicted responses and show a trend in that direction when producing Appropriate - predicted responses. The fact that

reaction time latencies are reduced for the formulaic sentence type provides some indirect evidence that the two types of language are not accessed from the lexicon in the same manner. On the other hand, it is possible that the differences related to reaction time may be a result of the frequency of occurrence of formulaic versus novel sentences in the English language. This issue will be discussed in the general discussion section.

Looking at type of response for formulaic and novel sentences does not directly address the issue of lexical storage of formulaic and novel sentences. This appears due, in part, to the likelihood that formulaic sentences would be completed with a predicted response much more than novel sentences. This study was designed for such responses and all subjects completed formulaic and novel sentences as anticipated.

This experiment does provide evidence regarding another linguistic issue proposed in the introduction of this study, namely the notion that formulaic language forms a continuum. When reaction time measures were examined for the two types of formulae (idioms and small talk phrases), differences were noted. Small talk phrases were responded to faster than idioms when an Appropriate - predicted response was given and slower when an Appropriate - not predicted response was given. These results suggest that idioms and small talk phrases are at different places on the continuum of formulaic language with small talk phrases being markedly more "formulaic" than idioms. When response type for the two types of formulae was examined, again differences emerged. Appropriate -

predicted responses were more likely to be given to small talk phrases than to idioms. This result suggests that familiarity with subtypes of formulae can differentially affect results.

The last question posed for this experiment explored the issue of reaction time slowing with aging. The results of this experiment indicate that normal aging does not slow one's ability to complete formulaic and novel sentences. That was evidenced by the fact that the normal elderly subjects performed as accurately the normal young subjects. Additionally, response time was indistinguishable between the normal groups for all responses except those categorized as Appropriate - predicted. In this case the normal young control group was faster than the normal elderly control group which suggests that cognitive slowing with age is inconsistent. The pattern of performance was also similar for these groups, in that they both were faster at completing formulaic sentences than they were at completing novel sentences. The fact that the normal elderly control group performed equivalently to the normal young control group (for both response types to novel sentences and Appropriate - not predicted responses to formulaic sentences) supports some results obtained by Nebes et al. (1986) and Nebes and Brady (1991), whose normal elderly subjects did not show an age effect for sentence completion reaction time for any stimulus sentence type. In terms of increased automaticity of language processing proposed by Brown and Jaffe, these results suggest that with advanced age formulaic language does not become more automatic nor does processing of novel language become compromised in

response to aging. The fact that the normal young controls were the fastest for producing Appropriate - predicted responses may indicate that these sentences were easiest for this group.

Taken together, the results from Experiments 1,2 and 3 indicate that some formulaic language abilities (i.e., comprehension of idioms) present greater difficulty to the subject with Alzheimer's disease than others (i.e., grammaticality judgment). But further analysis is warranted. For example production of formulaic and novel language (using a repetition task) should be explored to determine if formulaic language shows the same advantage as it does in sentence completion or if it is compromised as noted during comprehension. Such a task would provide further evidence to the questions raised regarding formulaic and novel language with respect to age and AD. Experiment 4 will explore the issue of production of formulaic and novel language.

EXPERIMENT 4

INTRODUCTION

Repetition skills encompass a number of psycholinguistic abilities. According to Luria (1970, 1966) successful repetition requires correct perception of auditory patterns, discrimination of features of phonemes and differentiation of sound patterns in words. Kertesz (1983) proposed that the process of repetition also required the ability to monitor sound and word "assembly." It was Luria (1963) who suggested that one must produce the correct motor program to produce the intended articulatory patterns and to inhibit "irrelevant alternatives" (p. 315). Comprehension of the stimulus material is not required for repetition because semantically aberrant sentences are repeatable. Thus, repetition is a type of task which reduces the role comprehension plays in performing novel and formulaic language tasks (as seen in Experiment 1).

Repetition abilities have been studied in persons with Alzheimer's disease. Although Appell et al. (1982) showed that this ability was essentially spared in persons with Alzheimer's disease, Obler and Albert (1984) stated that repetition of sentences with high probability of occurrence is spared in early stages of Alzheimer's disease but sentences with low frequency of occurrence are repeated with errors. As the disease progresses according to these authors, repetition of high probability-of-occurrence items that are longer than six words is affected also. The issue at hand is: Does Alzheimer's disease affect repetition of

formulaic versus language?

The second question raised for this experiment is a general and broad question relating to the organization of formulae in the lexicon. Is there a difference in the organization of formulaic and novel language in the lexicon? Recall that a theory of formulaic language organization is that a formula is one unit in the lexicon similar to one lexical item (Swinney and Cutler, 1979; Dronkers, 1990). This experiment seeks to clarify the nature of the organization of the formulaic phrase in the lexicon and to explore if formulaic language is organized in the lexicon in the same fashion as a single lexical item, in the same manner as novel language, or in another manner.

If formulaic sentences are stored in the lexicon in the same manner as novel sentences both kinds of sentences should be repeated with equal proficiency. If a formula is stored in the lexicon as one unit, the entire phrase or sentence should be available to the speaker simultaneously. Therefore, a formulaic utterance of a given number of words should be repeated with little or no error. If formulaic sentences are stored like novel sentences (each lexical item is separate) there should be no difference between repetition scores for these two sentence types.

The last question this experiment asks is related to repetition abilities of the normal elderly control group. Do repetition abilities for formulaic and novel language change with aging?

RATIONALE

The hypotheses proposed are based on clinical observations reported in the literature (Obler and Albert, 1984) and results of pilot work (De Santi et al., 1992). In the pilot study the AD group performed significantly poorer than the control groups for repeating both formulaic and novel sentences. All groups repeated formulaic sentences better than novel sentences, although only the AD group results were significant.

HYPOTHESES

The hypotheses are.

1. The Alzheimer's group will repeat formulaic sentences more accurately than novel sentences and the healthy groups will repeat both sentence types equally well.
2. The Alzheimer's group will repeat both formulaic and novel sentences less accurately than the normal control groups but the normal control groups will be equally proficient.
3. Repetition errors will occur within formulaic phrases and novel phrases.

PROCEDURES

Each subject was asked to repeat formulaic and novel sentences of varying lengths. Sentences were auditorily presented to the subject by the examiner. The examiner read each sentence at a slow conversational rate, normal conversational

loudness, and deliberate clarity of pronunciation of each word. Immediately after the examiner finished saying the sentence, the subject repeated it. Subjects received the following directions: "I'm going to say some sentences and I want you to repeat them after me exactly as you hear them." The examiner repeated a sentence if requested to do so by the subject and noted that a repetition was required. The examiner gave no feedback during this task other than "o.k." after each sentence was repeated. Responses were tape recorded, transcribed and scored.

STIMULI

The stimuli consisted of 40 sentence trials of two types; 20 formulaic and 20 novel sentences. These stimuli were the same as those used in Experiment 1, developed by Kempler et al. (1988, in preparation) described above. The sentences were matched for syntactic complexity, word length and word frequency. Three versions of these experimental sentences were created to avoid order effects. Within each version, stimuli were pseudo-randomly ordered so that no more than three occurrences of any one sentence type occurred consecutively. The stimuli for this experiment are found in Appendix 4.

CALCULATION OF CORRECTNESS SCORES

Verbatim repetition received a score of 1. Non-verbatim repetition received a score of 0. A speech-language pathologist scored each sentence for

errors by marking all responses on a written transcript. The tape-recorded sentences were listened to using a Norelco Dictaphone (model 2510) with a foot pedal for easy review of sentence repetitions. This machine also had a speed control button to slow the speed of the tape for closer listening.

A linguist coded all errors according to the following error types: substitutions, additions, expansions (e.g., expansion of a clitic from he's to he is), change (tense, number or aspect), metathesis, deletions, repetitions, movement (of auxiliary verb) and inability to repeat any part of the stimulus sentence.

ANALYSIS OF DATA AND RESULTS

The mean correct score of accurate repetitions for formulaic and novel sentences was derived for each group and is shown in Table 4.1. Individual data scores are found in Appendix 15.

Table 4.1

Mean Correct Scores - Sentence Repetition.

Group	Formulaic Phrases	Novel Phrases
Young		
\bar{X}	18.6	18.1
(SD)	(1.2)	(1.4)
Elderly		
\bar{X}	17.6	15.0*
(SD)	(2.6)	(3.1)
A. D.		
\bar{X}	16.6	13.6*
(SD)	(3.4)	(3.4)

Note.

* score significantly lower than the normal young control group.

Repeated measures ANOVA on these scores revealed a significant main effect for group and sentence type and a significant group by sentence type interaction (see Table 4.2).

Table 4.2

Repeated Measures Anova - Sentence Repetition.

Between-Subject Effect

Source	SS	df	MS	F	p
Within Cells	1.06	33	.03		
Group	.32	2	.16	4.94	.013

Within-Subject Effect

Source	SS	df	MS	F	p
Within Cells	.13	33	.00		
Group	.19	1	.19	48.81	.000

Interaction Effect

Source	SS	df	MS	F	p
Within Cells	.13	33	.00		
Group X Stype	.06	2	.03	7.23	.002

Note. Stype = Sentence type

To determine where the significant effects lay post hoc Fisher LSD testing was employed. The results indicated that the normal young control group performed significantly better than the normal elderly control group ($t(33) = 2.73$, $p = .01$) and subjects with Alzheimer's disease ($t(33) = 4.000$, $p < .001$) for repetition of novel utterances but not repetition of formulaic utterances (normal young versus elderly control group ($t(33) = .94$, $p = .354$), normal young control group versus AD ($t(33) = 1.81$, $p = .07$). There was no significant difference in the performance of the subjects with Alzheimer's disease as compared to the normal elderly control group for formulaic ($t(33) = .86$, $p = .39$) utterances or novel utterances ($t(33) = 1.25$, $p = .22$).

The within group analysis, tested using a Fisher LSD test, showed that the normal elderly control group's performance was significantly better for formulaic sentences than it was for novel sentences ($t(33) = 5.06$, $p < .001$). The same results were noted for the subjects with Alzheimer's disease ($t(33) = 6.04$, $p < .001$). The normal young control group did not show a significant difference in repeating formulaic and novel sentences ($t(33) = 1.56$, $p = .334$).

The fact that the normal elderly control group's performance on repetition of novel and formulaic sentences was not significantly better than the performance of the AD group warranted further investigation. An error analysis was done to identify differences between these two groups regarding the number and types of errors they made on novel sentences only. The mean number of errors for these groups is shown in Table 4.3.

Table 4.3

Mean Error Scores - Novel Sentence Repetition.

Group	Novel Phrases
Young	
\bar{X}	2.83
(SD)	(2.1)
Elderly	
\bar{X}	7.41*
(SD)	(5.5)
A. D.	
\bar{X}	12.16*
(SD)	(7.2)

Note.

* score significantly lower than the normal young control group.

An independent t-test was run to determine if the number of errors produced by the two older groups was significantly different. The results show that due to the high variability in performance within groups the normal elderly control group did not make significantly fewer errors than the subjects with Alzheimer's disease, although a trend in that direction is noted ($t(22) = -1.82$, $p = .08$).

So far the normal elderly control group did not differ from the subjects with Alzheimer's disease in the number of sentences or the number of errors produced for repetitions of novel sentences. The total number of errors per error type for novel sentence repetition is listed in Table 4.3.

Table 4.4

Number of Occurrences of Error Type - Novel Sentence Repetition.

Error Type	Young	Elderly	A.D.
Substitutions	19	35	45
Additions	8	17	24
Expansions	5	6	6
Change	0	11	13
Metathesis	2	1	1
Deletions	0	14	39
Repetitions	0	3	13
Movement	0	1	3
No response	0	0	4

A series of t-tests was run which compared the normal elderly control group with the subjects with Alzheimer's disease by error type. The analyses examined substitution errors, additions, expansions, change, metathesis, deletion errors, repetition errors, movement and failures to repeat any portion of the sentence. The results indicated that deletion was the only error type that differentiated the normal elderly control group from the subjects with Alzheimer's disease. That is, the subjects with Alzheimer's disease made significantly more deletion errors than the normal elderly control group ($t(21) = -2.53, p < .05$).

DISCUSSION

The above results confirm some of our hypotheses and provide new questions to answer. Hypothesis 1 proposed that subjects with Alzheimer's disease would repeat formulaic sentences better than novel sentences and that the normal groups would not show this difference. The subjects with Alzheimer's disease performed as expected. They repeated formulaic sentences significantly more accurately than novel sentences. The normal elderly control group's performance was unexpected. They performed more like the AD group than the normal young control group in that formulaic sentences were repeated significantly better than novel sentences. The normal young control group did not show any differential repetition pattern.

Hypothesis 2 was not completely confirmed. It was predicted that the Alzheimer's disease group would perform significantly worse than both control

groups for the repetition of formulaic and novel sentences. The Alzheimer's disease group repeated formulaic sentences as well as the two normal control groups. When repetition performance of the AD group was compared to the normal control groups on novel sentences, the hypothesis was not confirmed. The normal elderly control group was as inaccurate as the AD group at repeating novel sentences. The normal young control group was significantly better than the AD group. The second part of Hypothesis 2, that no differences between the two control groups for repeating sentences would exist, was disconfirmed. These two groups performed equally well on the repetition of formulaic sentences but the normal young control group performed significantly better than the normal elderly control group on repetition of novel utterances. The latter was an unexpected finding.

The final hypothesis, that repetition errors would occur within formulaic and novel sentences was supported by all groups but not to the same degree for each sentence type. All groups made errors in repeating formulaic sentences ($\bar{X} = 1.4$, normal young control group; $\bar{X} = 2.4$, normal elderly control group; $\bar{X} = 3.4$, AD subjects) although these results were not statistically significant between the groups. All groups produced repetition errors on novel sentences which differentiated the normal young control group from the two older groups. Further the normal elderly control group and the Alzheimer's disease group showed a differential pattern in that both older groups were significantly better at repeating formulaic sentences than they were at repeating novel sentences. The

normal young control group did not show this result.

The first question posed at the beginning of this experiment asked if AD affects repetition of formulaic versus novel language. The answer to this question is that Alzheimer's disease affects repetition of novel language but not formulaic language. The results of this experiment indicate that the Alzheimer's disease group was unimpaired in repetition of formulaic sentences. Yet, repetition of novel sentences was significantly less accurate than the repetition of formulaic sentences for the AD group. These results extend what is known about repetition abilities in AD. Obler and Albert (1984) postulated that when high frequency language exceeds six words in length repetition becomes problematic in moderate AD. The stimuli used here were as long as 11 words and AD subjects repeated these sentences without error. The discrepancy between Obler and Albert's (1984) findings and those reported here could be accounted for by the stage of AD. The subjects tested here were less demented than those studied by Obler and Albert (1984). Alternatively the sentences used here not only contained high frequency words, but also occurred frequently in the language. This suggests that those sentences which are highly familiar and over-learned remain relatively spared in Alzheimer's disease, whereas those sentences which are new and unfamiliar are difficult to repeat without error.

The second question posed for this experiment asked whether the organization of formulaic sentences in the lexicon occurred as single units. The fact that errors occurred within formulaic utterances suggests that these utterances

were not stored in the lexicon as single units. The performance of all groups on repetition of formulaic utterances confirms this statement. All subject groups had errors within formulae.

The results of Experiment 4 indicate that formulaic and novel language may not be repeated in the same manner, stored in the same manner or accessed in the same manner. There may be several factors that effect the repetition of formulaic and novel utterances. These formulaic sentences are frequently used in our language, while these novel sentences are not frequently used in our language. Perhaps this factor (frequency of use) accounts for the differential repetition ability of the two elderly groups for these sentences by making those items (idioms and familiar phrases) more accurately produced. Another factor which may account for the differential repetition skills is related to the storage of the two sentence types in the lexicon. Repetition of novel utterances presumably requires retrieving the individual units that comprise the sentence from the lexicon. Repetition of formulaic sentences appears to proceed without conscious consideration. This is suggested from the errors subjects made while repeating formulaic sentences. For example, when asked to repeat the sentence "Sticks and stones will break my bones but words will never hurt me." responses included "Sticks and stones may break my bones but words will never hurt me."; "Sticks and stones will break my bones but names will never hurt me."; "Sticks and stones will break my bones but words will never harm me." (The underlined words were repeated incorrectly.) Each response appeared to indicate that each subject had

coded that stimulus sentence differently in his or her lexicon and was reproducing that memory rather than the sentence that they had just heard.

The last question from Experiment 4 sought to answer was if repetition abilities changed with normal aging. The answer is novel language repetition abilities change in normal aging but formulaic language repetition does not. The normal elderly control group performed in the same manner as the AD group for the repetition of novel sentences and as accurately as the normal young control group for repetition of formulaic sentences. This may indicate that age plays a role in repetition abilities, in that as one ages the ability to repeat novel sentences becomes affected. It is possible that a decline in immediate short term episodic memory, which the repetition of novel sentences might rely on, could account for the results found here. This would be consistent with reports in the literature (e.g., Botwinick and Storandt, 1974) of a modest age-related change in the memory span of older adults. On the other hand, the lack of an age-related change in repetition of formulaic sentences adds support to the argument that rehearsal-independent long term memory remains unaffected with age. The fact that formulaic sentences are used repeatedly in one's language may provide a special status to this type of language (i.e., it becomes increasingly automatic) and is therefore preserved in aging. Alternatively, it is possible an idiom is stored as several chunks (rather than single lexical units) and thus those sentences are shorter, and require less memory to reproduce than novel sentences.

CHAPTER 3

GENERAL DISCUSSION

The three main issues addressed in this set of experiments were the effects of Alzheimer's disease on formulaic versus novel language, the organization of formulaic and novel language in the lexicon, and the possibility of age-related changes in the representation or processing of formulaic and novel language. The discussion of Alzheimer's disease will be followed by the discussion of lexical organization and last, a discussion of aging. Additionally, the differences between comprehension results and those of other language areas tested in this study will be presented. Included in each discussion will be a summary of the results across the four experiments administered in this study. Finally a section on future research will be offered.

ALZHEIMER'S DISEASE

The first main issue this dissertation sought to clarify was the effect of Alzheimer's disease on formulaic and novel language. The specific question was: Does formulaic language remain intact relative to novel language in persons with Alzheimer's disease? Based on the results of Kempler et al. (1988) and pilot work (De Santi, et al., 1992), it was hypothesized that novel language would be more negatively affected by Alzheimer's disease than formulaic language in all areas investigated except comprehension. The evidence from the four

experiments administered (comprehension, grammaticality judgment, sentence completion and repetition) indicated that the answer was not straightforward.

There are two ways to answer the question concerning formulaic and novel language in Alzheimer's disease. One approach is to contrast what occurs in AD with what occurs in normal aging. Another approach is to contrast what occurs within the disease process by focusing exclusively on the results of the patients with AD. Consider first a comparison of the AD group with the normal elderly control group. It was hypothesized that the subjects with Alzheimer's disease would perform worse than the normal elderly control group on all language tasks. The results that supported the hypothesis will be discussed first followed by those that did not (see Table 5.1).

Table 5.1

Results of AD and Normal Elderly Control Groups on 4 Experiments

EXPERIMENTS	FORMULAIC PHRASES	NOVEL PHRASES
Comprehension	A.D. = N.E.C.	A.D. < N.E.C.
Grammaticality Judgment Percentage Correct	A.D. = N.E.C.	A.D. = N.E.C.
Grammaticality Judgment Reaction Time	A.D. Slower than N.E.C.	A.D. Slower than N.E.C.
Sentence Completion Percentage Correct	A.D. < N.E.C.	A.D. < N.E.C.
Sentence Completion Reaction Time	A.D. = N.E.C.	A.D. Slower than N.E.C.
Repetition	A.D. = N.E.C.	A.D. = N.E.C.

Note. A.D. = Alzheimer's Disease Group

N.E.C. = Normal Elderly Control Group

< = Worse Than

Recall that the AD group comprehended novel sentences less accurately than the normal elderly control group, confirming that comprehension deficits exist with the disease. This result supports previous findings of impaired comprehension associated with Alzheimer's disease (Appell et al., 1982; Bayles and Kaszniak, 1987; Kempler et al., 1987; Faber-Langendoen et al., 1988). The AD group appears to have lost some of their idiom knowledge as indicated by the number of errors they made on the formulaic sentences (see Table 5.2) relative to the novel sentences. The errors might indicate that strategies are being employed for formulaic sentences (as well as propositional ones) as subjects' responses were often to one word in the sentence (e.g., For the sentence "He's turning over a new leaf", the response was the picture of a person raking leaves.). Equally possible is that the AD group's conceptual knowledge is beginning to deteriorate and subjects no longer have the full meaning of the idiom represented in their knowledge base. This conclusion would be consistent with a theorized deterioration in the semantic memory in AD (Bayles and Kaszniak, 1987).

With respect to sentence completion, one may focus on the fact that the AD group made more Inappropriate responses than the control groups. The AD group was less likely than the normal elderly control group to complete formulaic and novel sentences with Appropriate responses and more likely to complete them with Inappropriate responses, which suggests similarities in the deterioration of formulaic language and novel language. No one has previously reported this result with respect to formulaic sentences and it was thought that such sentences

would be spared.

Alternatively one can note the amount of Inappropriate responses produced by the AD group. While it is of interest that the AD group produced more Inappropriate responses than the control groups, the Inappropriate responses constituted only 5% of their responses. Further, surprisingly in the light of the characteristic paraphasias of mid-late stage AD, the majority (60%) of the Inappropriate responses were not semantically problematic but multiword responses rather than the required single word. This suggests a word-finding problem, perhaps, manifested as circumlocutions. There was rare evidence of breakdown in lexical search for formulaic sentences. This could be because the stimuli (both formulaic and novel sentences) were highly predictable. Examining the data from this perspective, one might report that formulaic language is relatively spared in AD.

Reaction time scores for sentence completion were longer for the AD group regardless of response type. Additionally, increased latency periods for grammaticality judgments for both formulaic and novel sentences were noted. Both results suggest that the language processing difficulties noted in these tasks can be accounted for by accessing problems, cognitive slowing and motor slowing in dementia relative to normal aging.

Two results were unanticipated. The group with Alzheimer's disease was as accurate as the normal elderly control group at making grammaticality decisions regarding formulaic, novel and ungrammatical sentences, indicating that

this aspect of syntactic processing was intact. Syntactic processing studies in Alzheimer's disease have shown mixed results. Schwartz et al., 1979 found that subjects with Alzheimer's disease corrected syntactically aberrant sentences. Kempler, Curtiss and Jackson (1987), Appell et al. (1982) and Kertesz (1980) all support relatively spared syntactic abilities. Emery (1985), in contrast, showed that syntactic processing was compromised with Alzheimer's disease when subjects were required to act out responses to syntactically complex sentences without semantic information. The current study supports the preserved syntactic abilities in mild-moderate AD with regard to accuracy in grammaticality judgment. However, one must remember that the AD group took longer to arrive at their decisions and this might support either the theory that decline of syntactic abilities exists with AD as suggested by Emery (1985) or alternatively that one sees general cognitive slowing secondary to brain damage.

The next unexpected result was that repetition of formulaic and novel sentences was unaffected by the disease, suggesting that this ability, at least as far as these stimulus sentences are concerned, is preserved. Repetition of formulaic sentences or high frequency sentences has been shown to be preserved in mild dementia, moreover in late stages one sees echolalia (as well as palilalia) (Opler and Albert, 1984). The results from the current study showed that the subjects with Alzheimer's disease were not only as good at repeating these formulaic sentences as the normal elderly control group, but as good as the normal young control group. What is of interest is that the repetition of these formulaic

sentences showed little if any decline with age or dementia, suggesting that perhaps practice and continued use of this type of language aids repetition abilities as suggested by Jackson (1878). The AD group was not differentiated from the normal elderly control group in the number of accurate repetitions of novel sentences, and the normal young control group was significantly more accurate than both elderly groups. This indicates that perhaps normal aging deficits (i.e., memory decline) were seen in the AD group on this sub-task. This suggests a differentiation between formulaic and novel sentences in the AD group, however.

Let us now focus on the differentiation between formulaic and novel sentences across the different tasks (Table 5.2).

Table 5.2

Results of AD Group on Formulaic and Novel Sentences

EXPERIMENTS	PERFORMANCE COMPARISON
Comprehension	Formulaic < Novel
Grammaticality Judgment Percentage Correct	Formulaic > Novel
Grammaticality Judgment Reaction Time	Formulaic = Novel
Sentence Completion Percentage Correct	Formulaic = Novel
Sentence Completion Reaction Time	Formulaic Faster than Novel
Repetition	Formulaic > Novel

Note.

> = BETTER THAN

< = WORSE THAN

It was hypothesized that novel language would be more negatively affected by dementia than formulaic language in all areas tested except comprehension. This hypothesis was not supported. The Alzheimer's disease group was less impaired on repetition and grammaticality judgment for formulaic language than novel language. Additionally, formulaic sentences were completed faster than novel sentences, a finding consistent with Nebes et al. (1986). These results supported the hypothesis that novel language is impaired relative to formulaic language. Comprehension of formulaic language, on the other hand, was more impaired relative to comprehension of novel language, a finding consistent with the hypothesis that confirmed the results of Kempler et al. (1988).

The only result contrary to the hypothesis was that sentence completion scores regarding type of response (i.e., number of Appropriate or Inappropriate responses) were not different for formulaic and novel sentences. Indeed, as mentioned above, AD subjects made relatively few Inappropriate responses, but these were equally distributed for both sentence types. Further they tended to be multiword responses as opposed to semantically or syntactically inappropriate ones. Perhaps the fact that the AD group as a whole was not that demented could account for the small number of Inappropriate responses. It is also possible that the high predictability of responses (e.g., DOGS for the formula "It's raining cats and ____." and for the novel sentence "He's petting cats and ____".) could account for the similar findings for both sentence types.

The results, as far as the sentence completion task is concerned, are

consistent with those found by Nebes et al. (1986, in press) who administered a similar task to Alzheimer's subjects. In the study by Nebes et al. (1986), subjects were asked to complete sentences that varied in their degree of lexical constraint. Performance on highly constrained sentences did not vary for the AD or normal control groups. The sentences presented here (both formulaic and novel) appear to be highly constrained, as semantic errors were minimal.

A second finding discrepant from the formulaic language preservation hypothesis was that response time for making the grammaticality judgments was equal for formulaic and novel sentences. Here, the results raised new issues. It was anticipated that formulaic language would provide a reaction time advantage for the subjects with Alzheimer's disease. However the subjects with Alzheimer's disease, like the normal elderly control group, took the same amount of time to respond to formulaic, novel and ungrammatical sentences. This appears to indicate that conscious consideration of language stresses the processing system and delays reaction time responses to formulaic language (and novel language also) for both older groups.

One issue that has not been previously discussed in this study relates to the variability of performance of the AD group. In all four experiments, the performance of the AD group varied disproportionately compared to control groups. (i.e, there were disproportionately large standard deviations within the AD group.) The variance can be accounted for in several ways. The AD subjects included in this study were both mildly and moderately impaired. The fact that

all subjects were not at the same stage of the disease could account for the variability of scores. Indeed some patients performed well and others performed poorly. Further, Alzheimer's disease is not a homogeneous disease and manifests itself in a variety of symptoms (Martin, 1987). It is possible that the subjects included in this study exhibited a broad range of symptoms and therefore performance variability resulted. Performance of AD subjects varies from day to day and this could have also contributed to the group variability. To decrease the variability in performance, it would appear that numerous criteria are needed for subject selection. Not only are strict diagnostic criteria (NINCDS-ADRDA) important but so is stage of disease and symptom presentation. On the other hand it is unlikely that even stricter subject selection would dramatically reduce variability since increasing variable performance in tasks like narrative discourse is the rule with normal aging (Obler et al., in preparation).

In summary, this study provides some new information and supports some previously reported evidence about formulaic language abilities in Alzheimer's disease: 1) comprehension abilities are impaired with the disease and comprehension of formulaic language is more susceptible to the effects of Alzheimer's disease than comprehension of novel language, 2) grammaticality judgment abilities are intact for mild-moderate subjects but show no reaction time advantage for formulaic language, 3) lexical search problems affect formulaic and novel language equally, although a reaction time advantage is seen for formulaic sentences during sentence completion, 4) repetition skills are preserved for

formulaic language. While these findings must be replicated, taken together, all the results suggest that formulaic language is not totally resistant to the effects of Alzheimer's disease.

LEXICAL ORGANIZATION AND PROCESSING

The second area this study addressed was related to the lexicon. Both formulaic and novel language were tested, with the expectation that evidence for the organization and/or processing of formulaic language in the lexicon would be obtained. The primary goal of this dissertation was not to sort out the organization of the lexicon and therefore, this question was not directly tested. It was not the intent to look at the lexicon for novel phrases but rather to ask about the status of formulaic phrases vis-a-vis the lexicon. It was hypothesized that formulaic language would not have the same status as novel language and it would be processed (during comprehension and production tasks) as single lexical units with unitary meaning.

Consider the comprehension task. The response choices for the formulaic stimuli were the idiomatic interpretation and 3 foils, none of which were literal interpretations of the idioms. Both the AD group and the normal elderly control group showed a differential comprehension processing ability for both formulaic and novel sentences. For these groups novel sentences were comprehended with greater accuracy than formulaic sentences. One might hypothesize that comprehension of formulaic sentences (specifically idioms) requires accessing the

unitary meaning of the idiom whereas comprehension of novel sentences required parsing and accessing the individual words and their meanings.

It appears that what is being tested in comprehension of formulaic sentences (to derive the gestalt of the phrase) is different from what is tested in novel sentences (to parse the phrase). Essentially, to comprehend an idiom, one does not need to parse the sentence into its constituent parts. More errors were produced for the formulae, indicating that the subjects did not recognize the unitary meaning of these phrases. It is possible that these subjects switched from a non-literal idiomatic processing mode to a literal processing mode and, using this new mode, could not access the intended meaning of the idiom. It is also possible that the intended meaning of this phrase begins to deteriorate. In either case, the results of the comprehension task provide indirect evidence that idioms may not be processed as single lexical units in the lexicon.

With respect to the grammaticality judgment task, the greater accuracy with formulaic than novel sentences for all groups suggests that formulae are unitary in nature and are more likely to be identified as grammatically correct. In addition, formulae were responded to faster than novel sentences by the normal young control group. From these results it appears as though formulae are accessed faster than novel sentences. We cannot know if formulaic sentences are organized in the lexicon as single lexical units, however. Whatever mechanism underlies the organization of formulaic language, groups appear to be able to use that information better than they can use the information about novel sentences.

The sentence completion task and the repetition task provided insight into the organization of the lexicon for formulaic and novel sentences. All groups produced more Appropriate-predicted responses to formulaic sentences and more Appropriate-not-predicted responses to novel sentences. It is possible that this finding indicates that formulaic phrases are stored in the lexicon as single lexical units, however, since all groups did not always provide the predicted response, we cannot state that there is single lexical organization of formulaic phrases.

In repetition, both older groups (normal elderly control and AD groups) were more accurate at repeating formulaic sentences than they were at repeating novel sentences. Since formulaic and novel sentences were matched by word length and syntactic structure, it is unlikely that the differences between the two sentence types can be accounted for by age-related memory difficulties. If that were the case, similar results would be expected for both sentence types. Since errors occurred within formulae, it is unlikely that these stimuli are stored in the lexicon as single lexical items. An example from an AD subject supports this statement. When asked to repeat "Sticks and stones will break my bones but words will never hurt me," the subject said "Sticks and stones may break my nose but will . . . Oh, I used to say that all the time; it's gone." It is also unlikely that the words within formulae are stored separately, the way novel sentences seem to be stored. However, formulae do appear to possess a special status in the lexicon. I propose that each formula is stored as several linked phrasal chunks (Peters, 1983), for example "Sticks and stones will break my bones but words will never

hurt me," might be stored as three linked chunks (i.e., Sticks and stones, break my bones, words never hurt me.). This might explain why errors like "break my nose" could be obtained and well as the omission of the last portion of the phrase "words will never hurt me".

Another component to the lexical organization of formulaic language is related to processing. There is evidence that formulae are processed in one of several ways. This is derived from comparing the results of both older groups on Experiments 1 and 4. In experiment 1, comprehension of formulaic sentences was more impaired than comprehension of novel sentences; by contrast, in Experiment 4 repetition of formulaic sentences was better than repetition of novel sentences. The same stimulus sentences were used in both these experiments.

One processing mode for idioms may be called the "idiom mode" (also called non-literal processing in the psycholinguistic literature, Swinney and Cutler, 1979) . When operating in this mode during comprehension, one accesses the non-literal interpretation of the sentences. What this study adds to the psycholinguistic literature is that subjects can get into the "idiom mode" in repetition. While correctly repeating sentences provides evidence for this processing mode, error patterns provide even stronger evidence. For example, subjects in all three groups repeated an idiom as they know it, regardless of the words used by the examiner. "Why don't you pick on someone your own size" was repeated for "Why don't you pick on somebody your own size".). It was as if once the subject recognized the idiom, they reproduced their personal version of it.

Another processing mode for idioms is the "literal processing mode" (Gibbs, 1980). Using this mode, the literal meaning of the idiom is derived during comprehension. Support for this was not provided from this study, but it has been discussed in the psycholinguistic literature. Evidence for using a literal processing mode during repetition comes from anecdotal observation during this study. AD subjects in particular used a questioning intonation pattern that suggested that they did not recognize what they had to repeat as a familiar idiom. The same pattern was noted during reading of sentences for the grammaticality judgment task, again indicating to the examiner that they did not recognize the idiom. Further, some subjects then commented that the idiom was a bad sentence. This observation was never noted in the performance of the normal control groups.

In summary, the results of the experiments suggest that formulae are not stored in the lexicon as single lexical units or as individual lexical items, but perhaps, as something in between the two extremes, namely as linked phrasal chunks. Further formulae may be processed using an "idiom mode" or a "literal mode." Normal young control subjects have full access to their formulaic processing information (both lexical information and access to this information) but these appear to begin to breakdown in normal aging and in AD.

The next lexical question that this study addressed was the controversy regarding language forming a dichotomy (formulaic language versus novel) or a continuum (Van Lancker, 1987). The answer for this question is best arrived at

using data from the formulaic sentences only. Formulaic stimuli consisted of small talk phrases and idioms. The most compelling results come from Experiment 3. Post hoc analysis revealed that groups were faster at providing the responses to small talk phrases than to idioms during sentence completion. They were more likely to respond to small talk phrases with Appropriate - predicted responses and to idioms with Appropriate - not predicted responses. Taken together, these results suggest that formulae form a continuum and that small talk phrases are not at the same point on the continuum as idioms or are processed differently. Since small talk phrases are used frequently (probably daily) in speech, it seems plausible that they would be further from propositional language than idioms on the formulae continuum.

NORMAL AGING

The purpose in studying the normal elderly control group was to learn if the representation or processing of formulaic language changed with aging. The primary interest was in finding out if formulaic language becomes more automatic with age. Based on the Brown and Jaffe (1975) hypothesis, it was hypothesized here that there would be a small but systematic advantage of formulaic language for the normal elderly control group relative to the normal young control group. A comparison of results between the normal young control group and the normal elderly control group provided evidence to evaluate the hypothesis (see Table 5.3). Looking at the table one realizes that there is only one task where the

normal elderly perform differently from the normal young control group, namely in repetition. The evidence from the older group's performance suggests that for the sentences tested in this study, language does not become more automatic with age, but the aging adult might perform at its best when dealing with familiar/over-learned language.

Table 5.3

Results of Normal Elderly Control and Normal Young Control GroupsComparison of 4 Experiments

EXPERIMENTS	FORMULAIC PHRASES	NOVEL PHRASES
Comprehension	N.E.C. = N.Y.C.	N.E.C. = N.Y.C.
Grammaticality Judgment Percentage Correct	N.E.C. = N.Y.C.	N.E.C. = N.Y.C.
Grammaticality Judgment Reaction Time	N.E.C. = N.Y.C.	N.E.C. = N.Y.C.
Sentence Completion Percentage Correct	N.E.C. = N.Y.C.	N.E.C. = N.Y.C.
Sentence Completion Reaction Time	N.E.C. = N.Y.C.	N.E.C. = N.Y.C.
Repetition	N.E.C. = N.Y.C.	N.E.C. < N.Y.C.

Note. N.E.C. = Normal Elderly Control Group

N.Y.C. = Normal Young Control Group

< = Worse Than

The normal elderly control group was as accurate as the normal young control group in their comprehension of formulaic and novel sentences, in the number of accurate grammaticality judgments for formulaic, novel and ungrammatical sentences and in the number of appropriate responses for sentence completions of formulaic and novel sentences. Further, the older group was as fast as the younger group at performing grammaticality judgments and sentence completions.

An unforeseen result was noted in the repetition of novel sentences. Here the normal elderly control group performed unlike the normal young control group and similarly to the AD group. A modest age-related change in the memory span (Botwinick and Storandt's, 1974) might provide an account for the normal elderly control groups' performance. Indeed the most common error that the normal elderly control group made was substituting one word for another. That this age-related change was only noted for novel sentences and not for formulaic sentences appears to suggest that indeed these two different sentence types are processed differently, at least as far as repetition is concerned.

Hearing status is probably not a possible explanation for the results of the normal elderly group on the repetition experiment (formulaic sentences were repeated more accurately than novel sentences). Hearing abilities were not formally tested using pure tone audiometry, but informally assessed during conversation, and historically assessed from the initial questionnaire and personal reports. One might argue that hearing status could contribute to the

performance difference between the two control groups, but it cannot explain the sentence type difference (formulaic sentences better than novel sentences) seen by the normal elderly control group. Further, sentences were orally presented in the comprehension task, but there were no differences between the control groups' performance for either sentence type. Therefore, the only reasonable explanation for the performance difference of the normal elderly control group with respect to formulaic and novel sentences must be intrinsic to formulaic sentences; that they are stored as phrases. We will discuss the implications of this difference in the next section.

Age related changes do not necessarily present themselves for all tasks. An unanticipated result was that the normal elderly control group was as fast as the normal young control group in their response latencies for grammaticality judgments and sentence completions. This result supports the findings of Nebes et al. (1989, 1991) that normal elderly were not significantly slower than the normal young control group during sentence completion. It further indicates that these tasks (grammaticality judgment and sentence completion) do not show age-related cognitive slowing as other tasks do (Bromley, 1966; Botwinick and Storandt, 1974; Salthouse, 1985; Nebes and Brady, 1992).

The pattern of performance across sentence types within the control groups was the same, with a few exceptions (see Table 5.4).

Table 5.4

Results of Normal Elderly and Normal Young Control GroupsComparison of Formulaic and Novel Sentences

EXPERIMENTS	NORMAL ELDERLY	NORMAL YOUNG
Comprehension	Formulaic < Novel	Formulaic = Novel
Grammaticality Judgment Percentage Correct	Formulaic > Novel	Formulaic > Novel
Grammaticality Judgment Reaction Time	Formulaic = Novel	Formulaic Faster Than Novel
Sentence Completion Percentage Correct	Formulaic = Novel	Formulaic = Novel
Sentence Completion Reaction Time	Formulaic Faster than Novel	Formulaic Faster than Novel
Repetition	Formulaic > Novel	Formulaic = Novel

Note.

> = BETTER THAN

< = WORSE THAN

For half the measurements obtained in this study concerning formulaic and novel language comparisons, normal elderly control subjects performed just like normal young control subjects. An unanticipated result was noted on the comprehension task. Comprehension of novel sentences by the normal elderly control group was more accurate than comprehension of formulaic sentences. This result was not found in the normal young control group. This result differs from the performance of the normal elderly control group reported by Kempler et al. (1988) and Van Lancker and Kempler (1987). Van Lancker and Kempler's normal elderly control group performed at ceiling for comprehension of both stimulus sentence types. The normal young control group studied here was very accurate in comprehension of both sentence types, showing a ceiling effect. Unfortunately with ceiling effects one cannot know if there is a difference between the two sentence types. Since the normal elderly control group studied by Kempler et al. (1988) and Van Lancker and Kempler (1987) was 6 years younger than the elderly control group studied here, one might say increasing age affected performance. The result of the normal elderly control group in this study suggests that there may be an age-related decline for comprehension of non-literal types of stimuli, which is consistent with the decline in abstract reasoning abilities with advancing age (Schaie and Willis, 1986).

Age-related decline was further noted in the repetition task. In that task the normal elderly control group repeated novel sentences significantly worse than formulaic sentences, contrary to expectation. The normal young control group did

not show a sentence type difference. There are two possibilities to account for these results. It is possible that an age-related memory deficit is responsible for poor repetition of novel sentences. If this were the case, however, repetition of formulaic sentences would be expected to be equal to that of novel sentences since both sentence types were matched for length and syntactic structure. This was not the case. On the other hand, as was posited above, it is possible that formulaic sentences are not stored in the lexicon as individual morphemes but, as multimorphemic phrases or chunks (Peters, 1983). If that were the case, formulaic sentences would not require the same memory load as novel sentences and could account for the differential pattern the healthy elderly control group exhibits.

In summary, results from the grammaticality judgment and sentence completion tasks suggest that these language abilities do not exhibit an aging effect. There was no task where the normal elderly control group performed better than the normal young control group. Note that the lack of age-related change in reaction time measurements on the grammaticality judgment and sentence completion tasks is of interest because one would have expected the normal elderly control group to perform slower than the normal young control group. Where differences were noted, in the repetition task and in comprehension of auditory input, complex processing appears to stress the system and results in performance decline in the elderly. Thus the performance decline may not be reflecting a linguistic change but rather the interaction of cognitive

decline (such as memory problems) which is known to cause problems in aging and to influence linguistic performance. The results of these experiments do not suggest that language becomes more automatic with age but that declining cognitive abilities interact with linguistic processes and render processing of novel language more difficult than that of well rehearsed formulaic language.

COMPREHENSION VERSUS OTHER LANGUAGE SKILLS

A question that was raised from the results of a pilot study (De Santi et al., 1992) and this study was: Is there a dissociation between comprehension abilities and other language skills? The answer is yes for the two elderly groups.

Consider the patterns as they relate to formulaic versus novel items (refer to Table 5.5) for the AD group and the normal elderly control group. While no differences were seen in sentence completion for formulaic and novel sentences, comprehension of formulaic language was more difficult than comprehension of novel language. By contrast, grammaticality judgment of formulaic language was more accurate than novel sentences, and repetition of formulaic sentences was significantly more accurate than novel sentences. Taken together the results of the elderly groups seem to indicate that for formulaic language, comprehension is more negatively affected than other language abilities.

Table 5.5

Results of Normal Elderly Control Group and the AD GroupComparison of Formulaic and Novel Sentences

EXPERIMENTS	NORMAL ELDERLY	A.D. GROUP
Comprehension	Formulaic < Novel	Formulaic < Novel
Grammaticality Judgment Percentage Correct	Formulaic > Novel	Formulaic > Novel
Grammaticality Judgment Reaction Time	Formulaic = Novel	Formulaic = Novel
Sentence Completion Percentage Correct	Formulaic = Novel	Formulaic = Novel
Sentence Completion Reaction Time	Formulaic Faster than Novel	Formulaic faster than Novel
Repetition	Formulaic > Novel	Formulaic > Novel

Note.

> = BETTER THAN

< = WORSE THAN

The next logical question that arises is what can account for this dissociation? One possible explanation for the divergent results with regard to sentence type differences for comprehension and other language abilities, determined post hoc, could have been related to the issue of frequency of occurrence of the formulaic phrases versus novel phrases in English and/or to the level of abstraction of each phrase. That formulaic phrases occur in the language with greater frequency than novel phrases could account for the differential results between these sentence types. It was hypothesized (post hoc) that phrases that are more frequent in the language should:

1. be comprehended with greater accuracy,
2. be judged to be grammatically correct faster and with greater accuracy,
3. be faster to complete and more likely to be completed with the predicted response.
4. be repeated more accurately.

Five doctoral students were asked to rate the stimulus sentences in Experiment 1 and 4 for frequency of occurrence. A five-point frequency scale was used with 1 indicating infrequent and 5 indicating frequent. The students judged the mean frequency of the formulaic sentences to be 4.49, whereas the mean frequency of the novel sentences was judged to be 1.75. Clearly, the formulaic phrases were rated to be more frequent in English. Such a finding could only explain the repetition and grammaticality judgment results for two of the three groups and the tendency to complete formulaic sentences with predicted

responses. However it cannot, of course, explain the comprehension results here or in Kempler et al. (1988). To test whether abstractness particularly characteristic of the formulaic sentences explained the data we hypothesized (post hoc) that phrases that are more abstract should:

1. be more difficult to comprehend
2. be judged to be grammatically correct with less accuracy and slower
3. be difficult to complete and less likely to be completed with a predicted response.
4. be more difficult to repeat accurately.

Abstraction level was determined by five students for sentences in Experiments 1 and 4. A five-point abstraction level scale was used with 1 indicating concrete and 5 indicating abstract. The students were given examples of the two extremes of the scale as well as the mid-point. They judged the mean level of abstraction to be 4.68 for formulaic sentences and 1.42 for novel sentences. Therefore, the formulaic items should have been more difficult. However, this was only true for the comprehension task.

What we can conclude from these post hoc analyses are the following: frequency is the important component for metalinguistic tasks, such as grammaticality judgment and for production abilities, while abstraction level is the important component and may even override the frequency effect for comprehension.

IS ALZHEIMER'S DISEASE AN EXAGGERATION OF NORMAL AGING?

The question that arises when one examines both AD and normal elderly subjects is, Does AD represent an exaggeration of normal aging? The data from this project supports the notion that AD is a different process from normal aging. While the AD subjects do perform similar (e.g., if normal elderly controls have difficulty with the task, the AD group will perform worse) to the normal elderly (see Table 5.1), upon closer examination one notices a qualitatively different pattern between the two groups. The types of errors that the AD group produced are different from the normal elderly for sentence completion and sentence repetition. For example, in sentence repetition, errors such as deletions and changes of tense and number were not produced by the normal elderly but were produced by the AD group. If AD were an exaggeration of normal aging, one would expect to find the same types of responses by both groups. In that case the AD group would produce more errors but not different ones. Since our results show that there were different errors, it is concluded that AD is qualitatively different from normal aging, at least as far as these tasks are concerned.

FUTURE RESEARCH

There are many additional questions that this dissertation has not been able to answer, nor can they be addressed at this time. They remain to be examined in the future.

The comprehension task, Experiment 1, indicated that comprehension of

formulaic sentences was impaired in AD relative to comprehension of novel sentences. What we do not know from this study is exactly what the subject does when the meaning of the idiom is unavailable. What is needed in future research is to learn the strategies that the person with Alzheimer's disease uses when these difficulties arise. One way to undertake this task would be to design the foils in such a way that different sentence parsing strategies are represented. In this way one would hope to figure out the parsing strategies the AD patients used when their knowledge of idioms begins to deteriorate.

Another question that this dissertation raised was about reading errors. Experiment 2 and 3 required the subject to read sentences aloud and either make judgments or complete sentences. During this procedure many reading errors were produced by all subjects. Reading errors suggested the mode of processing for some idioms was non-literal. The questions such errors generated were: Do subjects with Alzheimer's disease make the same type of reading error as the other subject groups, or different errors? Do they monitor what they are reading through an auditory channel, visual channel or another mechanism? Do they use the same monitoring strategies as control subjects or do they use different strategies? What processing mode do they most frequently use? Future analysis of data collected in this study may directly answer these questions.

In Experiment 2, the grammaticality judgment task, post hoc analyses revealed that the design of the experiment, in particular the unequal number of grammatical and ungrammatical sentences, might have contributed to a positive

response bias by the subjects. Therefore, future research should address whether this was the case or if indeed subjects with Alzheimer's disease are excellent at making grammaticality judgments.

The formulaic sentence types included in the grammaticality judgment and sentence completion tasks incorporated both idioms and small talk phrases. A series of experiments comparing idioms versus small talk phrases should lead to knowledge about the status of different types of formulaic language in the lexicon, particularly in light of the post hoc findings reported for Experiments 2 and 3. Since idioms and small talk phrases were responded to differently, we have reason to believe that each type of formula will be processed somewhat differently by all groups.

The ungrammatical sentences in Experiment 2 were generated from formulaic and novel sentences. An elaboration of this experiment where one could compare the "ungrammatical formulaic" sentences with the "grammatical formulaic" sentences, and the "ungrammatical novel" sentences with the "grammatical novel" sentences might provide evidence for the organization of each of these two types of language in the lexicon. Further incorporating various levels of syntactic difficulty within formulaic and novel sentence stimuli might provide greater evidence for the status of each sentence type.

Another project that Experiment 2 generates relates to the lexical organization of formulaic and novel sentences. The reaction time measurements obtained in this study reflected a number of behaviors like reading time, judgment

time, processing time, and accessing time to name a few. To truly answer the lexical organization question, each component of the reaction time measurement should be isolated. In order to understand each component, a series of experiments needs to be undertaken that will separate the various components involved in grammaticality judgment.

An important question whose answer continues to elude researchers is related to the contribution of purely linguistic deficits relative to cognitive deficits in Alzheimer's disease. Essentially we need to analyze the degree of cognitive impairment outside language that is responsible for the performance seen in these Alzheimer's patients. Performance on tasks such as comprehension and repetition where complex processing abilities and memory skills were important and could contribute to the performance of the subjects with Alzheimer's disease, should be dissected. Since the AD patients in this study were also administered a neuropsychological battery at the Aging and Dementia Research Center of NYUMC, some additional analyses could be done. I plan to test some hypotheses (e.g., Patients who perform poorly on memory tests will also perform poorly on idiom repetitions.) relating to the results on that battery with the tasks administered here to determine the relationship between performance on these tasks and other cognitive abilities.

Lastly, the relationship between the language problems noted here and the brain areas that are responsible for language should be explored. Analysis of MRI scans of the subjects with AD to determine if important language areas (e.g.,

Wernicke's area) are more atrophic in those patients who show greater comprehension problems than in those that do not should be explored.

Appendix 1:

Questionnaire

1. Name _____

2. Address _____

3. Phone # _____

4. Date of birth _____

5. Place of birth _____

6. Age _____

7. Sex _____

8. Years of education _____

9. Occupation _____

10. LANGUAGE BACKGROUND:

What's the first language you learned? _____

Is there any other language you know as well as English? _____

OTHER LANGUAGES SPOKEN FLUENTLY.

11. Handedness: _____

12. MEDICAL HISTORY:

A. Did you ever have a head trauma?

EXPLAIN: _____

B. Did you ever have a CVA (Stroke)?

EXPLAIN: _____

C. Do you have any medical problems currently?

EXPLAIN: _____

D. Have you been treated for psychological problems?

EXPLAIN: _____

13. What medications do you take: _____

14. Do you use alcohol?

How much per day? _____

15. Do you use drugs like marijuana and cocaine?

Which ones? _____

How often? _____

16. Did you ever have special difficulty learning to read or with math?

EXPLAIN: _____

17. Did you ever go to speech therapy?

WHY: _____

18. Do you have visual problems?

Explain:

19. Do you have hearing problems?

Explain:

20. Do you have problems reading?

Explain:

21. Do you have periods of depression that last longer than two weeks?

EXPLAIN: _____

22. Score on MMS? _____

STAGE? _____

ONSET? _____

Appendix 2:

Informed Consent Form

FORMULAIC LANGUAGE IN AGING AND ALZHEIMER'S DISEASE

Principle Investigators: Susan De Santi, M.S., CCC, and

Lorraine Obler, Ph.D. from The Graduate School of CUNY

1. The purpose of this project is to study how formulaic language (songs, social phrases, idioms, proverbs) and propositional language (novel sentences and phrases) are affected by age in normal individuals and in individuals with Alzheimer's disease.

2. The procedures to be followed involve a picture pointing task, reading sentences silently, completing sentences, and repeating sentences. This testing will take approximately two one-hour sessions to complete.

In order to record exactly what is said, a tape-recorder will be used. The tape will only be listened to by members of the research team. I understand that the results of the testing will be kept confidential unless I ask that they be released.

3. No medical risks are associated with this study, though you may experience fatigue and/or stress when taking these tests. You will be able to take as many breaks as you wish during the testing session.

4. There are no known direct medical benefits to you for participating in this study.

5. Withdrawal from study: I may refuse to participate or may withdraw from this study at any time without prejudice to my medical care.

6. Questions: My questions have been answered satisfactorily;, if I have any additional questions about the study, I may call Susan De Santi at (516) 671-9635, Dr. Loraine Obler at (212) 642-2366 or CUNY research # (212) 642- .

I HAVE READ AND UNDERSTAND THE ABOVE AND AGREE TO PARTICIPATE IN THIS STUDY.

Signature of participant/Guardian

Date

Signature of responsible Investigator

Date

Appendix 3:

INDIVIDUAL SUBJECT CHARACTERISTICS

SUBJECT	GROUP	AGE	ED	MMS	GDS	SES
1	1	26	16	30	NA	48
2	1	26	17	30	NA	48
3	1	26	16	30	NA	58
4	1	25	18	30	NA	61
5	1	27	12	27	NA	32
6	1	21	12	30	NA	42
7	1	31	13	30	NA	45
8	1	27	12	29	NA	42
9	1	27	13	30	NA	40
10	1	26	13	30	NA	40
11	1	34	12	30	NA	27
12	1	29	12	30	NA	37
13	2	81	10	29	NA	24

Appendix 3 - Con't.

SUBJECT CHARACTERISTICS

SUBJECT	GROUP	AGE	ED	MMS	GDS	SES
14	2	80	08	30	NA	31
15	2	79	12	30	NA	32
16	2	75	15	30	NA	61
17	2	70	14	30	NA	45
18	2	72	16	29	NA	63
19	2	76	11	27	NA	29
20	2	72	12	30	NA	32
21	2	76	16	27	NA	58
22	2	72	13	27	NA	50
23	2	71	18	30	NA	61
24	2	69	12	28	NA	42
25	3	74	12	27	4	47
26	3	70	12	23	4	47

Appendix 3 - Con't.

SUBJECT CHARACTERISTICS

SUBJECT	GROUP	AGE	ED	MMS	GDS	SES
27	3	80	12	20	NA	37
28	3	78	16	21	3	66
29	3	73	12	16	5	42
30	3	68	12	21	4	47
31	3	79	16	17	5	61
32	3	77	11	20	5	29
33	3	74	15	24	4	55
34	3	68	12	20	5	22
35	3	71	08	21	3	26
36	3	70	12	21	4	47

Key: NA - subjects not tested at NYU and did not receive GDS.

Appendix 4:

Stimuli for Experiment 1 and 4 (Kempler, Van Lancker and Read, 1988)

FORMULAIC PHRASES

1. I'd like to give you a piece of my mind.
2. Sticks and stones will break my bones but words will never hurt me.
3. She took a sudden turn for the worse.
4. Just in the nick of time.
5. It's like talking to a brick wall.
6. I've got a bone to pick with you.
7. I'll get back to you later.
8. The truth, the whole truth, and nothing but the truth.
9. He's saving up for a rainy day.
10. When our ship comes in.
11. She's got him eating out of her hand.
12. That's enough to drive a man to drink.
13. While the cat's away, the mice will play.
14. Keep your nose to the grindstone.
15. It seems like just yesterday.
16. Why don't you pick on somebody your own size?
17. He's living high on the hog.
18. Cat got your tongue?
19. How about a little peace and quiet around here?

20. He's turning over a new leaf.

NOVEL PHRASES

1. The dog's trying to give her a ride on the wagon.
2. The nails are under the square and the hammer is in the circle.
3. He's racing a truck against a horse.
4. Almost to the bottom of the mountain.
5. She tried jumping over the striped cat.
6. He's got a picture to show of her.
7. He jumped up to her suddenly.
8. The clown, the small clown, and not the one near a girl.
9. She's looking down at her black cat.
10. Then her dog walks in.
11. He sees her drinking from a bowl.
12. It's easy to teach a dog to swim.
13. Whenever the sun sets, the dog barks.
14. Follow your sister to the dinner table.
15. He kisses the thin lady.
16. Where are they not showing each other their own hats?
17. He's sitting deep in the bubbles.
18. Who's following the dog?
19. Show me the apple and large banana above a square.

20. He's chasing after a white duck.

Appendix 5:

EXPERIMENT 1 - COMPREHENSION

Number Correct for Sentence type by Subject

SUBJECT	GROUP	FORMULAIC	NOVEL
1	1	20.00	20.00
2	1	19.00	20.00
3	1	19.00	20.00
4	1	20.00	20.00
5	1	19.00	16.00
6	1	18.00	20.00
7	1	20.00	19.00
8	1	18.00	16.00
9	1	19.00	19.00
10	1	19.00	20.00
11	1	19.00	18.00
12	1	20.00	20.00

Appendix 5 - Con't.

Number Correct for Sentence type by Subject

SUBJECT	GROUP	FORMULAIC	NOVEL
13	2	16.00	20.00
14	2	9.00	16.00
15	2	19.00	19.00
16	2	17.00	19.00
17	2	20.00	20.00
18	2	19.00	20.00
19	2	18.00	18.00
20	2	20.00	20.00
21	2	18.00	14.00
22	2	13.00	18.00
23	2	20.00	20.00
24	2	25.00	18.00

Appendix 5 - Con't.

Number Correct for Sentence type by Subject

SUBJECT	GROUP	FORMULAIC	NOVEL
25	3	12.00	16.00
26	3	19.00	18.00
27	3	12.00	14.00
28	3	20.00	19.00
29	3	11.00	15.00
30	3	17.00	17.00
31	3	7.00	10.00
32	3	18.00	16.00
33	3	16.00	19.00
34	3	10.00	10.00
35	3	8.00	15.00
36	3	14.00	15.00

Appendix 6:

STIMULI FOR EXPERIMENT 2

A. SMALL TALK PHRASES

1. You know what I mean. (F)

You know what I want. (N)

You knowed what I mean. (UN)

2. Give her my regards. (F)

Give her my number. (N)

Give her mine number. (UN)

3. It's my pleasure. (F)

It's my turn. (N)

It my pleasure. (UN)

4. How's the weather? (F)

How's the food? (N)

How's food the? (UN)

5. It's a nice day. (F)

It's a nice dress. (N)

It a nice dress. (UN)

6. You look great. (F)

You dance great. (N)

You looks pretty. (UN)

7. Don't mention it. (F)

Don't say it. (N)

No say it. (UN)

8. Do you come here often. (F)

Do you meet here often. (N)

Do you going here often. (UN)

9. Haven't we met somewhere before. (F)

Haven't we gone somewhere before. (N)

Haven't we met before somewhere. (UN)

10. You look like somebody I know.

You talk like somebody I know.

B. IDIOMS

1. I'd like to give you a piece of my mind. (F)

I'd like to give you a piece of my cake. (N)

I'd like to give a piece of cake you. (UN)

2. Don't bust my bubble. (F)

Don't bust my balloon. (N)

Don't bubble bust my. (UN)

3. He's living high on the hog. (F)

He's living high on the hill. (N)

He's living high hill on the. (UN)

4. That's none of your business. (F)
 That's none of your concern. (N)
 That's none of you business. (UN)
5. I smell a rat. (F)
 I smell a skunk. (N)
6. Snap out of it. (F)
 Get out of it. (N)
 Get of out it. (UN)
7. Stick with me. (F)
 Stay with me. (N)
8. There's no end to our problems. (F)
 There's no solution to our problems. (N)
 There's no end to our problemed. (UN)
9. He doesn't have a leg to stand on. (F)
 He doesn't have a chair to stand on. (N)
10. The joke went over his head. (F)
 The ball went over his head. (N)
 The joke went over head he. (UN)

C. OTHER UNGRAMMATICAL SENTENCES

1. The couch is floor on the.
2. Him eat a cake.
3. May she rested in bed.
4. The blue is sky.

Note.

F = Formulaic sentence

N = Novel sentence

UN = Ungrammatical sentence

Appendix 7:

EXPERIMENT #2 - GRAMMATICALITY JUDGEMENT

Correctness Scores for Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
1	1	19.00	17.00	20.00
2	1	20.00	19.00	19.00
3	1	20.00	19.00	18.00
4	1	20.00	19.00	17.00
5	1	20.00	13.00	18.00
6	1	20.00	20.00	19.00
7	1	20.00	20.00	19.00
8	1	20.00	18.00	18.00
9	1	20.00	20.00	19.00
10	1	20.00	20.00	20.00
11	1	20.00	16.00	18.00
12	1	20.00	20.00	19.00

Appendix 7 - con't.

Correctness Scores for Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
13	2	20.00	19.00	17.00
14	2	19.00	18.00	16.00
15	2	20.00	20.00	16.00
16	2	20.00	20.00	19.00
17	2	20.00	20.00	20.00
18	2	20.00	19.00	18.00
19	2	19.00	19.00	15.00
20	2	16.00	19.00	18.00
21	2	19.00	17.00	16.00
22	2	19.00	16.00	18.00
23	2	20.00	19.00	18.00
24	2	20.00	16.00	17.00

Appendix 7 - con't.

Correctness Scores for Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
25	3	19.00	18.00	20.00
26	3	19.00	16.00	17.00
27	3	19.00	18.00	14.00
28	3	20.00	15.00	19.00
29	3	20.00	20.00	15.00
30	3	20.00	17.00	16.00
31	3	19.00	18.00	14.00
32	3	20.00	18.00	17.00
33	3	20.00	19.00	19.00
34	3	12.00	14.00	14.00
35	3	17.00	17.00	8.00
36	3	16.00	16.00	15.00

Appendix 8:

EXPERIMENT #2 - GRAMMATICALITY JUDGEMENT

Reaction Time (msec.) Data For Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
1	1	1535.35	1659.95	1818.20
2	1	2718.95	2627.55	2806.25
3	1	2275.00	2643.00	2520.35
4	1	2461.90	2302.10	2294.20
5	1	2235.75	1500.85	2722.25
6	1	2422.15	2983.70	3014.85
7	1	2316.50	2717.80	2637.05
8	1	3202.70	3117.15	3522.05
9	1	2435.50	2624.00	2874.40
10	1	2520.05	2712.65	2944.20
11	1	2109.55	1735.15	2166.25
12	1	2131.15	2240.75	2373.60

Appendix 8 - con't.

Reaction Time (msec.) Data For Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
13	2	3946.15	4343.50	4040.00
14	2	2272.10	2404.75	2596.00
15	2	2484.30	3017.45	2538.60
16	2	2355.75	2504.90	2268.60
17	2	2112.00	2148.25	2076.85
18	2	2996.85	3284.90	2984.45
19	2	2585.10	2951.80	3065.15
20	2	2293.50	2951.25	2661.55
21	2	2752.50	3083.20	2984.45
22	2	2262.30	1820.10	2597.40
23	2	2962.95	2695.75	3013.55
24	2	2245.30	1824.75	2666.95

Appendix 8 - con't.

Reaction Time (msec.) Data For Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
25	3	4872.20	5734.85	7827.05
26	3	4559.20	3864.75	5371.05
27	3	5630.15	5704.40	7143.20
28	3	5159.85	3418.35	3812.75
29	3	5212.25	8253.80	6912.45
30	3	2804.65	2987.00	2960.15
31	3	8188.80	6195.05	7019.85
32	3	4932.55	4141.85	4825.75
33	3	3401.05	3833.00	3335.80
34	3	5820.65	6197.11	8898.10
35	3	2391.90	2305.60	2484.90
36	3	2469.25	2607.55	2613.65

Appendix 9:

EXPERIMENT #2 - GRAMMATICALITY JUDGEMENT

Reading Time (msec.) Data For Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
1	1	1847.00	1915.40	2111.45
2	1	2506.50	2415.30	2569.20
3	1	2208.45	2353.00	2522.80
4	1	2085.85	2105.85	2229.00
5	1	2071.45	1276.20	2478.00
6	1	1979.15	2290.85	2582.75
7	1	2283.45	2558.15	2635.34
8	1	2795.50	2445.65	2991.65
9	1	2254.95	2297.80	2542.95
10	1	2498.20	2564.70	2942.85
11	1	2100.25	1620.65	2137.45
12	1	2134.60	2163.65	2389.40

Appendix 9 - con't.

Reading Time (msec.) Data For Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
13	2	2893.55	2818.40	3237.30
14	2	2372.95	2358.40	2639.75
15	2	2561.40	2707.95	2723.25
16	2	2399.75	2370.45	2521.15
17	2	2158.00	2215.55	2308.00
18	2	2797.60	2822.85	3007.40
19	2	2079.45	2330.60	2159.47
20	2	1750.55	2428.05	2321.50
21	2	2440.00	2526.35	2713.95
22	2	2112.90	1842.89	2461.00
23	2	2557.90	2364.30	2920.15
24	2	2197.15	1718.65	2823.40

Appendix 9 - con't.

Reading Time (msec.) Data For Individual Subjects

Subject	Group	Formulaic Phrases	Novel Phrases	Ungrammatical Phrases
25	3	3146.15	3366.30	5609.20
26	3	3147.05	2340.85	3600.05
27	3	3143.95	3384.70	3964.30
28	3	2628.10	2178.60	2646.05
29	3	3812.30	4157.50	4790.25
30	3	2628.45	2405.20	2659.65
31	3	3533.05	3683.85	3561.15
32	3	3228.35	2651.65	3569.85
33	3	2827.40	2902.70	3309.68
34	3	2236.15	2269.20	3602.40
35	3	2281.50	2233.75	1527.10
36	3	2345.45	2345.45	2280.55

Appendix 10:

STIMULI FOR EXPERIMENT 3

A. SMALL TALK PHRASES.

1. How are _____? (YOU)
Where are _____? (YOU)
2. How do you _____? (DO)
What will we _____? (DO)
3. I'll see you _____. (LATER)
I'll meet you _____. (LATER)
4. I love that dress you're _____. (WEARING)
I want that hat you're _____. (WEARING)
5. Do me a _____. (FAVOR)
You have my _____. (FAVOR)
6. Give me a _____. (HAND)
Lend me a _____. (HAND)
7. Tell him I said _____. (HELLO)
Ask him to say _____. (HELLO)
8. Give him a kiss for _____. (ME)
Tell him a story about _____. (ME)
9. I'll be seeing _____. (YOU)
She'll be watching _____. (YOU)
10. Come back again _____. (SOON)

Call back again _____. (SOON)

B. IDIOMS

1. It's raining cats and _____. (DOGS)

He's petting cats and _____. (DOGS)

2. She took the words right out of my _____. (MOUTH)

I spit the food right out of my _____. (MOUTH)

3. She looks like a million _____. (DOLLARS)

It costs almost a million _____. (DOLLARS)

4. He's living on borrowed _____. (TIME)

He's getting the correct _____. (TIME)

5. You take my breath _____. (AWAY)

You drove my car _____. (AWAY)

6. We won fair and _____. (SQUARE)

We made circles and _____. (SQUARES)

7. She rubs me the wrong _____. (WAY)

She helps me the right _____. (WAY)

8. He's a snake in the _____. (GRASS)

There's a dog in the _____. (GRASS)

9. She's getting under my _____. (SKIN)

She's scrubbing on my _____. (SKIN)

10. Your name is _____. (MUD)

The lawn is _____. (MUD)

Appendix 11:

EXPERIMENT 3 - SENTENCE COMPLETION.

Correctness Scores for Individual Subjects

APPROPRIATE

INAPPROPRIATE

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
1	2	50.00	50.00	.00	.00
2	1	50.00	50.00	.00	.00
3	1	50.00	47.50	.00	2.50
4	1	50.00	50.00	.00	.00
5	1	47.50	50.00	2.50	.00
6	1	47.50	47.50	2.50	2.50
7	1	50.00	47.50	.00	2.50
8	1	50.00	47.50	.00	2.50
9	1	47.50	50.00	2.50	.00
10	1	50.00	50.00	.00	.00
11	1	50.00	50.00	.00	.00
12	1	50.00	50.00	.00	.00

Appendix 11 - Con't.

Correctness Scores for Individual Subjects

APPROPRIATE

INAPPROPRIATE

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
13	2	47.50	50.00	2.50	.00
14	2	45.00	45.00	5.00	5.00
15	2	47.50	45.00	2.50	5.00
16	2	47.50	47.50	2.50	2.50
17	2	50.00	47.50	.00	2.50
18	2	50.00	50.00	.00	.00
19	2	47.50	50.00	2.50	.00
20	2	47.50	50.00	2.50	.00
21	2	47.50	50.00	2.50	.00
22	2	50.00	45.00	.00	5.00
23	2	50.00	47.50	.00	2.50
24	2	47.50	50.00	2.50	.00

Appendix 11 - Con't.

Correctness Scores for Individual Subjects

APPROPRIATE

INAPPROPRIATE

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
25	3	40.00	47.50	10.00	2.50
26	3	50.00	45.00	.00	5.00
27	3	45.00	45.00	5.00	5.00
28	3	45.00	50.00	5.00	.00
29	3	50.00	40.00	.00	10.00
30	3	47.50	47.50	2.50	2.50
31	3	45.00	37.50	5.00	12.50
32	3	45.00	45.00	5.00	5.00
33	3	47.50	42.50	2.50	7.50
34	3	47.50	40.00	2.50	10.00
35	3	45.00	47.50	5.00	2.50
36	3	32.50	45.00	17.50	5.00

Appendix 12:

EXPERIMENT 3 - SENTENCE COMPLETION.

Correctness Scores for Individual Subjects

Appropriate-Predicted Appropriate-NotPredicted

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
1	1	40.00	30.00	10.00	20.00
2	1	42.50	27.50	7.50	27.50
3	1	40.00	25.00	10.00	25.00
4	1	40.00	22.50	10.00	22.50
5	1	40.00	22.50	7.50	22.50
6	1	32.50	22.50	15.00	22.50
7	1	37.50	22.50	12.50	22.50
8	1	42.50	22.50	7.50	17.50
9	1	35.00	17.50	12.50	30.00
10	1	42.50	30.00	7.50	30.00
11	1	32.50	30.00	17.50	30.00
12	1	42.50	30.00	7.50	

Appendix 12 - Con't.

Correctness Scores for Individual Subjects

Appropriate-Predicted Appropriate-NotPredicted

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
14	2	32.50	17.50	12.50	27.50
15	2	35.00	17.50	12.50	27.50
16	2	32.50	20.00	15.00	27.50
17	2	40.00	22.50	10.00	25.00
18	2	45.00	27.50	5.00	22.50
19	2	40.00	25.00	7.50	25.00
20	2	37.50	30.00	10.00	20.00
21	2	37.50	22.50	10.00	27.50
22	2	37.50	17.50	12.50	27.50
23	2	40.00	22.50	10.00	25.00
24	2	35.00	20.00	12.50	30.00
25	3	25.00	15.00	15.00	32.50

Appendix 12 - Con't.

Correctness Scores for Individual Subjects

Appropriate-Predicted Appropriate-NotPredicted

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
26	3	40.00	20.00	10.00	25.00
27	3	35.00	20.00	10.00	25.00
28	3	37.50	20.00	7.50	30.00
29	3	32.50	17.50	17.50	22.50
30	3	40.00	25.00	7.50	22.50
31	3	32.50	20.00	12.50	17.50
32	3	30.00	15.00	15.00	30.00
33	3	40.00	17.50	7.50	25.00
34	3	35.00	15.00	12.50	25.00
35	3	35.00	25.00	10.00	22.50
36	3	22.50	07.50	10.00	37.50

Appendix 13:

EXPERIMENT 3 - SENTENCE COMPLETION

Reaction Time for Appropriate and Inappropriate responses

APPROPRIATE

INAPPROPRIATE

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
1	1	1947.60	2298.45		
2	1	2125.15	2425.75		
3	1	1901.50	2445.95		1956.00
4	1	1981.05	2361.40		
5	1	2018.11	2474.60	2200.00	
6	1	2151.00	2666.32	1781.00	1912.00
7	1	1976.10	2508.89		3556.00
8	1	2505.60	4647.37		4287.00
9	1	1762.79	1962.20	1869.00	
10	1	2020.50	2497.30		
11	1	1942.45	2129.90		
12	1	2023.90	2163.70		

Appendix 13 - Con't.

Reaction Time for Appropriate and Inappropriate responses

APPROPRIATE

INAPPROPRIATE

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
13	2	2691.16	4077.20	2280.00	
14	2	2015.67	2483.22	6671.50	1777.00
15	2	2351.53	3890.44	1487.00	2456.00
16	2	2473.84	2417.37	2487.00	1456.00
17	2	1721.05	2050.58		2694.00
18	2	2220.45	2765.15		
19	2	2393.42	2800.00	1875.00	
20	2	2238.79	2647.90	1837.00	
21	2	2152.53	2394.60	2125.00	
22	2	1937.70	4102.33		2712.50
23	2	2193.65	2971.84		2344.00
24	2	2277.16	2274.30	1712.00	

Appendix 13 - Con't.

Reaction Time for Appropriate and Inappropriate responses

APPROPRIATE

INAPPROPRIATE

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
25	3	5359.75	9301.11	7921.75	4050.00
26	3	2864.35	4316.83		4134.50
27	3	2572.17	5457.44	4733.50	5836.50
28	3	2158.17	2941.65	2244.00	
29	3	6399.75	7174.38		6762.50
30	3	2079.53	4066.05	2750.00	2431.00
31	3	3194.67	4736.47	17274.50	6876.60
32	3	3280.11	3843.67	1962.50	3531.00
33	3	2527.89	2418.18	1813.00	3141.67
34	3	3382.74	3911.00	12100.00	6778.50
35	3	2587.06	2826.53	3381.00	10880.00
36	3	2430.69	2630.56	3309.71	2771.50

Appendix 14:

Reaction Time for Appropriate-predicted and Appropriate-not predicted responses, formulaic and novel sentences.

Appropriate-Predicted Appropriate-NotPredicted

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
1	1	1884.19	2239.67	2201.25	2386.63
2	1	2182.25	2640.64	2529.00	2163.11
3	1	1920.25	2544.30	1826.50	2336.67
4	1	1993.63	2253.33	1930.75	2449.82
5	1	1847.31	2154.00	2929.00	2736.91
6	1	2334.92	2368.56	2141.67	2934.30
7	1	1937.33	2619.56	2092.40	2409.30
8	1	2170.94	3031.89	4402.00	6101.30
9	1	1824.07	2052.00	1591.20	1913.85
10	1	2033.35	2328.92	1947.67	2749.88
11	1	1935.08	2219.67	1956.14	1995.25
12	1	2023.41	2165.00	2026.67	2161.75

Appendix 14 - Con't.

Reaction Time for Appropriate-predicted and Appropriate-not predicted responses, formulaic and novel sentences.

Appropriate-Predicted Appropriate-NotPredicted

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
13	2	2798.19	3601.75	2120.33	4790.38
14	2	2060.23	2116.29	1899.80	2716.73
15	2	2312.36	2653.57	2461.20	4677.55
16	2	2188.42	2813.25	3457.00	2129.45
17	2	1715.81	2146.00	1742.00	2179.30
18	2	2274.11	2548.09	1737.50	3030.44
19	2	2305.81	2796.80	2860.67	2803.20
20	2	2135.40	2617.67	2626.50	2693.25
21	2	2172.80	2158.89	2076.50	2587.45
22	2	2016.20	2260.57	1702.20	5274.36
23	2	2260.13	3295.00	1927.75	2681.00
24	2	2224.86	2632.17	2423.60	2474.42

Appendix 14 - Con't.

Reaction Time for Appropriate-predicted and Appropriate-not predicted responses, formulaic and novel sentences.

Appropriate-Predicted Appropriate-NotPredicted

SUBJECT	GROUP	FORMULAIC	NOVEL	FORMULAIC	NOVEL
25	3	4453.60	7859.50	6870.00	9966.46
26	3	2951.50	2973.38	2515.75	5391.60
27	3	2434.21	3164.25	3055.00	7292.00
28	3	2264.00	3329.38	1629.00	2683.17
29	3	4661.54	10466.43	11232.50	5190.63
30	3	1985.44	4115.80	2581.33	4010.78
31	3	3302.23	3896.63	2915.00	5696.29
32	3	3193.58	2644.50	3453.17	4443.25
33	3	2675.31	1930.14	1741.67	2759.80
34	3	2913.64	3488.83	4696.20	4164.30
35	3	2787.86	2479.30	1884.25	3212.33
36	3	2752.00	2052.00	1707.75	2746.27

Appendix 15:

EXPERIMENT 4 - REPETITION

Percent Correct - Subject Data

SUBJECT	GROUP	FORMULAIC	NOVEL
1	1	20.00	16.00
2	1	19.00	17.00
3	1	19.00	18.00
4	1	18.00	16.00
5	1	19.00	18.00
6	1	17.00	17.00
7	1	20.00	20.00
8	1	17.00	18.00
9	1	20.00	19.00
10	1	18.00	19.00
11	1	17.00	19.00
12	1	19.00	20.00

Appendix 15 - Con't.

Percent Correct - Subject Data

SUBJECT	GROUP	FORMULAIC	NOVEL
13	2	18.00	17.00
14	2	11.00	9.00
15	2	18.00	15.00
16	2	19.00	14.00
17	2	19.00	14.00
18	2	20.00	19.00
19	2	14.00	11.00
20	2	18.00	16.00
21	2	17.00	15.00
22	2	19.00	18.00
23	2	20.00	20.00
24	2	18.00	15.00

Appendix 15 - Con't.

Percent Correct - Subject Data

SUBJECT	GROUP	FORMULAIC	NOVEL
25	3	9.00	9.00
26	3	20.00	17.00
27	3	17.00	14.00
28	3	20.00	15.00
29	3	16.00	13.00
30	3	19.00	16.00
31	3	19.00	13.00
32	3	16.00	12.00
33	3	19.00	17.00
34	3	18.00	14.00
35	3	16.00	17.00
36	3	11.00	6.00

**KAY ELECTRONICS CORP. MODEL 5500
SIGNAL ANALYSIS WORKSTATION**

Date: DECEMBER 26 1991 Rec. Off Time: 1:50:46 AM
Analysis by:

INPUT SETTINGS	Channel 1	Channel 2
Source	LEFT CONNECTORS	ALL MEMORY FOR CH1
Frequency Range	DC - 8 kHz.	DC - 8 kHz.
Input Shaping	FLAT	FLAT
Buffer Size	38.0 SECONDS	4.0 SECONDS

ANALYSIS SETTINGS	Lower Screen	Upper Screen
Signal Analyzed	CHANNEL 1	CHANNEL 1
Analysis Format	WAVEFORM	NO DISPLAY
Transform Size	200 pts. (150 Hz)	100 pts. (300 Hz)
Time Axis	200ms (4sec)	10ms (1sec)
Frequency Axis	50% FROM CURSOR	50% FROM CURSOR
Analysis Window	HARDING	HARDING
Averaging Set Up	NO AVERAGING	NO AVERAGING

DISPLAY SETTINGS	Lower Screen	Upper Screen
Freq. Divisions	0 000 Hz	0 000 Hz.
Dynamic Range	42 dB	42 dB
Analysis Allen.	20 dB	20 dB
Set Up Options Set	to: # 02	

CURSOR READINGS:

FC1:	FC2:	^F:
FC1: dB.	FC2: dB.	^F: dB
^R1: 11.39 Sec.	^R2: 9.156 Sec.	
^T: 2.237 Sec.		

PITCH	TC1:	Hz.	TC2:	Hz.
AMPLITUDE	TC1:	dB	TC2:	dB

SUBJECT MATTER *HE'S A SNAKE IN THE GRASS*

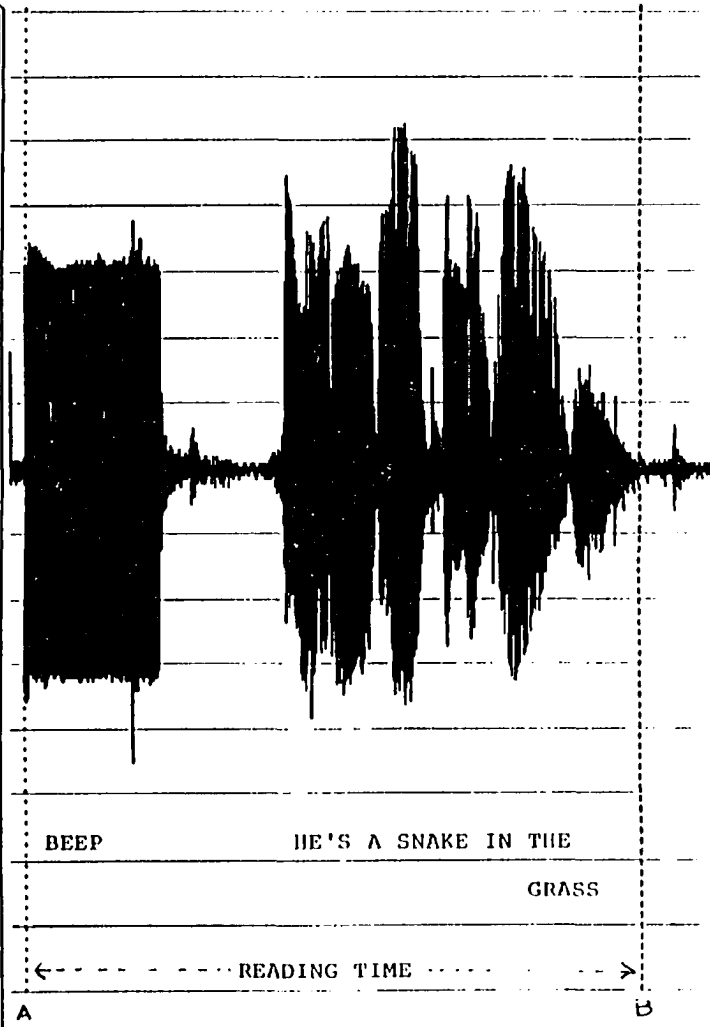


Figure 1.

**KAY ELECTRONICS CORP MODEL 5500
SIGNAL ANALYSIS WORKSTATION**

Date: DECEMBER 26 1991 Rec. Off Time: 1:50:46 AM
Analysis by:

INPUT SETTINGS	Channel 1	Channel 2
Source	LEFT CONNECTORS	ALL MEMORY FOR CH1
Frequency Range	DC - 8 kHz.	DC - 8 kHz.
Input Shaping	FLAT	FLAT
Buffer Size	38.0 SECONDS	4.0 SECONDS

ANALYSIS SETTINGS	Lower Screen	Upper Screen
Signal Analyzed	CHANNEL 1	CHANNEL 1
Analysis Format	WAVEFORM	NO DISPLAY
Transform Size	200 pts. (150 Hz)	100 pts. (300 Hz)
Time Axis	200ms (4sec)	50ms (1sec)
Frequency Axis	50% FROM CURSOR	50% FROM CURSOR
Analysis Window	HANNING	HANNING
Averaging Set Up	NO AVERAGING	NO AVERAGING

DISPLAY SETTINGS	Lower Screen	Upper Screen
Freq Divisions	0.000 Hz	0.000 Hz
Dynamic Range	-12 dB	-12 dB
Analysis Atten	20 dB	20 dB
Set Up Options Set to:	0%	

CURSOR READINGS:

FC1:	FC2:	FC:
FC1: dB, FC2: dB, FC: dB		
AR1: 9.156 Sec.	AR2: 10.86 Sec.	
AT: 1.706 Sec.		
PITCH TC1: Hz, TC2: Hz		
AMPLITUDE TC1: dB, TC2: dB		

SUBJECT MATTER : HE'S A SNAKE IN THE GRASS

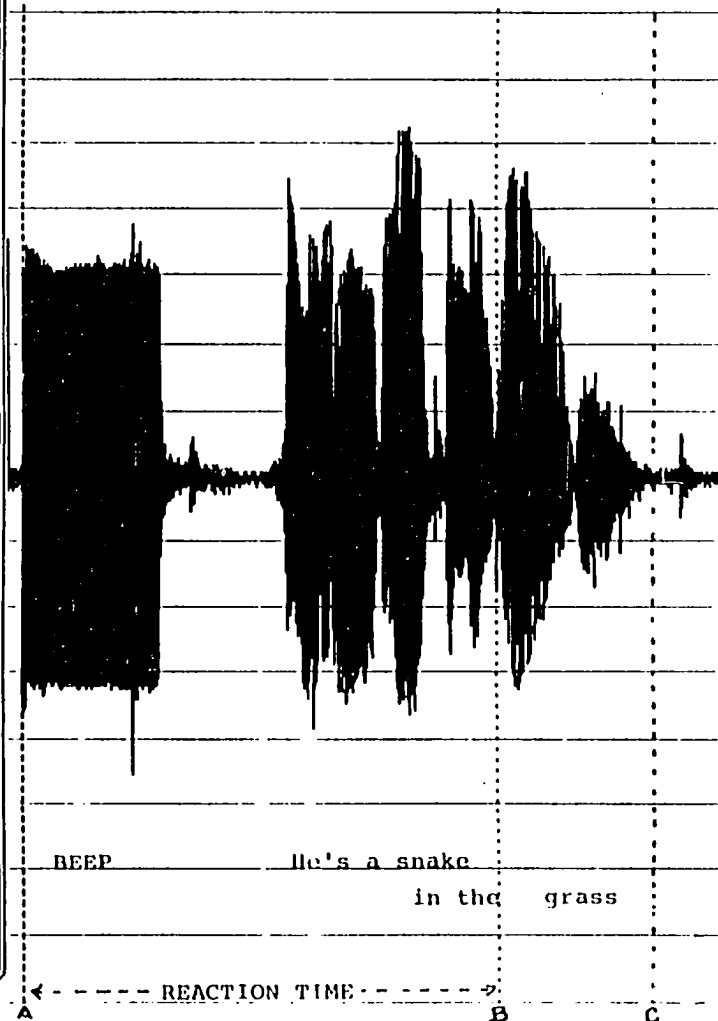


Figure 2

REFERENCES

- Abeyasinghe, S., Bayles, K., Trosset, M. (1990). Semantic memory deterioration in Alzheimer's subjects: Evidence from word association, definition, and associate ranking tasks. Journal of Speech and Hearing Research, **33**, 574-582.
- Appell, J., Kertesz, A., Fisman, M. (1982). A study of language functioning in Alzheimer's patients. Brain and Language, **17**, 73-91.
- Au, R., Obler, L.K., & Albert, M. (1988). The relation of aphasia to dementia. Aphasiology, **2**, 161-173.
- Bates, E., Wulfeck, B., Marchman, V., & Kritchevsky, M. (1991). Constraints on the use of complex syntax in fluent aphasia and in Alzheimer's disease. Paper presented at The Academy of Aphasia, Rome, Italy.
- Bayles, K. (1982). Language function in senile dementia. Brain and Language, **16**, 265-280.
- Bayles, K., Boone, D., Tomoeda, C., & Slauson, T. (1989). Differentiating Alzheimer's patients from the normal elderly and stroke patients with aphasia. Journal of Speech and Hearing Disorders, **54**, 74-87.
- Bayles, K., & Kaszniak, A. (1987). Communication and Cognition in Normal Aging and Dementia. Boston; Little, Brown and Co.
- Bayles, K., Rao, S., Trosset, M., Tomoeda, C. (1992). Effects of normal aging on production of descriptive discourse. Submitted for publication.
- Bayles, K., & Tomoeda, C. (1983). Confrontation naming impairment in dementia. Brain and Language, **19**, 98-114.
- Bayles, K., Tomoeda, C., & Caffrey, J. (1982). Language and dementia producing diseases. Communicative Disorders, **7**, 131-146.
- Bayles, K.A., Tomoeda, C.K., Kaszniak, A.W., Stern, L.Z., & Eagans, K.K. (1985). Verbal perseveration of dementia patients. Brain and Language, **25**, 102-116.
- Beeson, P.M., Bayles, K.A., Tomoeda, C.K., & Slauson, T.J. (1987). Oral discourse in demented, aphasic, and elderly individuals: Content analysis. Paper presented at the annual meeting of the American Speech-Language Hearing Association, New Orleans, LA.

- Blumstein, S., Milberg, W., & Shrier, R. (1982). Semantic processing in aphasia: Evidence from an auditory lexical decision task. Brain and Language, **17**, 301-315.
- Boatner, M.T., Gates, J.E., Makkai, A. (1975). A Dictionary of American Idioms. Woodbury, NY: Barron's Educational Series, Inc.
- Botwinick, J., & Storandt, M. (1974). Memory, Related Functions and Age. Springfield, Il: Charles C. Thomas.
- Bromley, D. (1966). The Psychology of Human Aging. Baltimore, MD: Penguin Books.
- Brown, J. & Jaffe, J. (1975). Hypothesis on cerebral dominance. Neuropsychologia, **13**, 107-110.
- Causino, M., Obler, L.K., Knoefel, J., & Albert, M.L. (in preparation). Pragmatic abilities in late-stage SDAT. Boston VA Medical Center.
- Chafe, W. (1968). Idiomaticity as an anomaly in the Chomskyan paradigm. Foundations of language, **4**, 109-125.
- Chomsky, N. (1980). Rules and Representations. New York: Columbia University Press.
- Code, C. (1982). Neurolinguistic analysis of recurrent utterances in aphasia. Cortex, **18**, 141-152.
- Code, C. (1989). Speech Automatism and Recurring Utterances. In C. Code (Ed.) The Characteristics of Aphasia. Philadelphia, PA: Taylor and Francis.
- Curtiss, S., Kempler, D., La Rue, A. (1983). Language and cognition in dementia: A case study. Working Papers in Cognitive Linguistics, UCLA
- De Santi, S., Obler, L.K., Sabo-Abramson, H., & Goldberger, J. (1989). Discourse abilities and deficits in multilingual dementia. In H. Brownell and Y. Joannette (Eds.) Discourse Ability and Brain Damage: Theoretical and Empirical Perspectives. New York: Springer-Verlag.
- De Santi, S., Obler, L.K., Gerstman, L., Rosen, W., & Redmond, C. (1992). Familiar language in aging and Alzheimer's disease. Paper presented at the TENNET conference, Montreal, Canada.

- de Villiers, P., & de Villiers, J. (1972). Early judgments of semantic and syntactic acceptability by children. Journal of Psycholinguistic Research, **1**, 299-310.
- Dronkers, N. (1984). The role of syntax in automatic speech processing. Paper presented at the Academy of Aphasia, Los Angeles, CA.
- Dronkers, N. (in preparation). Automatic speech in Broca's aphasia. Draft
- Emery, O. (1985). Language and aging. Experimental Aging Research, **11**, 3-60.
- Faber-Langendoen, K., Morris, J., Knesevich, J., LaBarge, E., Miller, J., & Berg, L. (1988). Aphasia in senile dementia of the Alzheimer type. Annals of Neurology; **23**, 365-370.
- Folstein, M. (1983). The Mini-Mental State Examination. In T. Cook, S. Ferris, R. Bartus (Eds.) Assessment in Geriatric Psychopharmacology. New Canaan, Ct.: Mark Pawley Assoc., Inc.
- Folstein, M.F., Folstein, S.E., & McHugh, P.R. (1975). "Mini-mental state", a practical method for grading the mental state of patients for the clinician. Journal of Psychiatric Research, **12**, 189-198.
- Fraser, B. (1970). Idioms within a transformational grammar. Brain and Language, **6**, 22-42.
- Friederici, A. (1982). Syntactic and semantic processes in aphasic deficits: The availability of prepositions. Brain and Language, **15**, 249-258.
- Gardner, H., Denes, G., & Zurif, E. (1975). Critical reading at the sentence level of aphasia. Cortex, **13**, 181-190.
- Gerwirth, L., Shindler, A., & Hier, D. (1984). Altered patterns of word association in dementia and aphasia. Brain and language, **21**, 307-317.
- Gibbs, R. (1979). Contextual effects in understanding indirect requests. Discourse Processes, **2**, 1-10.
- Gibbs, R. (1980). Spilling the beans on understanding and memory for idioms in conversation. Memory and Cognition, **17**, 149 - 156.
- Gibbs, R. (1984). Literal meaning and psychological theory. Cognitive Science; **8**, 275-304.

- Gibbs, R. (1991). Semantic analyzability in children's understanding of idioms. Journal of Speech and Hearing Research, **34**, 613-620.
- Gibbs, R., Nayak, N., Bolton, J., & Keppel, M. (1989). Speakers' assumptions about the lexical flexibility of idioms. Memory and Cognition, **17**, 58-68.
- Gibbs, R., Nayak, N., Cutting, C. (1989). How to kick the bucket and not decompose: Analyzability and idiom processing. Journal of memory and language, **28**, 576-593.
- Gleitman, L., Gleitman, H., & Shipley, E. (1972). The emergence of the child as grammarian. Cognition, **1**, 137-164.
- Goldstein, K. (1948). Language and Language Disturbances. New York: Grune & Stratton.
- Hamilton, H. (In preparation). Requests for clarification as evidence of pragmatic comprehension difficulty: The case of Alzheimer's disease. In R. Bloom, L.K. Obler, S. De Santi & J. Ehrlich (Eds.). Discourse in Adult Clinical Populations.
- Head, H. (1926). Aphasia and Kindred Disorders of Speech, Vol 1. New York: Macmillan.
- Hollingshead, A.B. (1977). Four Factor Index of Social Status. Unpublished paper, Department of Sociology, Yale University.
- Huff, F., Corkin, S., & Growdon, H. (1986). Semantic impairment and anomia in Alzheimer's disease. Brain and Language, **28**, 235-249.
- Huff, F., Mack, L., Mahlmann, J., & Greenberg, S. (1988). A comparison of lexical-semantic impairments in left hemisphere stroke and Alzheimer's disease. Brain and Language, **34**, 262-278.
- Hughlings Jackson, J. (1874). On the nature of the duality of the brain. Medical Press and Circular, vol. 1. Reprinted in Brain, 1915, vol. XXXVIII.
- Hughlings Jackson, J. (1878). On affections of speech from disease of the brain. Brain, vol. I, 203-222; 304-330. Reprinted in Brain, 1915, vol. XXXVIII.
- Jorm, A. (1988). Controlled and automatic information processing in senile dementia: A review. Psychol Med, 1986 Feb; **1**: 623-38.

- Kempler, D. (1988). Lexical and pantomime abilities in Alzheimer's disease. Aphasiology, **2**, 147-159.
- Kempler, D., Curtiss, S., & Jackson, C. (1987). Syntactic preservation in Alzheimer's Disease. Journal of Speech and Hearing Research, **30**, 343-350.
- Kempler, D., & Van Lancker, D. (in preparation). Familiar and Novel Language Comprehension Test. (revised edition).
- Kempler, D., Van Lancker, D., & Read, S. (1988). Proverb and idiom comprehension in Alzheimer's disease. Alzheimer Disease and Associated Disorders, **2**, 38-40.
- Kertesz, A. (1983). Localization of lesions in Wernicke's aphasia. In A. Kertesz (Ed.). Localization in Neuropsychology. New York: Academic Press.
- Lezak, M. (1983). Neuropsychological Assessment. New York: Oxford University Press.
- Linebarger, M., Schwartz, M., & Saffron, E. (1983). Sensitivity to grammatical structure in so called agrammatic aphasics. Cognition, **13**, 361-392.
- Luria, A. (1966). Higher Cortical Functions in Man. New York: Plenum Press.
- Luria, A. (1970). Traumatic Aphasia. The Hague, Mouton.
- Luria, A. (1977). Disturbances in grammatical operations in semantic aphasia. Neurolinguistics, **6**, 169-76.
- Marie, P. (1925). A singular trouble with speech: palilalia (dissociation of voluntary speech and of automatic speech). Le Monde Medical, **664**, 329-344. Reprinted in M. Cole & M. Cole (Eds.), Pierre Marie's Papers on Speech Disorders. New York: Hafner Publishing Co., 1971.
- McKahn, G., Drachman, D., Folstein, M., Katzman, R., Price, D., & Stadler, E.M. (1984). Clinical diagnosis of Alzheimer's disease: report of the NINCDS-ADRDA work group under the auspices of the Department of Health and Human Services task force on Alzheimer's disease. Neurology, **34**, 939-944.
- Myers, P.S., & Linebaugh, C.W. (1981). Comprehension of idiomatic expressions by right-hemisphere-damaged adults. In R. Brookshire (Ed.) Clinical Aphasiology Proceedings. Minneapolis: BRK Publishers.

- Nayak, N., & Gibbs, R. (1990). Conceptual knowledge in the interpretation of idioms. Journal of Experimental Psychology: General, **119**,315-330.
- Nebes, R., Boller, F., & Holland, A. (1986). Use of semantic context by patients with Alzheimer's disease. Psychology and Aging, **1**, 261-269.
- Nebes, R., & Brady, C. (1991). The effects of contextual constraint on semantic judgments by Alzheimer's patients. Cortex, **27**,237-246.
- Nebes, R., & Brady, C. (1992). Generalized cognitive slowing and severity of dementia in Alzheimer's disease: Implications for the interpretation of response-time data. Journal of Clinical and Experimental Neuropsychology, **14**,317-326.
- Nebes, R., Brady, C., & Huff, F.J. (1989). Automatic and attentional mechanisms of semantic priming in Alzheimer's disease. Journal of Clinical and Experimental Neuropsychology, **2**, 219-230.
- Nebes, R., Martin, D., Horn. (1984). Sparing of semantic memory in Alzheimer's disease. Journal of Abnormal Psychology, **93**,321-330.
- Nicholas, M., Obler, L.K., Albert, M.L., & Helm-Estabrooks, N. (1985). Empty speech in Alzheimer's disease and fluent aphasia. Journal of Speech and Hearing Research, **28**,405 - 410.
- Nielsen, J.M. (1936). Agnosia, Apraxia, Aphasia: Their Value in Cerebral Localization. New York: Hafner Publishing Co, Inc.
- Ober, B., & Shenaut, G. (1988). Lexical decision and priming in Alzheimer's disease. Neuropsychologia, **26**,273-286.
- Obler, L.K. (1980). Narrative discourse style in the elderly. In L.K. Obler & M.L.Albert (Eds.) Language and Communication in the Elderly: Clinical, Therapeutic, and Experimental Aspects. Lexington MA: D.C. Heath and Co.
- Obler, L.K. (1981). Review of le langage des dements, by L. Irigaray, 1973. The Hague: Mouton. Brain and Language, **12**,375-386.
- Obler, L.K. (1983). Language and brain dysfunction in dementia. In S. Segalowitz (Ed.) Language Functions and Brain Organization. New York: Academic Press.

- Obler, L.K., & Albert, M.L. (1981). Language in the elderly aphasic and in the dementing patient. In M. Sarno (Ed.) Acquired Aphasia. New York: Academic Press.
- Obler, L.K., Albert, M.L., Goodglass, H., & Benson, D.F. (1978). Aphasia type and aging. Brain and Language, **6**, 318 - 322.
- Peters, A. (1983). The Units of Language Acquisition. Cambridge: Cambridge University Press.
- Pick, A. (1931). Agrammatism (Chapter 14). In J.W. Brown (Ed) Aphasia. USA: Charles C. Thomas.
- Posner, M., & Snyder, C. (1975). Attention and cognitive control. In R. Solso (Ed.) Information Processing and Cognition. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Reisberg, B., Ferris, S., De Leon, M., Crook, T. (1982). The Global deterioration scale for the assessment of primary degenerative dementia. Journal of American Geriatric Society, **139**, 1136-1139.
- Ripich, D.N., & Terrell, B.Y. (1988). Patterns of discourse cohesion and coherence in Alzheimer's disease. Journal of Speech and Hearing Disorders, **53**, 8-15.
- Rosen, W. (1980). Verbal fluency in aging and dementia. Journal of Clinical Neuropsychology, **2**, 135-146.
- Salthouse, T. (1985). Speed of behavior and its implications for cognition. In J. Birren and K. Schaie (Eds.), Handbook of the Psychology of Aging. 2nd edition New York: Van Nostrand Reinhold.
- Santo Pietro, M., & Goldfarb, R. (1985). Characteristic patterns of word association responses in institutionalized elderly with and without senile dementia. Brain and Language, **26**, 230 - 234.
- Schneider, W., & Schiffrin, R. (1977). Controlled and automatic information processing: 1. Detection, search and attention. Psychological Review, **84**, 1-66.
- Schwartz, M., Marin, O., Saffran, E. (1979). Dissociation of language function in dementia: A case Study. Brain and language, **7**, 277-306.

- Stark, J. (1988). Aspects of automatic versus controlled processing, monitoring, metalinguistic tasks, and related phenomena in aphasia. In W. Dressler and J. Stark (Eds.) Linguistic Analysis of Aphasic Language. Berlin: Springer-Verlag.
- Swinney, D., & Cutler, A. (1979). The access and processing of idiomatic expressions. Journal of verbal learning and verbal behavior, **18**, 523-534.
- Van Lancker, D. (1987). Nonpropositional Speech: Neurolinguistic studies. In A. Ellis (Ed.) Progress in the Psychology of Language, Vol. III. Hillsdale, NJ: Lawrence Erlbaum Associates.
- Van Lancker, D. (1990). The neurology of proverbs. Behavioral Neurology, **3**, 169-187.
- Van Lancker, D., Canter, G., & Terbeck, D. (1981). Disambiguation of ditropic sentences: Acoustic and phonetic cues. Journal of Speech and Hearing Research, **24**, 330 - 335.
- Van Lancker, D., & Galloway, L. (unpublished paper). Auditory recognition of idioms by first and second speakers of English: It takes one to know one.
- Van Lancker, D., & Kempler, D. (1987). Comprehension of familiar phrases by left-but not by right hemisphere damaged patients. Brain and language, **32**, 265-277.
- Weinreich, U. (1969). Problems in the analysis of idioms. In J. Puhvel (Ed.) Substance and the Structure of Language. Los Angeles: University of California Press.
- Whitaker, H. (1976). A case of the isolation of the language function. In H. Whitaker and H.A. Whitaker (Eds.) Studies in Neurolinguistics. Vol. 2, New York: Academic Press.