Multilevel Discourse Processing Analyses in Adults with a Cognitive Impairment

by

Stephen Kintz

November, 2016

Director: Dr. Heather Harris Wright

Major Department: Communication Sciences and Disorders

Participants with a cognitive impairment associated with Alzheimer's disease (AD) present with discourse impairments early within the disorder. These discourse impairment are associated with declines in episodic, semantic, and working memory. These impairments provide researchers with the opportunity to examine the linguistic and other cognitive systems responsible for discourse, as well as determine how impairments to other cognitive systems impact discourse. Moreover, since these linguistic impairments are often qualitatively and quantitatively different from healthy aging, researchers may be able to use a multilevel discourse analysis to improve screening methods for cognitive impairment.

The purpose of this study, then, is two-fold: (1) determine how participants with AD fit into the construction-integration model of discourse processing with special attention given to the role semantic memory declines have on discourse and (2) determine if a multilevel discourse analysis can discriminate between the participants with AD and healthy controls.

Participants include 12 participants with AD and 12 healthy controls matched for age and education. To assess cognitive and linguistic abilities, participants complete three tasks: cognitive tasks, semantic tasks, and a discourse tasks. The cognitive task will include measures of episodic and working memory from the Wechsler Memory Scale - III. The semantic tasks involved the Pyramid and Palm Tree Tests, Boston Naming Tests, and a Category Flunecy Test.

The discourse task will require participants to tell a story from two wordless pictures books. The discourse samples were analyzed for micro- and macrolinguistic errors; percentage of living things; percentage of light verbs; and thematic elements and actions.

For study aim one, a MANOVA determined that participants with a cognitive impairment associated with AD produced more micro- and macrolinguistic errors, as well as fewer thematic actions compared with healthy controls. For aim two, a binary logistic regression model correctly grouped 87.5% of the participants into their correct group. While this is promising, more research is needed to understand the impact AD has on discourse and whether or not discourse can be used to improve screening method.

Multilevel Discourse Processing Analyses in Adults with a Cognitive Impairment

A Dissertation

Presented to the Faculty of the Department of Communication Sciences and Disorders

East Carolina University

In Partial Fulfillment of the Requirements for the

Ph.D. in Communication Sciences and Disorders

By

Stephen Kintz

November, 2016

Multilevel Discourse Processing Analyses in Adults with a Cognitive Impairment

by

Stephen Kintz

APPROVED BY:

DIRECTOR OF
DISSERTATION: ____
(Heather Harris Wright, PH.D., CCC-SLP)

COMMITTEE MEMBER: ____
(Yolanda Holt, Ph.D., CCC-SLP)

COMMITTEE MEMBER: ____
(D. Erik Everhart, Ph.D., ABPP, CBSM)

CHAIR OF THE DEPARTMENT
OF (Communication Sciences and Disorders): ____________________________________
(Jamie Perry, Ph.D., CCC-SLP)

DEAN OF THE
GRADUATE SCHOOL: ____
Paul J. Gemperline, PhD

ACKNOWLEDGEMENT

I would like to thank my professor and mentor, Dr. Heather Harris Wright, for providing me with the knowledge and opportunity to complete this endeavor. I have learned more from her than I ever thought possible. I would like to thank both Dr. Yolanda Holt and Dr. Erik Everhart for serving on my committee. I should also thank my wife, Hannia Bejarano, and son, Ian Bejarano Kintz, for standing by me during the past four years. I should also thank my family and friends who provided me the support to finish my Ph.D. Finally, I would like to thank East Carolina University and the faculty and staff of the Department of Communication Sciences and Disorders for providing me with the opportunity and resources to complete my degree and begin my research career.

TABLE OF CONTENTS

LIST OF TABLES viii

LIST OF FIGURES ix

CHAPTER 1: Introduction 1

Models of Discourse 3

Construction-Integration Model of Discourse 4

Levels of Representation 5

Micro- and Macrolinguistic Processes 7

Long-term Memory 9

Long-term Memory's Role in the CI Model of Discourse 10

Dementia and Alzheimer's Disease 13

Semantic Memory Memory 14

Microlinguistic Impairments in Alzheimer's disease 20

Macrolinguistic Impairments in Alzheimer's disease 27

Multilevel Discourse Analysis 29

Purpose of Study 32

CHAPTER 2: Methods 34

Participants 34

Cognitive Screening 35

Mini-Mental State Exam - 2 35

Dementia Rating Scale - 2 36

Semantic Memory Assessments 37

Pyramid and Palm Tree Test 37

Boston Naming Test 38

Category Fluency Test 38

Semantic Composite Score 38

Wechsler Memory Scale - III 39

Discourse Stimulus 39

Transcription 40

Language Coding 41

Lexical Analysis 41

Multilevel Discourse Analysis 43

Thematic Anaylsis 43

Procedures 44

Analyses 45

CHAPTER 3: Results 47

Data Preparation 47

Preliminary Analyses 49

Main Results 49

CHAPTER 4: Discussion 54

Microlinguistic Analysis 55

Macrolinguistic Analysis 65

Constructive-Integrative Model of Discourse 69

Multilevel Discourse Analysis 71

Conclusion 73

REFERENCES 76

APPENDIX A: IRB APPROVAL 101

APPENDIX B: MULTILEVEL ANALYSIS FORM 102

APPENDIX C: THEMATIC UNITS FORM 103

LIST OF TABLES

1. Participants' Demographic Information 90
2. Test of Between Subject Effects 91
3. Componenet Matrix 92
4. Pairwise T-Test Between Groups 93
5. Cognitive Results for Individuals with a Cognitive Impairment 94
6. Pearson Correlation Matrix 95

LIST OF FIGURES

1. Adpated Construction-Integrative Model of Discourse 96

2. Cognitive Scores Converted to Z-scores 97

3. Percentage of Microlinguistic Errors (y) by DRS-2 Impairment Score (x) 98

4. Percentage of Macrolingusitic Errors (y) by DRS-2 Score (x) 99

5. Scatterplot of Percentage of Living Things (y) by Semantic Score (x) 100

CHAPTER 1: INTRODUCTION

Discourse is defined as any language beyond isolated sentences (Gee & Handford, 2012; Ulatowska & Olness, 2004) that aims to convey a message. This broad definition encompasses many forms of language, including books, conversations, narratives, speeches, and more (Kemmerer, 2015), and it reflects a functional and natural form of language use. Discourse comprehension and production require a complex interaction between traditional linguistic processes (Kaan & Swaan, 2002), as well as other cognitive systems, including executive function (Tun & Wingfield, 1993), episodic memory (Dijkstra, Bourgeois, Allen, & Burgio, 2004), semantic memory (Lambon Ralph, 2014), and working memory (Marini, Boewe, Caltagirone, & Carlomagno, 2005; Wingfield & Stine-Morrow, 2000). This complex interaction between cognitive-linguistic processes possibly makes discourse the most complex linguistic activity performed by speakers and listeners (Ska, Doung, & Joanette, 2004).

The complex nature of discourse offers researchers the opportunity to use emerging discourse analysis procedures (Doung, Giroux, Tardif, & Ska, 2005; Glosser & Deser, 1990; Marini et al., 2005) to observe and understand the complex interaction between the cognitive and linguistic processes required for discourse. Discourse analysis offers clinicians and researchers the opportunity to understand the nature of cognitive-communication changes within clinical populations, as well as healthy older adults. Therefore, discourse analyses are gaining prominence among researchers. It has been used as a cognitive-linguistic assessment for different clinical populations (Marini, Andreetta, del Tin, & Carlomagno, 2011a; Marini, Galetto, Zampieri, Vorano, Zettin, & Carlomagno, 2011b), differential diagnosis for dementia (Chapman, Zientz, Weiner, Rosenberg, Frawley, & Burns, 2002; Doung et al., 2005; Fleming & Harris, 2008), and an assessment for the efficacy of treatment approaches for individuals with aphasia

(Cameron, Wambaugh, Wright, & Nessler, 2006; Marini, Caltagirone, Pasqualetti, & Carlomagno, 2007; Rider, Wright, Marshall, & Page, 2008).

Dementia is a progressive disease that presents with gradual cognitive decline within two or more cognitive systems (Budson, 2014) that is qualitatively and quantitatively different than healthy normal aging (Old & Naveh-Benjamin, 2008). Dementias also often presents with linguistic impairments (Reilly, Joshua, & Grossman, 2014) that research suggest may appear years before memory impairments are evident (Bayles, 1982; Chapman et al., 2002; Fleming & Harris, 2008; Snowden, Kemper, & Mortimer, 1996). Therefore, the analysis of discourse in adults with dementia may (a) elucidate the role long-term memory, including semantic memory, have at different stages of discourse processing (Doung et al., 2005) and (b) improve clinicians' and researchers' ability to assess and screen for dementia (Chapman et al., 2002; Hudon, Belleville, Souchay, Gély-Nargeot, Chertkow, & Gauthier, 2006).

The focus of this paper, then, is the role cognitive decline has on discourse abilities in adults with cognitive impairments and healthy older adults. Alzheimer's disease (AD), which is the most frequently diagnosed form of dementia (Budson, 2014) was the focus of this paper. The cognitive and discourse abilities are considered within the construction-integration (CI) model of discourse (Kintsch & van Dijk, 1978). Unfortunately, most research into discourse is descriptive in nature and lacks model driven, hypothesis-guided approaches that could identify specific component of discourse, the cognitive operations involved, and how these change in clinical populations (Stemmer, 1999). Therefore, the paper begins with a description of the construction-integration model of discourse (Kintsch & van Dijk, 1978). Next, the role of long-term memory is discussed in relation to the CI model with a focus on semantic memory. Finally, the cognitive and linguistic changes for AD was examined within the framework of the CI model of discourse.

Models of Discourse

Discourse requires more than generating a stream of linguistic units. Successful discourse requires cognitive and linguistic processes to generate grammatical utterances (i.e. microlinguistic processes), as well as cognitive and linguistic processes that organize and structure the utterances to convey an overall message to an audience (i.e. macrolinguistic processes; Glosser, 1993; Glosser & Deser, 1990; Glosser & Deser, 1992; Marini et al., 2005). How discourse is structured and organized is known as coherence (Ulatowska & Olness, 2004). Researchers use discourse models to formalize and test their understanding of how discourse is processed and understood by individuals. These models are primarily concerned with how micro- and macrolinguistics elements are realized to produce coherent discourse (Glosser, 1993).

Several models of discourse have been developed, considering various micro- and macrolinguistic elements (Chafe, 1994; Glosser, 1993; Glosser & Deser, 1992; Halliday, 1985; Labov, 1972; Longacre, 1996; Mandler, 1984; Schank & Abelson, 1977). Longacre's (1996) discourse framework classifies discourse into various discourse types through the analysis of the knowledge structure and the linguistic elements used to realize the discourse. Lobav's (1972) discourse framework analyses how sentential grammar produces the overall organization and structure to the discourse. Mandler's (1984) schema model of discourse is concerned with the hierarchical progression of plot for specific discourse types. Glosser and Deser's (1993) framework considers both micro- and macro-linguistic elements that are required for a story to have coherence. Chafe (1994) considers how thoughts are transformed into units of language.

The above models have several limitations. Several models, such as Lobav's (1972) and Mandler's (1984) models of discourse, only consider macrolinguistic elements. Other models of discourse consider both the micro and macrolinguistic elements that are used to realize coherent discourse (Glosser, 1993; Glosser & Deser, 1992) but make no mention of the different roles cognitive systems play within discourse. Moreover, all the above models share, at least, one limitation. Their structure is dependent on discourse type. Discourse can be subdivided into several types, such as conversation, expository, procedural, or narrative (Heath, 1986).

Kintsch and van Dijk's (1978) CI model of discourse solves all three of these limitations. First, all discourse types are considered. Second, the models consider all components of discourse from the smallest linguistic unit to the organization of macro-scale concepts, which accounts for both the microlinguistic and macrolinguistic processes required to comprehend and produce coherent discourse. Third, the CI model descriptively implicates cognitive processes that are involved in discourse comprehension and production (Kintsch, 1998; Stemmer, 1999).

Construction-Integration Model of Discourse

Kintsch and van Dijk (1978) developed the Construction-Integration (CI) model of discourse, which proved to be their seminal work and is considered a possible cognitive architecture for discourse comprehension and production. Kintsch and Welsch (1991) describe the principle characteristics of the Construction-Integration (CI) model as the following: (1) the CI model extends previous work on discourse by incorporating knowledge activation and use within discourse models; (2) the CI model includes an interaction between the text and the general knowledge and personal experiences of the listener/speaker; (3) knowledge is represented in an associated network, either in the form of propositions or global structures, such as discourse schemata; and (4) the CI model combines features of symbolic systems (i.e. constructions) and connectionists systems (i.e. integration).

Levels of Representation

The basis of the CI model of discourse is that several cognitive operations are involved at different levels of representations. Kintsch and van Dijk (1978) postulated that any model of discourse would require four different levels of mental representations. The four levels of representation are: (1) surface; (2) semantic; (3) situational; and (4) structural level. However, additional levels of representations might be required for special text (e.g. poetry). The surface level includes traditional linguistic units, such as phonology, lexical-semantics, and syntax. The semantic level represents concepts and the links between them. The situational level represents the relations among concepts that represent the situation and/or events depicted within the overall discourse topic. The structural level represents the organization of conceptual units as schemata, represented sequentially and/or temporally (Kintsch & van Dijk, 1978).

The surface level of representation includes the words, phrases, and utterances, along with the phrase-structure grammars that produce these utterances (Kintsch & Welsch, 1991). A deficit at the surface level would be a deficit in language production or comprehension. For example, in people with aphasia, the cardinal deficit is anomia (Goodglass & Wingfield, 1997), which is defined as the inability to recall the name of certain items within the lexicon. This can limit the information available and produce vague, hard to comprehend discourse.

The semantic level is concerned with semantic units, called micro-propositions, and the lexical and inferred links between them. Graesser, Gernsbacher, and Goldman (1997) defined the micro-proposition as a theoretical unit of meaning, which typically include a predicate (i.e. verb) and one or more arguments (i.e. nouns and other propositions). Micro-propositions are the basis of knowledge for the CI model because they reduce unnecessary information, like function words, and access long-term memory traces of concepts from the semantic memory network (Kintsch & van Dijk, 1978).

The situational level of representation produces a situational representation that includes causal, spatial, and temporal information about the discourse. This level of representation appears necessary to (1) connect distant sentences (Zwaan & Radvansky, 1998); (2) explain comprehension across modalities (Zwaan & Radvansky, 1998); (3) explain expertise effects (Schneider & Korkel, 1989); and (4) explain learning. Moreover, the situational level of representation provides a way to represent connections between distant propositions. Whereas the semantic level contains connections between propositions, the situational level refines those propositions into gists and organizes them based on the text and the listener's or speaker's prior world knowledge.

The structural level of discourse is the most abstract level within the CI model (Kintsch & van Dijk, 1978). Ska et al. (2004) describes the structural level of discourse as the level "at which information is organized with respect to a given script" and denotes the type of information that should be included for the discourse to be considered coherent (p. 304). Simply put, the structural level of discourse contains abstracted information from the situational level that specifies what type of information must be included for specific discourse types. For example, a narrative must minimally contain a setting, complication, and resolution to be considered a narrative. Within the CI model, the structural level has two main functions: (1) it allows listeners/speakers to know which discourse type is being produced and (2) it provides a constraint for the situational level by specifying what information is relevant for a particular discourse task (Kintsch & van Dijk, 1978). Without this level of discourse, individuals could not generalize or categorize situational models into specific types of discourse.

Micro- and Macrolinguistic Processes

Kintsch and van Dijk’s (1978) CI model is realized in several stages. First, the surface forms are produced. The units at the surface level are words and syntactic constituents that are incorporated into an utterance. The model does not specify how the surface forms are generated. Grammar has been generally neglected in most discourse research (Kintsch & Welsch, 1991). Next, from the surface form, the semantic level is realized. The processes that transform surface forms into micro-propositions is not fully realized but can be reliably done through hand coding (Kintsch, 1994). Third, micro-propositions held within short-term or working memory from repeated exposure can begin a generalization process that produces a gist proposition, along with its associations, within long-term memory. These propositions are called macro-propositions. (Kintsch & van Dijk, 1978).

The utterance generation is not further elaborated on since the model lacks specification. It is assumed that the surface form is generated from the rules and processes from conventional phrase-structure grammars, such as the minimalist program (Kintsch & Welsch, 1991). Micro-propositions are constructed directly from the text on the basis of lexical information stored in long-term memory. As the propositions enter working memory, they are hierarchically and temporally organized. Since working memory is a limited buffer, only a few micro-propositions are stored within memory as the next cycle begins. If at any time, the next utterance does not contain any relation with the micro-proposition stored within working memory, an inferencing process begins (Kintsch & van Dijk, 1978). The inferencing process adds new information from long-term memory to connect the utterance without explicit connections to the concepts stored within working memory (Kintsch, 1994).

Macro-propositions move beyond the hierarchical list of relationships between the elements of the discourse produced by micro-propositions (i.e. the transformation of the micro-propositions into the situational level of representation). Macro-propositions create a global, hierarchical structure of the main themes needed to understand a story. These macro-propositions are created in parallel with the micro-propositions and represent the world knowledge and strategies that the listener uses to decide what to keep and what to discard (Kintsch, 1994). Kintsch and van Dijk (1978) outlined several rules that produced macro-propositions from micro-propositions:

1. Deletion: propositions that have no connection, direct or indirect, to a previous proposition will be deleted
2. Generalization: propositions can be replaced by more general propositions
3. Construction: propositions can be replaced by conventionalized facts.

Macro-propositions are considered the themes and gist of a story. They allow listeners and speakers to establish a coherent discourse.

According to Kintsch and van Dijk (1978), the rules for producing macro-propositions are applied under the constraint from the structural level in the form of schema. Schemata are abstract mental constructions that organize information and the relationships between the information that are developed through repeated exposure to experiences (Brown & Craik, 2000). Schemata allow listeners and speakers to understand discourse in terms of structure. For example, the opening line in many fairy tales, “once upon a time,” activates a schema for that specific genre of discourse that outlines the abstract narrative structure the story should follow. An abstract schema for fairy tales will include a beginning, middle, and end. The beginning might further specify what type of information is typically included to orient the listener

(Mandler, 1984). Within the CI model, the application of macro-rules depends on the information specified by that discourse genre's schema (Kintsch & van Dijk, 1978).

Long-term Memory

The construction-integration model (CI) of discourse assumes long-term memory plays an essential role in maintaining construction activation at different levels of representations, as well as a role in the micro- and macrolinguistic processes that integrative information from the different levels of representation and information stored in long-term memory (Kintsch & van Dijk, 1978). According to the dual memory model, long-term memory is the third and final stage of memory processing where information can be stored indefinitely (Atkinson & Shiffrin, 1968). According to Budson (2014), long-term memory relies on neural structures in the medial temporal lobe: dentate gyrus, entorhinal cortex, hippocampus, and subiculum, but it also relies on the basal forebrain, fornix, frontal/prefrontal cortices, mammillary bodies, and thalamus. Within the medial temporal lobe, the entorhinal cortex acts as the interface between the hippocampus and neocortex. When information is encoded into long-term memory, the entorhinal cortex transfers information to the dentate gyrus, which transfers the information to the hippocampus, which indexes the pattern of neural activity associated with the memory. When recalling a memory, the request is sent to the entorhinal cortex, which helps activate the hippocampus memory index. This information is then transferred to the subiculum, which transfers the information back to the entorhinal cortex.

Long-term memory can be subdivided into several different types of memory, including semantic and episodic memory (Wood, Baxter, Belapaeme, 2011). Semantic memory is a type of long-term memory that stores an individual's general world knowledge, which includes knowledge about beliefs, concepts, facts, and words (Lambon Ralph, 2014). For example, repeated exposure to a certain type of animal (e.g. bird) will eventually allow an individual to abstract the general overall shape and body structure of the animal (e.g. has wings). Semantic memory stores this information by abstracting information from an individual's experiences in episodic memory (Kintsch, 1998). Episodic memory refers to the long-term memory system used to remember specific events that are temporally and/or spatially situated (Budson, 2014). For example, an individual remembering the events of their wedding day would be accessing episodic memory. While this paper is concerned mainly with semantic memory within discourse, the role of episodic and semantic memory within the CI model is discussed below. Both are discussed because it is important to distinguish between the types of long-term memory, and it is important to understand the exact role of episodic and semantic memory in discourse processing.

Long Term Memory's Role in the Construction-Integrative Model of Discourse

Within the CI model of discourse, episodic and semantic memory play an important role in both the micro- and macrolinguistic stages, as well as at the different levels of representation (Kintsch & van Dijk, 1978). For the microlinguistic processes that occur at the surface and semantic levels of representation, semantic memory plays a more important role than episodic memory. At the surface level, semantic memory plays an important role in allowing access to the concepts and words required to produce grammatical sentences and coherent discourse (Dell, Schwartz, Martin, Saffran, & Gagnon, 1997; Kemmerer, 2015). Degradation to semantic memory might produce language that is ambiguous, vague, or missing (Glosser & Deser, 1990; Kim & Thompson, 2004), which can disrupt the other levels of discourse. Episodic memory does not play a major role at the surface level of discourse (Kintsch & van Dijk, 1978).

The semantic level is also more closely related to semantic memory than episodic memory. At this level, the individual's world knowledge is accessed to produce micro-proposition and the association between them. Impairment to semantic memory produces incomplete micro-propositions that lack clear connections (Ska, Doung, & Joanette, 2004). Ska and colleagues (2004) argue that these connections are most closely linked with cohesion in traditional discourse analysis procedures. Ska et al. (2004) reviewed a study by Stemmer and Joanette (1998) who demonstrated that individuals with left hemisphere damage produced discourse with fragmented micro-propositions but normal surface level representations. Both episodic and semantic memory play a role in the inferencing process that occurs between the surface and semantic level of representation (Kintsch & van Dijk, 1978). According to Kintsch (1998), when a connection between micro-propositions is not found, a memory search occurs that searches both episodic and semantic memory for any information stored in long-term memory to resolve this lack of connection. At this level of discourse, degradation in either episodic or working memory could play a role in lack of information and cohesion within the discourse.

Macrolinguistic processes include both the situational and structural level of discourse, as well as the generalization processes that occur as information is taken and abstracted to the situational level (Kintsch & van Dijk, 1978). For the situational level, semantic memory stores the general knowledge used to make decisions on what information should be kept and what should be deleted. Episodic memory is important for the situation level of discourse because it stores the generalized information into a situation or episode (Kintsch, 1998; Kintsch & van Dijk, 1978). This allows the listener or speaker to recall these themes and check the themes against incoming information, usually stored in working memory, with the overall thematic goals of the discourse. In this regard, episodic memory is important for macrolinguistic processes, as well as inference processing. An impairment in either episodic or semantic memory can make it difficult to produce a coherent situational representation, as well as disrupt the ability to make generalization and store these generalization into episodic memory for later recall.

For the structural level of discourse, Ska et al. (2004) suggests that issues with semantic memory should disrupt the structural level. The schema used to constrain and inform discourse are stored within semantic memory (Brown & Craik, 200). The inability to maintain schema would results in a loss of information (i.e. aborted phrases), topic shifts, and repetitive phrases. Repetition errors are possible because schema enhance recall of previously stated information (Mandler, 1984), but it could also be interpreted as a problem with working memory. Episodic memory maintains the abstracted elements (i.e. themes) within the discourse that produces an overall situation. Therefore, episodic memory is important for allowing speakers or listeners to recall the themes stored in episodic memory with the schema stored in semantic memory. Therefore, an impairment in either semantic memory or episodic memory should disrupt the overall global coherence of the discourse sample. See Figure 1 for an adapted verison of the CI model of discourse.

Episodic memory and semantic memory play an important role at all stages of discourse processing. Semantic memory is important for accessing concepts, information, schema, words, and world knowledge. Episodic memory is important for inference processing, as well as storing the generalized themes of the story that will be checked against other events and information stored within semantic memory. While Kintsch and van Dijk (1978) descriptively implicated these cognitive systems, the researchers do not specifically identify the actions and interaction these different systems play at the different levels of discourse. Therefore, to understand the role long-term memory has on discourse, clinical populations with impairments to both episodic and semantic memory can be measured as well as the micro- and macrolinguistic elements produced by this clinical population in relation to healthy age matched adults.

Dementia and Alzheimer's disease

According to the American Psychiatric Association (2013), dementia first requires the diagnosis of a major or mild neurocognitive disorder. The diagnostic criteria for a major or mild neurocognitive disorder includes: (1) evidence of cognitive decline in attention, executive function, learning, memory, language, perceptual-motor, or social cognition from either the individual, family member, clinician, or standard cognitive assessment; (2) the cognitive deficits interferes with daily living; and (3) the cognitive deficits are not better explained by another mental disorder or delirium (APA, 2013, p. 602-603). Once an individual meets the criteria for a major or mild neurocognitive disorder, the clinician needs to specific whether this is due to Alzheimer's disease (AD), Frontotemporal dementia (FTD), Lewy body dementia (DLB), vascular dementia, traumatic injury (TBI), medication use, HIV infection, Prion disease, Parkinson's disease (PD), Huntington's disease, and/or other (APA, 2013, p. 603).

For a diagnosis of Alzheimer's disease (AD), an individual must present with (1) evidence of decline in memory and learning, along with a decline in at least one other cognitive domain, (2) steady, gradual decline in cognition, and (3) no mixed etiology. The person is diagnosed as either having probably or possible AD depending on whether there is evidence from genetic testing or family history for AD (APA, 2013, p. 611). The primary feature of AD is a loss of long-term memory (Budson, 2014) followed by disturbances in other cognition domains (Reilly et al., 2014). In the early stages of the disease, memory impairments manifest in the form of missed appointments and events (Huppert & Beardsall, 1993) and eventually progresses to a point where new information cannot be stored for more than few minutes and coherent thought is impossible (Mesulam, 2003).

According to McKee and Gavett (2014), AD typically presents with atrophy in the frontal-temporal cortices and medial temporal cortex (e.g. amygdala, hippocampus, and entorhinal) during the initial phases of the disease and becomes more diffuse within the moderate to severe stages of the disease (McKee & Gavett, 2014). In fact, Lim et al. (2012) found that adults with a mild cognitive impairment (MCI) presented with atrophy in the hippocampal formation. A mild cognitive impairment is defined as an impairment in some cognitive domain, typically long-term memory, which does not interfere with an individual's daily life (Peterson et al., 1999). For some individuals, a MCI may be a transitional stage between healthy cognition and Alzheimer's disease. This seems more prevalent when the individual with an MCI present with a long-term memory issue, termed amnestic MCI. Approximately 10% to 15% of these individuals will progress to Alzheimer's disease per year (Grundman et al., 2004). Therefore, atrophy in neural regions associated with long-term memory are present even in the earliest stages of the disease, so it is probable that participants with AD present with some impairments in both micro- and macrolinguistic processes.

Semantic Memory in Alzheimer's disease

Since the primary feature of AD is a progressive decline in long-term memory, it is not surprising that many researchers have found deficits in both episodic and semantic memory (Budson, 2014). While the decline in episodic memory is well supported and accepted, (Budson, 2014; Reilly, 2014), semantic memory impairments are more controversial (Reilly, 2014). However, researchers have found semantic memory impairments in individuals with AD that reflect disturbances in storage and process (Beeson et al., 2006; Koenig et al., 2007; Koenig et al., 2010; Smith et al., 1995). Healthy older adults appear to have preserved semantic memory (Rönnlund et al., 2005; Spaniol et al., 2006) with some disturbance in executive function and processing speed (Maintenant et al., 2011).

Evidence for semantic memory impairments in AD first came from measures of semantic memory. Some measures of semantic memory include naming tasks (Beeson et al., 1997), feature verification tasks (Smith et al., 1995), and verbal fluency tasks (Adlam et al., 2006). Beeson et al. (2006) investigated semantic representations and lexical retrieval in a confrontation naming task. The task involved naming famous people. During the task, the participants were probed for the availability of semantic and word-form information. The participants included 33 individuals with aphasia and 27 individuals with mild to moderate AD. The researchers found that participants with AD did not differ in immediate, or delayed, recall of famous faces compared with participants with aphasia. Yet the groups differed in their ability to produce semantic information and words forms for unnamed faces. While participants with mild AD produced semantic information when probed for unnamed faces around 75% of the time, the semantic information was not detailed and often vague. Participants with moderate AD only produced semantic information 42% of the time. The researchers concluded that the results are consistent with a breakdown in semantic knowledge and, possibly, lemmas.

Smith et al. (1995) analyzed the degradation of semantic representations through a feature verification task. The task required participants to make truth judgements for features. For example, “apple is red” would be considered true while “apples have fins” is false. The concepts were either high or low-typical exemplars for their respective categories. For example, in the category *birds*, sparrow would be a highly typical concept compared with a non-typical concept such as penguin. The features were controlled for dominance and distinctness.

Participants included 11 with mild AD and 11 healthy controls. The researchers found that both groups were fairly accurate at correctly identifying features, and the accuracy was affected by typicality and feature importance in both groups. However, participants with AD had longer reaction times compared with the healthy controls for low-typical objects and dominant features of low importance. The reaction time differences remained even after transformations. Since transformations treat differences in proportions, the difference cannot be the result of simple slowing. The researchers concluded that there is a degradation to representations that strikes concepts and features with low typicality.

Adlam et al. (2006) investigated semantic memory in 10 participants with MCI, 11 with mild Alzheimer's disease, and 30 healthy controls matched for age and education. The study included several measures of semantic memory. For example, participants completed a series of matching tasks that asked participants to match objects with similar functions, actions, and recipient of actions. The researchers found that participants with MCI and AD correctly identified the object in the match tasks less often than healthy controls. However, the MCI group was less impaired than the mild AD group. Taken together, the researchers concluded that semantic impairments begin early in the progression of the disease and continue to progress as the disease progresses. This study and the ones above demonstrate compelling evidence for degraded semantic representations in AD. Reilly et al. (2014) notes that these impairments are seen on nonverbal domains, such as demonstrating function of objects and category sorting. Moreover, participants with AD show greater impairment on semantic fluency tasks than letter fluency.

In summary, individuals with AD present with a loss of semantic representations. However, healthy older adults do not present with the same lose to the semantic memory system

(Rönnlund et al., 2005; Spaniol et al., 2006). Rönnlund and colleagues (2005) conducted a longitudinal study on semantic memory with 829 participants between the ages of 35 and 80. The study had two sessions separated by 5 years. The semantic memory measures consisted of tests for general knowledge, vocabulary, and word fluency. The researchers found that the participants' scores on the semantic memory measures increased between the ages of 35 to 55, stabilized until the age of 65, and slightly declined after the age of 65. The researchers concluded that semantic representations are maintained in older adults. These results are similar to findings by other researchers examining semantic memory (Spaniol et al., 2006) and word access (LaBarge et al., 1986), indicating that semantic memory is preserved in older adults.

While the representations are preserved in healthy aging, it is unknown whether these representations change over the lifetime (Brosseau & Cohen, 1996; Yoon et al., 2004). Yoon et al. (2004) conducted a study that included younger and older participants in both America and China. Participants were tasked with naming 5 concepts within the 105 specified categories (e.g. diseases). The younger and older participants had a high level of agreement (Chinese: 85%; American: 91%) for the concepts listed for each category. This has been replicated (Craik & Ross, 2012). However, Brosseau and Cohen (1996) found large differences in the concepts listed for specified categories between younger (mean age = 27.3 years) and older (mean age = 71.8 years) adults. The researchers found that 21 of 30 categories has significant differences for the four most common concepts named between the two groups, with 63.3% of the most common concepts being different. Therefore, while older adults have preserved semantic representations, they may or may not have similar representations to younger adults.

AD also appear to present with degradation to semantic processes (Koenig et al., 2007; Koenig et al., 2008), which is best captured in categorization tasks. Koenig et al. (2007) and

Koenig et al. (2010) employed a novel categorization paradigm to examine the interaction of content and process in the categorization of novel stimuli. For the stimuli, the researchers constructed novel pictures for both animals and tools. The participants had to choose which concepts belong to the correct category in two conditions: (1) a similarity-based judgement task and (2) a rule-based judgement task. The similarity-based judgement task displayed a prototype and asked participants to judge which of two concepts belonged to the prototype's category. The similarity-task taps into automatic processing where concepts representations are automatically accessed and the novel stimuli is categorized based of its visual similarity to stored representation. The rule-based judgement task required participants to examine features and judge which concepts belong to the category with similar features. The rule-base task should require the integration (i.e. processing) of features, as well as executive functions processes, such as selection and inhibition, that select the most important features and inhibits features that do not facilitate categorization.

Koenig et al. (2007) taught novel animals to 18 participants with mild-to-moderate AD, 8 participants with corticobasal degeneration, and 20 healthy controls. The researchers assessed participants with the MMSE, measures of executive function (e.g. STROOP task, word generation task, and reverse digit span task), measures of memory, and a measure of semantic memory (e.g. categorization task). They found that the participants with AD performed similarly to the healthy controls on the similarity-based judgements. However, the same participants required more training trials, had longer response times, and made more errors in the rule-based judgements. Moreover, the participants with AD who performed most poorly on the rule-based judgements task also performed poorly on measures of executive function and semantic memory. The results indicated that feature representations are preserved enough to discriminate concepts that belong to the animal category, but the processes of semantic memory appear to be impaired. The researchers could not rule out representation degradation, and with the results from Smith et al. (1995) where concepts with low typicality and features of low importance appear to be subject to degradation first, it is possible that information that does not facilitate similarity-based processing are lost in the early stages of the disease.

Koenig et al. (2010) repeated the experiment with novel tools, instead of novel animals. Participants included 20 participants with mild-to-moderate AD. The participants' scores on the MMSE were not significantly different from the participants in Koenig et al.'s (2007) study as indicated by a t-test. The researchers found that participants with AD were impaired in the similarity-based judgements task and rule-based judgements task. The researchers concluded that representations for tools are less constrained than animals. For example, most mammals will have four legs, but a new tool could be a shape or size. Since the categorization strategy focused on learning a novel tool category, the less constrained nature of tools produces more abstract representations. The representations would not be able to facilitate learning of a novel category, unlike the animal category.

Healthy older adults may also have some difficult processing semantic information. Maintentant et al. (2011) found that healthy older adults were less able to accurately switch between different categories of concepts. The researchers conducted a study examining semantic processing in younger adults (age 21 to 40) and older adults (age 60 to 91). In the task, participants chose one picture that did not belong to the group. Participants were required to either maintain categories between tasks or switch between categories with interfering pictures from the last category task. Older participants had a harder time maintaining and switching between categorical knowledge compared with younger adults. Koenig et al. (2007) and Koenig et al. (2010) demonstrated that people with mild AD have trouble integrating semantic information and, possibly, accessing and using representations on some tasks. The previous studies provided evidence for degradation of semantic representations. Therefore, people with AD have degraded semantic representations and impairments in managing semantic resources. Healthy older adults do not have degraded representations (Rönnlund et al., 2005; Spaniol et al., 2006), but they might have some processing difficulty.

Microlinguistic Impairments in AD

For language, degraded semantic representations would suggest AD would produce words that are more frequent and ambiguous. Within discourse, people with AD should present with lexical retrieval errors in the form of semantic paraphasias and ambiguous lexical items. This is typically what researchers find within discourse. However, since semantic memory is preserved in healthy older adults, one would expect to not find as many microlinguistic problems associated with semantic memory.

Gayraud et al. (2011) investigated the non-verbal and verbal aspects of speech productions in AD within a narrative discourse task. The non-verbal aspects included pauses and hesitations. The verbal aspects included speech errors and word frequencies. The study included 20 participants with AD and 20 healthy controls matched for age, education, sex, and socio-economic status. The narrative task required participants to narrate the best/worst day in their life. The researchers found that participants with AD did not produce significantly more speech errors, but did produce a higher number of errors associated with verbs and adjectives. The participants with AD also produced lexical items with a higher frequency than the healthy controls. The researchers concluded that participants with AD have lexical retrieval difficulty, most likely associated with both semantic degradation and lexical control processes.

Foster et al. (2013) investigated semantic spreading activation in 25 participants with AD and 20 healthy controls. The researchers argue that when individuals access words for a naming task, the higher frequency words are activated first with activation eventually spreading to the lower frequency words. Therefore, a lower mean frequency for a naming task indicates an activation of a larger semantic-lexical network. The researchers hypothesized that because of degraded semantic representations, the participants with AD would only be able to access higher frequency lexical items on semantic test. The study included the Controlled Oral Word Association Test (COWAT; Benton, Hamsher, & Sivan, 1983) and Animal Naming (AN; Davis et al., 2010). The COWAT, a verbal fluency test, requires participants to name as many words as possible that begin with specific letters. The AN, a semantic test, requires participants to name as many different animals as possible. The researchers found that participants with AD had a significantly higher mean word frequency on the AN, but a significantly lower mean word frequency on the COWAT. The researchers concluded that while the semantic memory activates a smaller network, the lexical network spreads further. The researchers argued that lexical control processes typically inhibit information within the lexicon in healthy adults. In AD, a disruption might lead to greater activation. While this greater activation was facilitated performance on the COWAT, it could lead to lexical selection problems during discourse.

The previous two studies demonstrated that a degradation in semantic memory produces lexical access changes in AD. However, a degraded semantic network also changes what words can be accessed and used. Kim and Thompson (2004) examined the nature of verb deficits in AD. Participants included 14 individuals with AD, 9 participants with agrammatic aphasia, and 10 healthy controls. The study included a naming task, comprehension task, sentence completion task, and narrative task. The naming task required participants to name the verb depicted in a line drawing. The comprehension task required participants to match words with a picture. The sentence completion task required participants to choose a verb to complete a sentence. The verbs were classified by arguments and semantic complexity. The narrative task required participants to tell a story from the wordless picture book, *Cinderella*. The researchers found that while participants with agrammatic aphasia had trouble across all task in handling verbs with a complex argument structure, the participants with AD had trouble with semantically complex verbs. The researchers reasoned that semantic degradation of verbs occurs in a bottom-up fashion, where specific features are lost before more abstract features. Therefore, participants with AD might be able to comprehend *go* but be unable to comprehend a more semantically complex verb, such as *walk*.

Participants with AD present with difficulty in lexical retrieval and produce more ambiguous words. Within discourse, a similar pattern can be found. Reilly et al. (2014) cited another study Garrard et al. (2005) that investigated lexical access in Iris Murdoch, a renowned British author who suffered from AD. The researchers compared lexical diversity in a novel written during the early stages of the disease compared with her earlier work. Lexical diversity is an estimate of an individual's vocabulary size within a specific context. Lexical diversity is affected by the number of words stored and retrieval processes. The authors found that lexical diversity, measured by type-token ratio, was significantly reduced in her novel written in the early stages of AD. These findings support previous research that found reduced activation of semantic networks (Foster et al., 2013).

Within more controlled discourse studies, Glosser and Deser (1990) conducted a discourse analysis examining the micro- and macrolinguistic structure in participants with fluent aphasia, participants with Alzheimer's disease (AD), participants with a traumatic brain injury

(TBI), and healthy controls. The participants were audio recorded and interviewed for 10 to 20 minutes about their family and work experience. The discourse was transcribed and analyzed for syntactic errors, lexical errors, cohesion, and coherence. The researchers found that participants with AD produced more ambiguous items compared to the other groups but no more verbal or literal paraphasias compared with the healthy controls. This is indicative of a degraded semantic network, where participants are unable to access the correct, typically lower order, word and, instead, produce a higher order word.

In conclusion, individuals with AD present with many microlinguistic disturbances that can be linked to a decline in semantic memory. This includes trouble accessing concepts and words, as well as producing more complex lexical items. Within the CI model of discourse, these disturbances would mainly be associated with disturbances in the surface and semantic level of discourse. The surface level will input fewer lexical items that are often more ambiguous and less complex. The semantic level will include these less complex concepts, which will make associations and connections between the concepts more difficult to make and maintain.

Macrolinguistic Impairments in AD

Semantic memory impairments should also have an impact on macrolinguistic aspects of discourse. According to the CI model of discourse, semantic memory impairments could impact inferencing ability, as well as the ability to access schema (Kintsch & van Dijk, 1978; Mandler, 1984). Moreover, episodic memory declines associated with AD will also impact the ability of individuals with AD to maintain coherence within discourse. Therefore, this section will explore the research associated with macrolinguistic processing impairments in individuals with AD.

Researchers have found differences in coherence in MCI and mild AD compared with healthy adults. However, the results are somewhat mixed. Hudon et al. (2006) investigated gist formation in participants with MCI and mild AD. The study included two experiments. In the first experiment, participants included 14 MCI, 14 mild AD, and 22 healthy controls as participants. The experiment required participants to learn word list and later recall whether presented words belong to the studied or non-studied category. In the second experiment, participants included 20 MCI, 14 mild AD, and 26 healthy controls matched for age and education. The experiment required participants to read a printed narrative and later recall information about the text. The researchers found that in the word recall list, only participants for AD were impaired, since the MCI grouped performed similarly to the healthy controls. For the second experiment, both MCI and AD groups were impaired at recalling story information, though the MCI group were less impaired than the AD group. The researchers argued that the difference between experiment one and two might be reflected in the fact that item recognition is easier than free recall. The inability to recall story information might be associated with episodic memory declines, as well as a decline in semantic memory schema to support the information stored in episodic memory.

Chapman et al. (1995) investigated discourse in mild Alzheimer's disease compared to healthy controls in regard to aspect of content and form. The participants included three groups of 12: AD group (M age = 67.5), normal old-elderly group (M age = 81.9), and healthy controls (M age = 65.7). The study required participants to produce narrative for three Norman Rockwell paintings. The researchers analyzed the discourse for whether or not the narratives followed a typical and complete schema and for amount of proposition produced. The researchers found that participants with AD only produced around 40% of the propositions in the pictures compared with around 75% in the old-elderly and 85% in the healthy controls. Moreover, participants with AD produced fewer stories within the narrative genre or typical narrative structure compared with the other groups. The researchers concluded that participants with AD have qualitatively different discourse patterns compared to age match healthy controls or adults who are much older.

Chapman et al. (2002) found that participants with MCI and AD had difficulty producing gist information after reading a text. The study included 20 participants with MCI, 24 with mild AD, and 25 healthy controls. For the study, participants read a 578-word biographical text and produced a summary, the main idea, and a lesson in regard to the text. Participants with MCI and AD produced fewer informational units and made less inferences in their summaries. Moreover, many participant with MCI and AD produced lower quality main ideas and lessons, often missing the point of the story and producing explicit content. The authors concluded that participants with MCI and AD had difficulty making inferences not associated with the healthy controls.

Both Chapman et al. (2002), and Chapman et al. (1995), and Hudon et al.'s (2006) results agree with other researchers who have found narrative impairments in MCI and mild AD (i.e., Ash et al., 2007; Glosser & Deser, 1993), which are qualitatively and quantitatively different from normal aging. Decline in semantic memory might explain the results for both MCI and AD. Inability to reliably access information stored in semantic memory would prevent participants with MCI and AD from making the proper inferences. Moreover, the inability to encode new information would prevent processes associated with generalization. This could cause the disruptions in narrative structure (Hudon et al., 2006) and reduction in overall theme production (Chapman et al., 1995; Chapman et al., 2002). This is different from healthy older adults who reliably accessed schema for narrative structures and generalized information from the text.

Researchers examining coherence in moderate AD also found disruptions in narrative structure (Doung et al., 2005) and an increase in coherence disrupting elements (Dijkstra et al., 2004). Doung et al.'s (2005) study examined coherence patterns in 46 participants with AD (M age = 74.3, SD = 5.5) and 53 healthy controls (M age = 73.8, SD = 6.3). The participants with AD were mild to moderate according to the Reisberg scale/Global Deterioration Scale (GDS). For the study, participants told stories from single and sequential pictures. The researchers analyzed coherence by counting the number of schema elements used, the number of macro-propositions per element, and the number of elements that linked together the schema elements. The researchers found that participants with AD performed poorly on all coherence measures compared to healthy adults on the sequential picture, but it was the single picture stimuli that produced the most distinct discourse for the participants with AD. Similar to Hudon et al. (2006), the researchers found the single pictures failed to produce a narrative structure, resulting in some participants producing nearly 0% of the expected narrative schema and macro-propositions. However, the researchers ran a cluster analysis that failed to distinguish between high performing participants with AD and low performing healthy adults. Unfortunately, the researchers could not rule out MCI in the healthy adults.

Dijkstra et al. (2004) compared conversational discourse in moderate AD (n = 30) and healthy controls (N = 30). The researchers conducted interviews to collect conversational discourse samples, and the samples were analyzed for discourse binding elements (e.g. information units, topic maintenance, etc.) and discourse disrupting elements (e.g. empty phrases, aborted phrases, etc.). The researchers found that participants with AD had a lower number of discourse binding elements and a higher number of discourse disrupting elements. The authors expanded on the concept of coherence by examining what elements within coherence are disrupted. In fact, the authors found that participants with AD produced more repetitions, empty phrases, indefinite terms, aborted phrases, and disruptive shifts compared to healthy adults. For discourse binding elements, the participants with AD produce much fewer utterances that maintained the discourse theme. The researchers concluded that memory impairments within moderate AD probably resulted in the inability to maintain the topic and could possibly produce many of the disruptions. For example, disruptive topic shifts or aborted phrases might both be related to their memory impairment.

While many researchers have found qualitative and quantitative differences in coherence among participants with MCI and mild AD (Chapman et al., 1995; Chapman et al., 2002; Hudon et al., 2006), it is in moderate AD where most of the differences arise in discourse analysis studies (Dijkstra et al., 2004; Tomoeda et al., 1996). Bayles (2003) suggested that deficits in working memory caused by atrophy in the frontal lobes, which occurs most often in the moderate stages of AD, might be to blame for the progressive decline from mild to moderate AD. Bayles conducted a series of comprehension tasks in 86 participants with mild to moderate AD. The tasks included following commands, comparative questions, reading comprehension, repetition, and other tasks from the Arizona Battery for Communication Disorders (ABCD; Bayles & Tomoeda, 1993). The tasks would tap episodic, semantic, and working memory. The researchers found a decline from mild to moderate AD on all tasks that required working memory (e.g. following commands, reading comprehension, and repetition). Other researchers have found that participants with AD increase discourse performance when allowed to use picture booklets or toys to support memory (Bourgeois & Manson, 1996; Hopper et al., 1998). These results, along with the continued decline in long-term memory, may explain the decline from mild to moderate AD.

Dijkstra et al. (2002) assess discourse samples from 60 participants with mild (25-18), moderate (17-10), and severe (<10) AD as determined by scores on the MMSE. Participants were interviewed for 5 minutes to produce a conversational style of discourse. The researchers performed a multilevel analysis on the samples, taking measures of cohesion, local coherence, global coherence, and more. Global coherence was measured by taking the number of utterances that represent the overall topic of discourse. Local coherence was measured by taking the number of utterances connected to the previous utterance. The researchers found that in severe AD, participants had lower local and global coherence compared with mild AD. However, the results disagreed with Tomoeda et al. (1996) who found lower global coherence between moderate and severe AD. Dijkstra and colleagues did not find a significant decrease in global coherence between moderate and severe AD. This might be explained by the time limit placed on the conversations or the specific type of discourse, conversational discourse, where the conversational partner can support the participant's discourse. The researchers did find that the stages of discourse appeared qualitatively different. Severe AD produce more empty phrases, repetitions, and indefinite words, as well as little to no local or global coherence. While global coherence was impaired in the moderate stages, local coherence was maintained in the moderate stages of the disease.

In summary, macrolinguistic processes associated with discourse do appear to decline in AD. Global coherence issues appear to arise in the earliest stages of the disease (MCI and mild AD), which are quantitatively and qualitatively different. For example, even in the mildest stages narrative schemas are disrupted and atypical and topic generalization are reduced, which are most likely explained by difficulty accessing semantic memory. Most studies, except for Dijkstra et al. (2002), found maintenance of global coherence declined in the moderate stages of the disease. Moderate AD probably also suffers from issues of executive function and working memory, as well as continued declines in long-term memory (i.e. semantic and episodic memory). Therefore, a decline in topic maintenance and an increase in elements that disrupt coherence are found. Though there are few studies examining the discourse of severe AD, the findings suggest that by the severe stage discourse is often empty and without local or global coherence. This is likely explained by diffuse atrophy and an increased amount of disconnection between brain regions that function as executive control and memory (Bayles, 2003).

Multilevel Discourse Analysis

Individuals with AD typically present with a progressive long-term memory decline (APA, 2013; Budson, 2014), along with impairments in both the micro- (Gatraud et al., 2011; Foster et al., 2013; Kim & Thompson, 2004) and macrolinguistic elements (Chapman et al., 1995; Chapman et al., 2002) associated with discourse. To understand how semantic memory decline (Reilly, 2014) is associated with the micro- and macrolinguistic impairments, a multilevel discourse analysis is required, as well as several measures of cognition. A multilevel discourse analysis examines the linguistic elements at all stages of discourse processing. These elements can be examined in relation to declines in semantic memory to determine the exact role a semantic memory impairment plays at the different stages of discourse processing. Multilevel discourse analyses are promising since they have been found to be more sensitive to language changes than standardized language assessments (Marini et al., 2011). However, the ultimate goal of the multilevel analysis for dementia is to determine linguistic measures that are more sensitive to neurocognitive impairments earlier in the disease progression (Chapman et al., 2002; Doung et al., 2005).

To improve sensitivity of language measures, Marini et al. (2011) developed a multilevel analysis of discourse for use within aphasia. A multilevel discourse analysis is one where discourse, typically narrative discourse, is analyzed at the micro-linguistic level and macro-linguistic level. Micro-linguistics include any within utterance processes (e.g. lexical access, syntactic structure, etc.). Macro-linguistics refers to processes that organize and connect utterances (e.g. cohesion and coherence). The multilevel analysis was conducted on two individuals with aphasia (IWA). Both participants conducted had standardized language assessment pre-therapy and after therapy. The standardized assessment used to measure language ability was the Aachener Aphasie Test (AAT; Luzzatti, Willems, & DeBleser, 1991). The AAT measures six domains of language: (1) spontaneous language, token test, repetition, written comprehension and production, renaming assessment, and spoken language comprehension. The assessment takes around 60 to 90 minutes. For one participant, the AAT failed to show any improvement after therapy. However, the multilevel analysis demonstrated improvement in organizing the semantic content of stories with global coherence errors decreasing to within normal range with a boost of informativeness. Therefore, multilevel discourse assessments might be more sensitive to change than standard linguistic assessments and, possibly, predict or distinguish between different types of dementia.

Unfortunately, the research is mixed when trying to distinguish between individuals with AD and healthy adults. Doung et al. (2005) analyzed discourse for lexical-semantic, conceptual-semantic, and organizational-semantic information. The discourse measures were analyzed within a hierarchical cluster analysis. The cluster analysis failed to accurately distinguish between participants with AD and healthy controls. The researchers concluded that heterogeneity of cognitive testing indicated increased heterogeneity on the language measures. The researchers also claim that age, education, and gender might be making the results more variable. Variability in cognitive and linguistic testing is a known problem in normal healthy aging, and the problems might be exacerbated in individuals with neurocognitive impairments. Therefore, they concluded that using discourse in a diagnostic battery is premature.

However, Chapman et al. (2002) assessed the participants' ability to summarize the story (gist-level understanding), provide a summary statement in one sentence (main theme understanding), and provide a lesson from the story. The Jonckheere-Terpstra test was used to distinguish between the groups. The researchers found that the healthy controls and participants with AD had little overlap in scores. The researchers theorized that problems with episodic and working memory prevented the participants with AD and MCI from accessing working memory to retrieve aspect of the story. Moreover, retrieval deficits in long-term memory made it difficult for the disordered groups to access knowledge that would allow them to synthesize and interpret the stories. The authors go further by explaining that while 5 participants with AD scored within a normal range on the MMSE, the discourse analysis placed them within the disorder populations.

A multilevel discourse analysis is necessary for two reasons: (1) a multilevel discourse analysis can elucidate the role semantic memory plays at both the micro- and macrolinguistic levels of discourse and (2) a multilevel discourse analysis provides enough linguistic information to potentially differentiate individuals with early stage AD, and perhaps even earlier, with healthy older adults. Since individuals with AD present with semantic memory impairments that are qualitatively different from healthy aging adults, examining semantic impairments at all levels of discourse might elucidate the role semantic memory plays at the later stages of discourse processing, as well as improve discourse analysis procedures in distinguishing between individuals with AD and healthy aging.

Purpose

The purpose of this study, then, was two-fold: (1) to determine the role semantic memory impairments within participants with a cognitive impairment might play in the micro- and macrolinguistic processing of discourse within Kintsch and van Disjk's (1978) model of discourse processing and (2) determine if a multilevel discourse analysis can reliably discriminate between participants with a cognitive impairment and healthy controls.

The specific aims of the study are (1) will there be significant difference in measures of both micro- and macrolinguistic abilities within the discourse of adults with a cognitive impairment and healthy older adults? (2) Will these micro- and macrolinguistic discourse impairments be correlated with declines in cognition in participants with a cognitive impairment? (3) Can discourse analysis procedures reliably distinguish older adults with a cognitive impairment from healthy older adults? For study aim one, it is predicted that participants with a cognitive impairment will produce significantly different discourse. It is expected that individuals with a cognitive impairment will produce more microlinguistic errors with radically different word choices than healthy adults. It is also expected that individuals with a cognitive impairment will present with macrolinguistic errors in story coherence. For study aim two, it is expected that the cognitive measures will be correlated with early processing impairments at the micro- and macrolinguistic level. For study aim three, it is predicted that the micro- and macrolinguistic elements will reliably distinguish between the individuals with a cognitive impairment and healthy older adults. Since semantic memory impairments are present in AD and not in healthy aging, it is expected that semantic information, such as word choice and information generation, should reliably differentiate between the two groups.

CHAPTER 2: METHOD

Participants

The study included 12 adults with a cognitive impairment and 12 cognitively healthy adults matched for age and education. The adults with a cognitive impairment met the following criteria for participation in the study: (a) a cognitive impairment as indicated by a score $\leq$ 9 on the Dementia Rating Scale – 2 (DRS-2; Mattis, 2002); (b) aided or unaided hearing acuity as indicated by Davis and Silverman's (1978) Conversational Hearing Screening form; (c) corrected or uncorrected visual acuity as indicated by Beukelman and Mirenda's (1998) Vision Screen form; (d) native English speaker per self-report; (e) negative history for a traumatic brain injury or major stroke. Participants with a cognitive impairment were recruited from local memory care units, dementia support groups, doctors' offices, and a participant pool maintained by the Aging and Adult Language Disorder Lab at East Carolina University. Participants from the pool with a Mini-Mental State Exam – 2nd Edition (MMSE-2; Folstein et al., 2010) score < 25 were randomly contacted to participate in the study.

The cognitively healthy adults met the following inclusionary criteria: (a) aided or unaided hearing acuity as indicated by the Davis and Silverman's (1978) Conversational Hearing Screening form; (b) corrected or uncorrected visual acuity as indicated by Beukelman and Mirenda's (1998) Vision Screen Form; (c) native English speaker per self-report; (d) no history of traumatic brain injury or stroke per self-report; (e) negative history for progressive, deteriorating cognitive conditions, such as AD, per self-report as well as by performance on the MMSE-2 with score > 25, and (f) demonstrate no depression at the time of the experiment as measured by a score of $\leq$ 5 on the Geriatric Depression Scale – Short Version (GDS; Greenberg, 2012). The healthy controls were recruited from the participant pool maintained by the Aging and Adult Language Disorders Lab at East Carolina University. Demographic information can be found in Table 1.

Cognitive Screening

Participants were administered several cognitive assessments to screen for cognitive impairments and determine general cognitive abilities. For potentially healthy controls, general cognitive functioning was assessed by the MMSE-2. The DRS-2 was used to assess the level of cognitive impairment in adults with a cognitive impairment. Adults with a cognitive impairment also participated in a series of semantic memory assessments that included the Pyramids and Palm Trees Test (PPT; Howard & Patterson, 1992), Boston Naming Test – Short Version (BNT; Kaplan, Goodglass, & Weintruab, 1983), and a category fluency task, where the participants were asked to name as many animals and tools as possible within 60 seconds (Jefferies et al., 2010). To provide a more comprehensive assessment of cognitive functioning, general and working memory measures were also administered to both participants with a cognitive impairment and healthy control participants. Some of the participants with a cognitive impairment were unable to complete the other cognitive assessments. Episodic and working memory was assessed using the Wechsler Memory Scale – 3rd Edition (WMS-III; Wechsler, 1997).

The Mini-Mental State Exam – 2nd Edition (Folstein et al., 2010) was used to assess the general cognitive abilities of cognitively healthy adults. The MMSE-2 is a screening tool used to measure the degree of cognitive impairments in adults, but it cannot be the sole criterion for diagnosing Alzheimer's disease. Instead, the tool is used to document if the healthy participants have a potential cognitive impairment. The MMSE-2 measures a participant's ability in five cognitive domains: attention, language, memory, orientation, and visuospatial. Attention is assessed by either serial calculation or backwards spelling. Language is measured by item naming, sentence repetition, 3-stage commands, and sentence reading and writing. Memory is measured by word registration and recall. Orientation is measured for both time and place with five questions each. Visuospatial is measured by the ability of participants to accurately copy a line drawing with two overlapping figures. The total score is 30 with higher lower scores indicating more cognitive impairment. A score between 20 and 25 is indicative of a mild cognitive impairment. The MMSE and MMSE-2 have been criticized for their lower predictive power (31%) for cognitive impairment compared to other assessment tools (Lischka, Mendelsohn, Overend, & Frobes, 2012). However, the MMSE does have the highest specificity rate at 96%, indicating the test is highly accurate at determining when participants do not have a cognitive impairment (Lischka et al., 2012). Moreover, the MMSE is the most widely used assessment tool for screening for the presence of cognitive impairment (Lezak, Howieson, & Jacomb, 1991). This, along with the extensive normative data provided for the test over the years have made it the gold standard for screening for presence of cognitive impairment.

The Dementia Rating Scale – 2 (DRS-2; Mattis, 2002) was used to assess the level of cognitive impairment in participants with a potential cognitive impairment. The DRS-2 is also a screening tool for cognitive impairments. The test is considerably longer than the MMSE-2, and measures several cognitive domains: attention; initiation/perseveration; construction; conceptualization; and memory. Attention is measured with forward and backwards digital spans, following multi-step commands, attending to specific stimuli in the face of distractors, and verbal and visual recognition measures. Initiation/perseveration is measured with a category fluency task, verbal fluency tasks, and completion of alternating movement tasks. Construction is measured with six design copying tasks. Conceptualization is measured with similarity/oddity tasks, as well as conceptualization task where participants are asked to consider how certain concepts are similar. Memory is measured with orientation tasks, word/sentence recall, and verbal recognition. The DRS-2 produces raw scores between 0 and 144. These scores are corrected for age and education to produce an overall total score between 1 and 18. A score of 9 to 10 is considered low-average to borderline. Score between 8 and 6 are considered a mild impairment. Scores between 5 and 4 are considered a moderate impairment. Score $\leq$ 3 are considered to be severely impaired. Unlike the MMSE, the DRS-2 has excellent sensitivity (96%) in determining if an individual has the presence of a cognitive impairment (Salmon, Thomas, Pay, Booth, Hofstetter, Thal, & Katzman, 2002).

Semantic Memory Assessment

Semantic Memory assessment was administered to participants with a cognitive impairment to determine how semantic impairments impact discourse. Healthy controls were not given these assessments because of possible ceiling effects. The semantic ability was assessed using three different tasks. The scores on the assessments for semantic memory were used in a factor analysis. Scores for the first component were computed for each individual participant and used as a composite score of semantic memory (Jefferies et al., 2010). A composite score for semantic memory provides a more stable measure of the participant's abilities (Ackerman & Cianciolo, 2000).

The Pyramids and Palm Trees Test (PPT; Howard & Patterson, 1992) assessed the participant's ability to access concrete semantic representations from pictures. The test is one of semantic association, where participants are required to match a top picture to one of two pictures below. For example, a *pyramid* has to be matched to either a *palm tree* or *pine tree*. Since both *pyramids* and *palm trees* are found in the desert, the *pyramid* should be matched with the *palm tree*. This requires participants to have detailed semantic representations of all three items as well as the ability to identify association between the items. The test can be administered in several modalities, including word-to-word matching or picture-to-picture matching. Participants matched picture-to-picture since the absence of overt language is considered a relatively pure measure of semantic processing. There are 52 items on the test. Lower scores indicate more impairment than higher scores.

Boston Naming Test – Short Version (BNT; Kaplan et al., 1983) was used to assess confrontational lexical retrieval. The short version of the BNT contains 15 pictures that participants must name within 20 seconds. If the participant is unable to name the picture, a stimulus cue and phonemic cue can be provided. The number of correct responses were used to assess lexical retrieval. Lower scores indicate more lexical impairment.

Category Fluency Tasks (Jefferies et al., 2010) required participants to name as many items as possible within 60 seconds that belong to a certain category. The task is included on the *Western Aphasia Battery – Revised* (WAB-R; Kertesz, 2007), and it is hypothesized to be a measure of lexical access. However, the task requires both lexical access and executive control abilities to successfully complete (Shao, Janse, Visser, & Meyer, 2014). For this study, the participants were asked to name as many animals and tools as they can remember in 60 seconds. The more animals or tools named indicate more semantic fluency than lower scores.

The Semantic Composite Score was an overall measure of semantic ability. A factor analysis was conducted with the raw scores for the PPT, BNT, and category fluency task. The raw score for the BNT and PPT included the number of items correctly named or matched. The raw score for the category fluency task included the number of items correctly named in 60 seconds. Factor analysis is a method of data reduction, where the underlying latent variable (i.e.

semantic processing) that are reflected in the manifest variables (i.e. raw scores for the PPT, BNT, and category fluency task). The first component was used as a measure of semantic processing ability. Higher scores indicate less semantic impairment, while lower scores indicate more semantic impairment.

Wechsler Memory Scale – 3rd Edition (WMS-III; Wechsler, 1997) is a neuropsychological assessment designed to test several domains of episodic and working memory. For episodic memory, the following subtests were used: Logical memory I and II, Faces I and II, Verbal Paired Associates I and II, Family Pictures I and II. The subtests Letter-Number Sequencing and Spatial Span are combined to provide an assessment for working memory. The maximum raw score for the episodic memory subtests is 224. This number can be scaled by age to produce an index score with a mean of 100 and a standard deviation of +/-15. The working memory subtests have a total raw score of 53 that can be scaled into an index score with the same properties as the episodic memory subtest. Scores between 80 and 110 indicate low-average to average abilities. Scores between 70 and 79 are considered borderline. Scores < 70 are considered impaired. The episodic and working memory scaled scores were used to assess episodic and working memory.

Discourse Stimulus

Participants' discourse samples included two storytelling narratives in the form of the wordless picture books *Pancakes for Breakfast* (dePaola, 1978) and *Picnic* (McCully, 1984). Wordless pictures books were used because they provide a richer vocabulary than either single pictures or sequential pictures (Fergadiotis & Wright, 2011; Fergadiotis, Wright, & Capilouto, 2011). *Pancakes for Breakfast* (dePaola, 1978) is a 28-page story that depicts an older woman waking up and craving pancakes. The book follows her journey as she tries making a batch of pancakes from scratch, only to be thwarted at every turn. When all hope appears lost, the older woman smells pancakes wafting out her neighbors' window, and she goes to the neighbors' home and invites herself in for pancakes. The story has a simple linear structure with few characters and relies heavily on the procedural rules required to make pancakes.

Picnic (McCully, 1984) is a story about a family of mice who have decided to go on a picnic. They pack everything up into a tiny pickup truck, along with the younger mice riding in the back of the truck. The youngest mouse is lost, and the family does not realize it until they are at their picnic ground and getting ready to eat. When the family realized the youngest mouse is missing, they retrace their steps until they are able to find her. This story is more complex. It contains numerous characters, and the story has sequential and spatial components. This makes the story more complex than *Pancakes for Breakfast* (de Paola, 1978).

Transcription

Discourse samples were digitally recorded and orthographically transcribed in the CLAN format (MacWhinney, 2000). The samples were segmented into c-units following the guidelines of Wright and Capilouto (2009). A c-unit consists of an independent clause with any subordinate clauses as modifiers (Loban, 1976). The following is an example of a c-unit from picnic:

Pre-c-unit segmented sample:

There is a family of mice who are packing up a red truck for a picnic and the younger mice are loading into the back of the truck ready for a picnic

C-unit segmented:

(1) There is a family of mice who are packing up a red truck for a picnic.

(2) And the younger mice are loading into the back of the truck ready for a picnic.

Twenty percent of the discourse samples were randomly selected and transcribed again for both intra- and inter-reliability for both words and c-units. Reliability was calculated by the number total number of agreements divided by the total number of agreements and disagreements (Agreements / (Agreements + Disagreements) * 100). For the transcription, reliability was 94.18% for intra-rater reliability and 96.81% for inter-rater reliability. For c-units, reliability was 80.28% for intra-rater reliability and 86.51% for inter-rater reliability.

Language Coding

To address the first aim of the study of whether early semantic impairments in AD contribute to later stage discourse impairment, a multilevel discourse analysis was conducted. The measures include a lexical analysis of the nouns and verbs used, an error analysis at the micro- and macrolinguistic level (Marini et al., 2005), and a thematic analysis.

Lexical Analysis.

Previously, researchers have shown that participants with a cognitive impairment present with impaired access to living and non-living things (Koenig, Smith, Moore, Glosser, & Grossman, 2007; Koenig, Smith, Grossman, 2010) and verbs (Kim & Thompson, 2004; Östberg, Fernaeus, Hellstrom, Bogdanovic, & Wahlund, 2005). Therefore, this study examined both nouns and verbs. Following the research of Kim and Thompson (2004), the proportion of light verbs were calculated for each participant by dividing the total number of light verbs produce by each participant by the number of total verbs. The light verbs included the verbs *be, come, do, get*, *give*, *go have*, *make*, *move*, *put*, and *take.* To extend lexical research into the realm noun production within discourse, nouns were extracted from the discourse samples and coded as belonging to different categories. The nouns were coded as either living or nonliving, since researchers have found differential access to living and non-living things in AD (Koenig et al., 2007; Koenig et al., 2010).

To prepare the transcripts, the discourse samples were passed through the CLAN (MacWhinney, 2000) programs called *mor* and *post* (MacWhinney, 2014). *Mor* creates a morphosyntactic analysis of the language files. The code for the mor was: *mor +t*SUB *.gem.cex*. *Mor* indicates the program to be run. *+t*SUB* indicates to the program to focus on discourse from the participant. **.gem.cex* indicates to the program to run the analysis on all discourse samples within a specific folder. *Post* uses a database of disambiguation rules for English to clean-up the mor files and place each word into its syntactic category, instead of its morphosyntactic category (MacWhinney, 2014). The code for post is "*post +t*SUB *.gem.mor.cex*." *Post* has been found to be 95% accurate in categorizing words into their proper category (MacWhinney, 2014).

To determine the proportion of light verbs, the *freq* program was used with the code: *freq +t%mor +t*sub +s"v|*" +d2 *.gem.mor.pst.cex*. *Freq* is a program that counts the number of items found within a language sample. *+t%mor* and *+t*sub* indicates to the program to focus on the *mor* tier with the participant's language sample. *+s"v|*"* indicates to the program to extract all verbs. *+d2* indicates for the program to extract these words into an excel file. **.gem.mor.pst.cex* tells the program to run on specific files in the folder. To determine the proportion of living things, all nouns were extracted with the freq program code: *freq +t%mor +t*SUB +s"n*|*"+d2 *.gem.mor.pst.cex.* Once the nouns were extracted, they were hand coded as either living or nonliving. A proportion was calculated by dividing the total number of living things produced by the total number of nouns. Intra- and inter-rater reliability was calculated by having dividing the total number agreements by the total number of agreements plus disagreements. Intra-rater reliability was 98.84%, and inter-rater reliability was 98.85%.

Multilevel Error Analysis.

The multilevel error analysis followed the guidelines of Marini et al. (2005), where microlinguistic and macrolinguistic aspects of the narratives were analyzed. The microlinguistic measures included the number of units that were considered false starts, phonological paraphasias, neologisms, lexical fillers, word repetitions, semantic paraphasias, passe-partout words (i.e. something), substitutions of function words, substitutions of bound morphemes, and ambiguous referents. The total number of words that contained microlinguistic errors were divided by the total number of words produced to produce a percentage of microlinguistic errors. The macrolinguistic measures included filler utterances, repetition of utterances, conceptually incongruent utterances, and tangential utterances. The number of c-units containing macrolinguistic errors were summed and divided by the total number of c-units. More information on the multilevel error analysis can be found in Appendix B. For reliability purposes, 20% of the discourse samples were re-coded for intra- and inter-reliability. Reliability was calculated by taking the number of agreements and dividing that by the number of disagreement plus the number of agreement (agreements / (agreements + disagreements) * 100). Intra-rater reliability was 85.74%, and inter-rater reliability was 80.13%.

Thematic Analysis.

Thematic analysis measures the information that should be included to construct structurally sound discourse (Glosser & Deser, 1992; Marini et al., 2005). To produce thematic units for the stories *Picnic* and *Pancakes for Breakfast*, four students were asked to produce elements and actions for both stories. Elements and actions included the elements and actions required for a listener to understand the overall gist of the story, as well as elements and actions that provide extra information for the listener. The thematic elements and actions were only included when three of the four students agree. A score was obtained by taking the number of elements and the number of actions produced by each participant for each story. The number of thematic units produced serves as an index of the participant's ability to convey information necessary for discourse. For *Pancakes for Breakfast*, the students produced 56 elements and 50 actions for a total of 106 thematic units. For *Picnic*, there were 36 elements and 43 actions for a total of 79 thematic units. This made means that together there 92 elements and 93 actions for a total of 185 thematic units. For more information on elements and actions see Appendix C. Reliability was calculated by dividing the total number of agreements by the total number of disagreements. Intra-rater reliability was 95.44%, and inter-rater reliability was 89.96%.

Procedures

Prior to enrolling in the study, all participants provided consident according to the East Carolina University's IRB guidelines. All participants who were diagnosed with Alzheimer's disease required their own signature and the signature of their legal representative (See Apendix A). Participants were tested individually. They provided consent, completed screening measures to ensure they met the inclusionary criteria, and provided information on their educational and medical history. Participants attended two sessions, each lasting approximately 2 hours. Participants were pseudo-randomly selected to start with the cognitive tasks or discourse tasks. The cognitive and discourse tasks were randomly presented to the participants. For the cognitive tasks, the standard instructions were followed for the BNT, PPT, and WCST. For the category fluency task, participants were asked to name as many tools and animals as possible within sixty seconds. For the discourse task, an examiner said, "These are wordless picture books that allow an individual to make-up their own story. First, I'll look through the book to get an idea of the story." Next, the examiner read the scripted story for *The Great Ape* (Krahn, 1978) to provide the participants with a model to complete the task. Narratives improve when the discourse task is modeled for the participants (Capilouto & Wright, 2009). Finally, the examiner handed the participant a wordless picture book and instructed him/her to look through the book to get an idea of the story and then tell a story that goes along with the pictures. The participants were given unlimited time to examine the book and were allowed to keep the book during the task.

Analyses

To address the first aim of the study, a multivariate analysis of variance (MANOVA) was conducted with the fixed factor as group and 6 dependent variables that included: (1) proportion of microlinguistic errors, (2) proportion of living things, (3) proportion of light verbs produced, (4) proportion of macrolinguistic errors, (5) the number of thematic elements, and (6) the number of thematic actions. A post-hoc power analysis was conducted using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007; Faul, Erdfelder, Buchner, & Lang, 2009). The inputs were effects size, alpha, sample size, number of groups, and number of response variable. The effect size was .6129, and it was calculated using Pillai V trace of .38888, which was obtained from running an MANOVA analysis on preliminary data. The alpha level was .05. The sample size was 24. The number of groups was 2, and the number of variables was 6. The Power was 66.43%. To get 80% power, a total of 30 individuals would needed to be included in the study.

For the second aim of the study, the four semantic memory tasks (PPT, BNT, Category Fluency for Animals, and Category Fluency for Tools) were entered into a factor analysis to reduce these four different scores to a single standardized residual for participants with a cognitive impairment. A bivariate Pearson correlation was conducted to on the six discourse variables, the cognitive measures, and the age and education corrected scores on the DRS-2. This determines the correlation between declines cognition with both the DRS-2's overall impairment score, as well as the different discourse analyses. To further understand the link between semantic decline, the cognitive impairment score, and the discourse analyses, linear regression models were also performed from any significant correlations. Linear regression allowed the researchers to determine how good participants with AD fit into the discourse model purposed by Kintsch and van Dijk (1978), specifically the role of semantic memory has on the different levels of discourse. A post-hoc analysis of the linear regression models determined that power was at 97.25%

To address the third aim of the study of whether the linguistic analysis can reliability distinguish between the healthy participants and participants with a cognitive impairment, the significantly different linguistic measures was added to a k-cluster analysis to determine the likelihood of distinguishing between healthy adults and adults with a cognitive impairment based off discourse alone. Two k-cluster analyses were conducted to determine if the discourse impairment could reliability distinguish between 2 groups (healthy and Impaired) or 3 groups (healthy, impaired, and borderline). Finally, a binary logistic regression was conducted to determine the percentage of individuals correctly identified as healthy or impaired.

CHAPTER 3: RESULTS

Data Preparation

The study followed Tabachnick and Fidell's (2012) guidelines for data screening to prepare the data for analysis. For Aim 1, the discourse variables were examined for univariate and multivariate outliers; normality, homogeneity of variance and covariance; and multicollinearity. For outliers, standardized z-scores (univariate) and Mahalanobis distances (multivariate) were calculated for the variables within group. Z-scores less than -2.3 or greater than 2.3 were considered outliers and removed from the analysis. For the discourse based variables, the impairment group had one outlier for percent of microlinguistic errors with a raw score of 22%, $z = 2.65$. The control group had one outlier for microlinguistic errors, raw score of 12.83%, $z = 2.68$, and one outlier for proportion of living things, raw score of 48.75%, $z = 2.65$. Removing these variables made the tests more conservative. Once the univariate outliers were removed, the Mahalanobis distances did not produce any outliers on the multivariate level. Normality was calculated by dividing the skewness values by the standard error for each variable. This creates a z-score where less than -3.3 or greater than 3.3 are considered non-normal. All discourse variables were normally distributed. All discourse variables had equal covariance as indicated by the Box's Test at an alpha level of .01. Levene's Test indicated all variables to have equal variance at an alpha level of .01. An alpha level of .01 was used at the suggestion of Tabachnick and Fidell (2012), since both Box's M test and Levene's Tests are conservative. To check for multicollinearity, a bivariate Pearson correlation was run on all variables. Variables with a correlation greater than .90 are considered multicollinear (Tabachnick & Fidell, 2012). No discourse variables correlated greater than 90%.

For Aim 2, the semantic variables (PPT, BNT, Category Fluency for Animals, and Category Fluency for Tools), DRS-2 AEMSS scores, general and working memory measures, and the 6 discourse variables were examined for univariate and multivariate outliers; normality; and multicollinearity within the impaired group. The PPT variable produced one outlier with raw score of 22, $z = -2.72$. It was removed. The variables had no multivariate outliers, were normally distributed, and did not correlate greater than 90% according to a Pearson bivariate correlation.

To produce a single cognitive score from the four semantic variables, a principal component analysis was conducted on the four semantic memory variables (PPT, BNT, Category Fluency for Animals, Category Fluency for Tools). The Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy measures the sum of partial correlations for the variables and returns a value between 0 and 1. A value of 0 indicates a diffused pattern with low correlation, while 1 indicates a more compact pattern with higher correlations. The KMO Measure of Sampling Adequecy produced a score of .784, which according to Hutchenson and Sofroniou (1999) is considered acceptable for a factor analysis. The Barlett's Test of Sphericity measures the null hypothesis that the original correlation matrix is an identity matrix. Barlett's Test of Sphericity was not significant, $X^2(6) = 28.182$, $p < .001$, indicating that the original correlation matrix was not an identity matrix. The factor analysis yielded a one factor solution explaining 79.80% of the variance for the entire set of variables. Each of the four variables loaded heavily on factor 1 as indicated in Table 3. Standardized regression values were produced for each of the 12 participants with a cognitive impairment.

Aim 3 followed the same procedures for the discourse variables, but the variables were not divided between groups. The variables had no univariate or multivariate outliers, were normally distributed, and did not have a greater than 90% correlation according to a Pearson bivariate correlation.

Preliminary Analyses were conducted to determine if the groups differed in age, education, number of words, number of utterances, lexical diversity, time, number of nouns, and number of verbs. Paired sample t-tests were conducted and results indicated no significant differences between any of the variables. Therefore, the difference in age, education, number of words, number of utterances, lexical diversity, time, and number of nouns, number of verbs were not considered in the remaining analyses. The degree of variability between the different discourse samples, especially in regards to length, means that the rest of the analysis focuses on the combined scores for both *Picnic* and Pancakes More information can be found in Table 4.

Results

Table 5 presents the cognitive results for the participants with a cognitive impairment. Seven participants had scores $\leq$ 3 on the DRS-2, indicating a severe impairment to cognition as indicated by the DRS-2 (Mattis, 2002). One participant scored 5 on the DRS-2, indicating a moderate impairment to cognition as indicated by the DRS-2. One participant scored a 7 on the DRS-2, indicating a mild impairment as indicated by the DRS-2. Three participants scored 9 on the DRS-2, indicating low-average or borderline scores as inidcaited by the DRS-2. Nine participants were diagnosed with possible or probable Alzheimer's disease. For the three participants without a diagnosis of Alzheimer's disease, all three had scored < 25 on the MMSE and scored a 9 on the DRS-2. For episodic memory, most of the participants had borderline to average scores, except for two participants who scored severely impaired as indicated by the DRS-2, as well as on the measure for episodic memory. Three participants, who were classified as severely impaired by the DRS-2, were unable to complete the episodic memory subtests due to an inability to understand the direction. For working memory, eight of the 12 participants with cognitive impairment were classified as borderline to average. For the three participants who scored within the impaired range for working memory, all were classified as severely impaired by the DRS-2. One participant was unable to complete the working memory portion of the Wechsler Memory Scale – III because she was unable to understand the directions. Figure 1 maps the cognitive variables against the DRS-2 z-scores (x-axis). The figure demonstrates that while the cognitive scores are highly variable compared to the DRS-2 z-scores, participants with cognitive impairments generally did worse on all three other cognitive tests, including the semantic tests. This might indicate that semantic memory is an appropriate measure of cognitive impairment for the more borderline cases.

To address the first aim of the study of whether the groups differed in their microlinguistic and microlinguistic production, a multivariate analysis of variance (MANOVA) was conducted with the fixed factor as group (impaired and control) and the microlinguistic (percent of microlinguistic errors, percent of living things, and percent of light verbs) and macrolinguistic variables (percent of global coherence errors, number of elements, and number of actions). The results indicated that the group main effect was significant, $F(6, 14) = 5.025$, $p =.006$, Wilks' $\Lambda = .317$, $\eta2 = .683$. The tests of between-subject effects were examined with a Bonferroni correction of the alpha level ($.05 / 6 = .0083$) to reduce the likelihood of a type I error. The test of between-subject effects found significant difference for the percent of microlinguistic errors, $F(1, 19) = 12.075$, $p = .003$, percent of macrolinguistic errors, $F(1, 19) = 9.351$, $p = .006$, and thematic actions, $F(1, 19) = 17.648$, $p < .001$, with participants with an impairment producing more micro- and macrolinguistic errors and fewer actions than the control group. More information can be found in Table 6.

To address the second aim of the study of whether cognitive measures correlated with discourse impairment in participants with cognitive impairments, the cognitive measures, as well as the six discourse variables and the age and education corrected scores from the DRS-2 (AEMSS) were entered into a Pearson Bivariate Correlation. As seen in Table 7, the cognitive scores correlated significantly with AEMSS, indicating that a lower score on the DRS-2 resulted in lower scores on the different cognitive measures. A linear regression model was conducted with the cognitive measures entered as predictors and AEMSS as the dependent variable. Cognitive scores significantly explained a significant proportion of variance in the AEMSS scores, $R^2 = .815$, $F(3, 5) = 7.335$, $p = .028$, indicating that semantic memory does play a significant role within cognitive decline. Only episodic memory was a significant predictor of AEMSS scores, $\beta = 1.625$, t(8) = -2.956, $p = .032$. Figure 2 plots the z-scores for the different cognitive measures.

For the discourse variables, microlinguistic errors had a significant negative correlation with episodic, semantic, and working memory. A linear regression model with microlinguistic errors as the dependent variable and the three cognitive measures predictors was conducted. The linear regression model for microlinguistic errors was not significant. Figure 3 plots the microlinguistic errors against the DRS-2 scores for individuals with a cognitive impairment. Macrolinguistic errors also had a significant negative correlation with all episodic, semantic, and working memory A linear regression model was conducted with macrolinguistic errors as the dependent variable and general, semantic and working memory as predictors. Cognitive scores significantly explained a significant proportion of variance in the AEMSS scores, $R^2 = .882$, $F(3, 5) = 12.409$, $p = .009$, indicating that semantic memory does play a significant role within cognitive decline. Only episodic memory was a significant predictor of macrolinguistic errors,

$\beta = -1.247$, t(8) = -2.837, $p = .036$. Figure 4 plots the macrolinguistic errors against the z-scores of the DRS-2 impairment score for individuals with a cognitive impairment.

The percentage of living things had a significant negative correlation with semantic memory, $r^2 = -.815$, $p < .01$. The percentage of light verbs had a significant negative correlation with episodic memory, $r^2 = -.849$, $p < .01$. Since the lexical items only had one significant predictor, regression models were not conducted. Figure 5 plots the percentage of living things against the composite semantic memory score. Thematic elements were only significantly correlated with semantic memory, $r^2 = .592$, $p < .05$. Since thematic elements only had a relationship with semantic memory, a regression model was not conducted. Thematic actions were significantly correlated with general, semantic, and working memory. A linear regression model with thematic actions as the dependent variables and the cognitive measures as predictor was not significant.

To address the third aim of the study of whether the discourse variables were able to reliably distinguish between participants with cognitive impairments and healthy controls, two K-cluster analyses were conducted with the variables percent microlinguistic errors, percent macrolinguistic errors, and thematic actions. The first cluster analysis specified two clusters with a maximum iteration of 10. The cluster correctly identified all control participants, but mislabeled 4 individuals in the impaired group as healthy for a correct percentage of 83.33%. This included three participants classified as borderline and one participant classified as moderately impaired per the DRS-2. The second cluster analysis specified three clusters with a maximum iteration of 10. The three-cluster solution did worse by misclassifying two healthy participants and three participants with a cognitive impairment for a correct percentage of 79.16%. Finally, a binary logistic regression was conducted with the three discourse variables entered as predictors and impaired and control as the dependent variable. The test correctly 87.5% of the cases, labeling one control participant as impaired and two impaired participants as controls. The two impaired participants were classified as borderline per the DRS-2, and the mislabeled control participant was an individual that produced a higher percentage of microlinguistic errors than the other healthy controls.

CHAPTER 4: DISCUSSION

The purpose of this study was two-fold: (1) to determine the role semantic memory impairments might play in the micro- and macrolinguistic processing of discourse within Kintsch and van Disjk's (1978) model of discourse processing and (2) to determine if a multilevel discourse analysis can reliably discriminate between participants with a cognitive impairment and healthy controls. The study specifically examined three research questions: (1) Will declines in cognition produce significant discourse impairment as indicated by a multilevel discourse analysis for participants with a cognitive impairment and healthy controls? (2) Will episodic memory, working memory, and semantic memory measures predict cognitive decline as indicated by the DRS-2 (Mattis, 2002), as well as correlate with the measures from the multilevel discourse analysis? (3) Can aspects from a multilevel discourse analysis reliably distinguish between participants with a cognitive impairment and healthy older adults?

For Aim 1, a significant difference between discourse measures for participants with a cognitive impairment and healthy controls was found. Participants with a cognitive impairment produced more micro- and macrolinguistic errors and also produced fewer thematic actions. For Aim 2, there was a significant correlation among episodic memory, working memory, and semantic memory measures and measures of general cognitive impairment as indicated by the DRS-2. Within a linear regression model, these cognitive measures significantly predicted overall impairment, and episodic memory was the most important predictor. Only semantic memory negatively correlated with the percentage of living things and thematic elements. Percentage of light verbs was only negatively correlated with episodic memory. Thematic actions and, also, micro- and macrolinguistic errors, evinced a significant relationship with all the variables. The cognitive tests could not significantly predict thematic actions or the percentage of microlinguistic errors. In a linear regression model, only episodic memory was a significant predictor of macrolinguistic errors and contributed most to the model. For Aim 3, a binary logistic regression model was able to correctly group the participants 87.5% of the time from the multilevel discourse variable alone.

As follows, this section addresses the microlinguistic errors in relation to other research into the discourse of individuals with AD, as well as the lexical analyses conducted on noun and verbs. Next, macrolinguistic errors in relation to discourse studies with individuals with AD, as well as the thematic elements and actions are addressed. Then, the paper will examine these findings in relation to Kintsch and van Dijk's (1978) CI model of discourse based on cognitive data. Finally, the implications of the k-cluster analyses and logistic regression models are discussed within the realm of clinical screening.

Microlinguistic Analysis

Error Analysis. Researchers agree that adults with AD present with an increase in microlinguistic errors (Chapman et al., 2002; de Lira, Ortiz, Campanha, Bertolucci, & Minett, 2011; Doung et al., 2005; Foster et al., 2013; Gayraud et al., 2011; Glosser & Deser, 1990; Kim & Thompson, 2004; Nicholas et al., 1985;). Yet, findings are mixed on what type of microlinguistic errors are significantly different for participants with a cognitive impairment compared to healthy controls. The current study found a significant difference in the percentage of microlinguistic errors, but results for microlinguistic errors are not as straight forward as the differences found in macrolinguistic errors.

For microlinguistic errors, Hier, Hagenlocker, and Shindler (1985) found a reduction in lexical diversity and important information. Glosser and Deser (1990) found that adults with Alzheimer's disease produced significantly more indefinite terms but not more paraphasias.

Chapman et al. (1995) did not find a significant difference in referential errors between participants with AD and healthy controls. De Lira et al. (2011) found that participants with AD had more lexical retrieval difficulties, revisions, and repetitions. Hier et al. (1985) found a reduction in lexical diversity and important information.

An increase in the number of indefinite terms (e.g. ambiguous referents or ambiguous terms, such as *thing* or *something*) and semantic paraphasias does fit within the narrative that participants with AD have degraded semantic representations (Adlam et al., 2006; Beeson et al., 2006; Budson, 2014; Koenig et al., 2007; Koenig et al., 2010; Reilly, 2014; Smith et al., 1995). Individuals with semantic degradation could be expected to produce more indefinite terms, such as "something," and a higher percentage semantic paraphasias since lexical access becomes more difficult as semantic features are lost. It is also likely that working memory deficits contributed to revisions and repetitions. Narrative elements for participants with AD may need to be repeated or revised to keep these elements active within working memory (Bayles, 2003).

While participants with AD do produce an increase in microlinguistic errors, the nature and type of errors are still debated. The current study did not separate the errors. Rather, we focused on the percentage of microlinguistic errors. Combining different types of microlinguistic errors into a single measure may reflect the heterogeneity of the discourse produced by individuals with AD better than focusing on specific type of errors (Doung et al., 2005).

The current study differed from previous studies for several reasons. First, 58.33% of participants were rated as severely impaired as indicated by the DRS-2. In previous studies, researchers only included participants classified as presenting with mild to moderate impairments. This may explain why results of the current study clearly showed a microlinguistic impairment whereas Glosser and Deser's (1990) and Chapman's (1995) findings were less clear with respect to presence of impairment. The current study also elicited narrative discourses from wordless picture books, which allowed participants to produce longer discourse samples (Fergadiotis & Wright, 2011; Fergadiotis, Wright, & Capilouto, 2011). This may also increase the number of microlinguistic errors found within the current study.

The correlations and regression model for the percentage of microlinguistic errors suggested that microlinguistic measures are related to episodic memory, working memory, and semantic memory. This finding supported Kintsch and van Dijk's (1978) CI discourse model, suggesting that episodic memory, working memory, and semantic memory are important for microlinguistic processing. However, with the nonsignificant linear regression model, it was not possible to determine the influence of each cognitive system on microlinguistic errors.

Lexical Analysis: <u>Nouns</u>. No difference in the percentage of living things or light verbs produced between the groups was found. Yet there is substantial evidence of degraded semantic representation within AD. Individuals with AD performed poorly on naming tasks (Beeson et al., 1997), feature verification tasks (Smith et al., 1995), and picture description tasks (Bschor, Kuhl, & Reischies, 2001). Researchers have also found impairments related to concrete concepts (Koenig et al., 2007; Koenig et al., 2010) and verbs (Grossman, Mickanin, Onishi, Robinson, & D'Esposito, 1997; Kim & Thompson, 2004).

Lambon Ralph's (2014) Hub-and-Spokes model of semantic processing postulates that semantic memory is organized into a widely distributed neural network of features (spokes) that are processed and combined within a central zone within the anterior temporal lobe (hub). These spokes are grouped into specific modalities located across the brain. For example, sensory features are more likely to be stored in the temporal lobe whereas functional features are more likely to be stored within the frontoparietal lobes. Whatmough et al. (2003) found that participants with AD performed worse on naming living things than nonliving things. The researchers suggested that the atrophy of the temporal lobe in the earlier stages of the disease may have caused a subtle living things deficit, which would progress to a nonliving thing deficit within the later stages of the disease.

Gonnerman, Andersen, Devlin, Kempler and Seidenberg (1997) also found a dissociation between living things and nonliving things in some individuals with Alzheimer's disease. The researchers included 15 mild to moderate participants with AD and 15 age- and education-match control participants and asked each to name black and white drawings. When the researchers examined the features of living and nonliving things, they were able to create a probabilistic model that explained why most of their participants with AD had a linear decline in nonliving things and a gradual decline in living things. Cree and McRae (2003) have demonstrated that living things possess more shared features and interconnections between features. Nonliving things shared fewer features between concepts and had less interconnection among those features. The researchers concluded that damage to features of living things will have less impact since the interconnections among features helped with access, but as the disease progressed the shared features between living things begin to take out multiple categories of concepts. Nonliving things declined linearly because they shared few features and had little interconnections. Therefore, when a feature was lost, the concept was affected to a greater extent, but this did not start a cascade into other nonliving categories as the disease progressed because nonliving concepts shared fewer features.

The current findings support Koenig et al. (2007) and Koenig et al. (2010) who argued that participants with AD performed worse on learning novel tools than animals because novel tools are less constrained and share fewer features than living things. The participants had more of an idea of what type of features were associated with animals than tools. Earlier work by Smith et al. (1995) suggested that participants with AD lose distinctive, atypical features with weak connections first. These distinctive features are more important for nonliving concepts than living concepts.

Collectively, from the results of previous research, it appears possible to draw several conclusions about semantic degradation of concrete concepts in individuals with AD: (1) the loss of semantic information is progressive (Adlam et al., 2006); (2) distinctive, atypical features have weaker connections and have a greater probability of being lost, which effects nonliving things more than living things (Gonnerman et al., 1997; Smith et al., 1995); (3) early atrophy in the temporal lobe might affect living things more than nonliving things (Whatmough et al., 2003); and (4) living things share more features between concepts and possess more interconnection between features within concepts, which makes living things more resilient in the initial stages of the disease.

None of these conclusions about semantic degradation can account for the lack of significant difference in the current study between participants with a cognitive impairment and healthy controls. Most of the participants with cognitive impairment presented with a severe impairment per the DRS-2. Following Gonnerman and colleagues (1997), these participants should have deficits in both living and nonliving things. The results may be explained by two non-mutually exclusive ideas: (1) the loss of semantic features facilitates access to the more robust category of living things or (2) narrative discourse from wordless picture books facilitated lexical access in individuals with AD because of the multiple representations across multiple layers, as well as the context the book provided.

Living things share more features between concepts and have a higher rating of interconnectedness amongst a single concept's features; as such, living things are typically easier to categorize but more difficult to recall (Cree & McRae, 2003; Reilly et al., 2014). For example, most mammals have four legs. Therefore, when an individual encounters a new mammal with four legs, the new creature can be easily categorized as a mammal since it shares a similar form with many other creatures categorized as mammals. Unfortunately, when an individual recalls living things, the shared features activate other concepts that must be inhibited to correctly recall the intended item. In AD, it is possible that these semantic degradations might facilitate living thing recall by removing neighborhood effects and distractor concepts. This may be especially true if long-term memory (consisting of episodic and semantic memory) is more impaired than the general linguistic processes that access lexical items. There is some evidence that purely linguistic processes are preserved in AD. Kim and Thompson (2004) found that participants with AD did not have consistent trouble with accessing and using verb argument structure.

Kintz and Wright (in press) examined the proportion of living things produced in the discourse of healthy younger (n = 30, 20-39 years old) and healthy older adults (n=30, 60-89 years old). The study used wordless pictures books and categorized nouns in a similar manner to the current study. The researchers found that healthy older adults produced significantly fewer living things than younger old adults. They concluded that it is possible that declines in executive function make it difficult for older adults to access or switch between the category of living things to non-living things. In an unpublished regression model, the same researchers found that measures of executive function do significantly explain a small amount of the variance in living things. If individuals with AD are more impaired in semantic memory than executive function, it is possible that the reduction in shared features and neighborhood sizes might facilitate living thing production.

Aim 2 provides further evidence for the idea that declines in semantic memory may facilitate living thing access in participants with AD. For participants with a cognitive impairment, the percentage of living things produced was significantly correlated with the semantic memory measures. Participants who scored lower on the semantic memory measures produced a higher percentage of living things. However, the current study did not examine whether declines in feature access related to living thing production. More importantly, no measures of executive functioning were obtained for the participants due to the severity of their impairments, so the current study could not determine if executive function was less impaired in relation to lexical access than semantic memory. Future research should explore the role of features access and executive function have on participants with AD's ability to recall living things compared to nonliving things. It is also possible that since living things are usually the agents of the story, adults with more semantic degradation will focus on these elements at the exclusion of other details, which are often non-living. This should be explored in further research.

Possibly, the nature of the wordless picture books facilitated discourse production for the participants with cognitive impairment. The elicitation task provided: (1) may have reduced memory demands since the stimulus remained visible for the participant and (2) more context than single pictures or recounts possibly facilitating the access of lexical items. Bschor, Kuhl, and Reischies (2001) conducted a study examining narrative discourse from the single picture Cookie Theft (Goodglass & Kaplan, 1973) with other standardized measures. The study included 115 German-speaking participants who either had MCI, AD, or were healthy controls. The researchers found that participants with MCI and AD produced narrative discourses that were less informative compared to the healthy controls, but the standardized measures differentiated between the groups better than narrative discourse. Possibly then, eliciting narrative discourses from wordless pictures books might provide enough support to facilitate language abilities.

Researchers have found that discourse is more sensitive to changes in linguistic function as compared to standardized tests for other clinical populations including TBI (Marini et al., 2011b) and aphasia (Marini et al., 2011a). Individuals with TBI typically have preserved discourse at the microlinguistic level but not the macrolinguistic level due to executive function impairments (Marini et al., 2011b). Individuals with aphasia have disruptions at the microlinguistic level due to linguistic impairments (Marini et al., 2011a). Participants with AD present with impaired memory (Buson, 2014). Therefore, it is possible that wordless picture books facilitate lexical access with rich context and reduce memory load, which may facilitate the surface level productions in individuals with AD. However, since wordless picture books require more organization and sequential processing, this type of stimuli may be best suited for investigating macrolinguistic features. More research is needed to determine if wordless picture books facilitate the surface level productions more so than single pictures or sequential pictures.

Lexical Analysis: Verbs. We did not find that participants with a cognitive impairment produced significantly different percentage of light verbs compared to control participants. This does not agree with previous researchers' findings (Grossman et al., 1997; Kim & Thomposon, 2004). Researchers have argued that verbs suffer from the same semantic degradation as nouns in individuals with AD (Kim & Thompson, 2004). Kim and Thompson (2004) concluded that verbs are lost in a bottom-up manner; more complex "heavy verbs" are lost before simple "light verbs." For example, *walk* is a heavy verb because its core meaning has two components: (1) the idea of going and (2) the manner in which the entity goes. *Go* is a light verb because it only denotes “the idea of going” and not manner. Participants with AD would have more difficulty with *walk* earlier in the disease compared with *go*.

Verbs occupy a unique place in language. Verbs are stored in anatomically distinct regions from most nouns (for review see, Kemmerer, 2015). Vigliocco, Vinson, Druks, Barber, and Cappa (2011) suggested that verbs also require more processing demands than nouns. Verbs require not only semantic information but argument structure, as well as thematic role processes that assign roles within an utterance. Moreover, according to Kemmerer (2015) verbs typically have more abstract features and have shallow hierarchical structures compared to nouns. This information likely affects processing demands on verbs.

Kim and Thompson (2004) found that participants with AD produced more light verbs than healthy controls in a narrative discourse task but not in a sentence completion task. Grossman et al. (1997) found that participants with AD produced more light verbs in sentence completion tasks, but they did not control for verb length, frequency, or number of arguments. Collectively, these researchers have concluded that verbs were more impaired than nouns. Moreover, Kim and Thompson concluded that the nature of their sentence completion task might have allowed the participants to tap into verbs that had not been lost. Possibly, then the narrative discourse elicitation task of using wordless picture books may have facilitated verb access. Alternatively, the wordless picture books may have offered participants with AD a wider range of options for different verbs. As such, it is likely that verb retrieval is facilitated by the discourse context, and wordless picture books may be more facilitative than a sentence completion task or other types of narrative discourse elicitation.

It is less likely that verbs are facilitated by semantic degradation. In the current study, we found that semantic memory measures did not significantly correlate with the percent of light verbs produced. Moreover, the shallow nature of verbs suggests that losing features of one verb should not impact the surrounding verbs. If an individual lost the verb *walk* to semantic degradation, it is unlikely to facilitate or inhibit the processing of other heavy verbs, such as *run*, *jog*, or *skate*, as well as the light verb *go*. However, the lack of significant correlation might be a product of study's design. The semantic memory measures were all based on semantic processes in respect to concrete concepts or nouns. The semantic measures might not have captured verb impairments because of the over reliance on concrete concepts.

In sum, findings from the current study along with previous research demonstrate that participants with cognitive impairments that are related to AD do demonstrate an increase in microlinguistic errors. However, the current study did not find a difference between the groups in the types of nouns or verbs produced. This may be because of the unique nature of living things and verbs, or it may be because the discourse task facilitated lexical retrieval. Future research should consider the types of microlinguistic errors produced by participants with AD, as well as the cognitive systems that contribute to these errors. While the current study demonstrated that percentage of microlinguistic errors produced correlate with general impairment, research on the types of errors produced may improve researchers' ability to distinguish between different cognitive impairment. Future research should also consider the types of lexical items produced. While the current study did not find differences in living things or light verbs between healthy controls and participants with a cognitive impairment, it seems reasonable that degradation to semantic memory should affect the type of content being produced during a discourse task.

Macrolinguistic Analysis

Error Analysis. Researchers agree that adults with AD present with a disruption to macrolinguistic processes (Chapman et al., 1995; Chapman et al., 2002; Dijkstra et al., 2002; Dijkstra et al., 2004; Doung et al. 2005; Hudon et al, 2006 Tomoeda et al., 1996). The present study also revealed that participants with a cognitive impairment produce significantly more discourse-disruptive elements compared to healthy controls. This agrees with other researchers who found disruptions to narrative structure and coherence (Chapman et al., 1995; Doung et al., 2005) and an increase to coherence disrupting elements (Dijkstra et al., 2002; Dijkstra et al., 2004).

Dijkstra et al. (2002) found that participants with severe AD produced more empty phrases, repetitive phrases, and topic shifts. In a later study with less severe participants with AD, Dijkstra et al. (2004) also found that the participants with AD produced more empty phrases, repetitive phrases, and topic shifts. The macrolinguistic errors for the current study also included empty phrases (fillers utterances), repetitive phrases (repetition of utterances), and topic shifts (tangential utterances). These results suggest that there is a disruption to the situational level of discourse. It is difficult to speculate which cognitive systems play a role for each disruptive element. However, Kintsch and van Dijk's (1978) CI discourse model assumed that the situational level of discourse was heavily dependent on episodic memory. However, if working memory plays a role in repetitive phrases and topic shifts then when working memory is limited, phrases may need to be repeated to stay activated within memory. Topic shifts may be a disruption between the disruption of working memory and executive function (Bayles, 2003). Finally, episodic memory and semantic memory might play an important role in empty phrases and conceptually incongruent phrases.

Findings from Aim 2 indicated that macrolinguistic errors significantly correlated with estimates of episodic memory, working memory, and semantic memory. The linear regression model demonstrated that episodic memory was the greatest predictor of macrolinguistic errors, followed by semantic memory. These results agree with Kintsch and van Dijk (1978), who claimed that the situational model relies heavily on episodic and semantic memory for inferencing processes. For example, if a listener cannot connect the new elements entering the semantic or situational levels of discourse, an inferencing process begins searching long-term memory (i.e. episodic memory) for episodes or information that can fill in the gaps. Individuals with AD have degraded semantic representations, as such, maintaining activation of important concepts and correctly identifying other concepts is more difficult. When these degraded representations are encountered within in discourse, a resource intensive inferencing process begins to reestablish coherence. Unfortunately, individuals with AD have degraded episodic and semantic memory. Therefore, stories are less likely to be conceptually coherent, and the inferencing process to resolve lack of coherence is degraded. This may explain why participants with a cognitive impairment in the current study produced many utterances that were conceptually incoherent for the story or the real world. It also might explain the increase in empty or filler phrases. If an individual does not have a coherent idea of the story, they may produce empty phrases to buy processing time (Marini et al., 2005).

Thematic Analysis. Researchers generally agree that individuals with AD produce fewer themes at the situational level compared to healthy matched peers (Chapman et al., 1995; Chapman et al., 2002). In the current study, we found a significant difference between the groups for the number of thematic actions produced but not thematic elements; participants with a cognitive impairment produced significantly fewer actions. Though both Chapman et al. (1995)

and Chapman et al. (2002) found that their participants with AD produced fewer thematic units or propositions, our study is the first to examine concepts (elements) and events (actions) separately. Since participants with a cognitive impairment did not demonstrate a significant difference compared to healthy controls on the percentage of living things produced, it was less surprising that thematic elements were not significantly different between groups at the situational level. The only significant correlation among thematic elements and the cognitive measures was for the measure of semantic memory. Possibly then, nouns and thematic elements were more easily handled by semantic memory than verbs and thematic actions. Further, it may be that the simplistic nature of nouns and elements allowed individuals with cognitive impairment to activate at the semantic level as well as the situational level with minimal effort. However, this was not the case for verbs and thematic actions.

Chapman et al. (1995) and Chapman (2002) found that their participants with AD produced fewer propositions compared to healthy control participants. Propositions were built a priori from the events or actions within the story that related to one or more verbs. Thus, the core of a proposition is built from the verb. Thematic actions are similar. Collectively, across studies there is converging evidence that individuals with AD produce fewer thematic actions than healthy controls. Thematic actions may be more difficult to process than thematic elements. The idea that thematic actions may be more difficult to process or maintain follows the same reasoning that Kim and Thompson (2004) provided for verb disruptions. Thematic actions contain one or more verbs as their core. Since verbs tend to be more abstract and complex (Vigliocco et al., 2004), it may be more difficult for individuals with cognitive impairment to access thematic actions and maintained them within the situational level of the story compared with thematic elements.

Whether thematic actions are lost in the generalization processes or not maintained within the situational level of discourse cannot be determined from the current study. Hudon et al. (2006) and Chapman et al. (2002) both found that participants with AD had trouble summarizing discourse and producing gist information. According to Kintsch and van Dijk (1978), between the semantic and situational levels a generalization process reduces information for storage in episodic memory. Findings from the current study may be explained by disruptions to the generalization process making it difficult for the participants with cognitive impairment to handle complexity of verbs and thematic actions. Alternatively, declines in general and semantic memory are such that the participants with cognitive impairment were unable to store or maintain thematic actions. Finally, it may be that the group differences in thematic actions may be a result of both number of thematic actions conveyed significantly correlated with performance on all of the cognitive measures for the cognitive impairment group. However, the regression model with the cognitive measures as predictors for thematic actions was not significant. As such, concluding the extent to which cognitive ability predicts ability to convey thematic actions cannot be ascertained. Future studies should investigate whether the breakdown in thematic actions are the result of maintanence issues within working memory or the breakdown in the generalization processes that reduce information load within working memory.

To summarize, the current study adds to previous research findings that participants with cognitive impairments related to AD experience an increase in the number of macrolinguistic errors. Thematic elements produced did not significantly differ across groups; however, thematic actions did. Two possibilities may account for these difference – (1) a disruption to the generalization process between the semantic and situation levels, or (2) the complex nature of thematic actions causes storage difficulties within the situational level of discourse.

Construction-Integrative Model of Discourse

As follows is discussion of the current study's findings within the Kintsch and van Dijk's (1978) CI model of discourse framework from the perspective of a listener because a listener begins their processing cycle at the surface level. A speaker would begin the model at the semantic or situational level because speakers typically have a concept(s) in mind when beginning a story. Alternatively, a listener is processing the surface forms as they enter working memory and these processes begin to breakdown the utterances into semantic components.

Surface Level. For a listener with AD, the surface forms enter working memory. Working memory is typically impaired (Bayles, 2003) resulting in a limit to how many linguistic units can be held. Working memory impairments may account for many of the microlinguistic errors that appear in participants with AD. Semantic memory is also impaired in this population (Budson, 2014), which may cause the individual to have trouble accessing concepts. However, no group difference was found the percentage of living things or light verbs produced, suggesting that discourse may have facilitated access of these concepts from semantic memory because of the context it provides. Yet if the concept is complete, it is very likely the concept was accessed and activated within the semantic level of discourse because lexical priming does not differ between individual with AD and healthy controls (Arroyo-Anllo, Beauchamps, Ingrand, Neau, & Gil, 2013). While the current study did find that estimates of episodic memory correlated with microlinguistic errors produced by the cognitive impairment group, this finding may be because episodic memory stored linguistic forms; or, alternatively it may be the interrelatedness of episodic memory and semantic memory.

Semantic Level. The semantic level is effected by working memory and semantic memory. Disruptions to working memory make it difficult to hold multiple concepts within either the surface or semantic levels. Moreover, concepts may be missing because of semantic degradation, or concepts may have missing features that disrupt the intended meaning. When the meaning is not understood, an inferencing process begins that searches episodic and semantic memory for a possible solution. This inferencing process could be impaired, which might increase the number of microlinguistic errors, but it is also possible that the impairment comes from degraded episodic and semantic memory. These inferencing processes that may be more prevalent in individuals with AD, also put a strain on working memory as new concepts are accessed and integrated into the overall discourse model.

Situational Level. The situational level begins in a generalization process that reduces information. Evidence exists that the ability of individuals with AD to produce summaries or gist of a narrative is impaired (Chapman et al., 2002; Hudon et al., 2006). This may come from disruptions to the generalization processes. In the current study, we found that participants with cognitive impairment produced fewer thematic actions. No impairment to nouns or verbs at the surface or semantic levels was found; however, the generalization processes may have trouble reducing the information associated with thematic actions because, like verbs, they are more abstract and more complex (Kim & Thompson, 2004; Vigliocco et al., 2011). Further, impaired episodic memory (Budson, 2014) may make it more difficult to store and maintain thematic actions. It is also at this level that inferencing may occur if a coherent story is not realized. As with the surface and semantic level, it is likely that the inferencing is impaired.

Structural Level. Though the current study was not designed to investigate the structural level; macrolinguistic errors may occur because the structural level is not constraining the situational level of discourse. According to Ska et al. (2004), the structural level contains the schemas that inform an individual how to proceed with the story. These schemata include information about beginnings and endings and, also, how to structure a story around an episode. Researchers have consistently demonstrated that the structural level of discourse is impaired in adults with cognitive impairment (Chapman et al., 1995; Doung et al., 2005). Anecdotal evidence from reviewing the participants' transcripts for structure suggests that many participants with cognitive impairment provided lists or heaps of information rather than using a story grammar structure. Future research should examine the narrative structure of the stories produced by participants with AD and examine how degradation to the schemata impair discourse production. It is possible that general and working memory impairments make it difficult to remember what was stored at the semantic and situational level, but the loss of schemata does make it more difficult to maintain the overall narrative. Schemata are possibly lost in individuals with AD because they are the most abstract level of discourse (Ska et al., 2004). According to Lambon Ralph (2014), it is usually abstract knowledge that degrades first.

Multilevel discourse analysis

Individuals with AD typical present with progressive long-term memory decline (APA, 2013; Budson 2013), as well as semantic memory (Reilly et al., 2014) and working memory (Bayles, 2003) impairments. The ultimate goal of a multilevel discourse analysis is two-fold: (1) determine the micro- and macrolinguistic abilities and adults with impairments and (2) determine if these impairments are able to distinguish between healthy adults and adults with a cognitive impairment. Findings from multilevel discourse analyses have shown to be more sensitive to cognitive-linguistic impairments in participants with aphasia (Marini et al., 2011a) and TBI (Marini et al., 2011b).

The finding from the current study demonstrate that while a k-cluster analysis was most unsuccessful, a binary logistic regression was able to correctly identify 87.5% of the participants with discourse features alone. Yet the ability to distinguish healthy participants from participants with AD from discourse alone is mixed (Chapman et al., 2002; Doung et al., 2005). Doung et al. (2005) conducted a hierarchical cluster analysis to determine if their discourse analysis could successfully cluster participants with AD and healthy controls, but the analysis failed. Chapman et al. (2002) used the Jonckheere-Terpstra test (Jockheere, 1954; Terpstra, 1952) to classify their participants into three groups (control, mild cognitive impairment, and AD). The researchers found that participants could be ranked from normal control to participants with MCI to participants with AD. Moreover, some researchers have found difference in discourse production between the different stages of AD. Dijkstra et al. (2005) found that discourse disrupting elements increased as the disease progressed, whereas discourse binding elements decreased. Fleming (2014) found that discourse could distinguish between participants with MCI and healthy controls. These findings are promising and suggest that discourse may add novel information to current screenings that would be useful for screening for presence or even diagnosis of cognitive impairment.

The current study focused on semantic memory impairments. The lexical and thematic analyses focused on concrete concepts, such nouns and thematic elements, and actions, such as verbs. Semantic memory was the focus of this discourse analysis because researchers have consistently found semantic impairments in AD (Adlam et al., 2006; Reilly et al., 2014). More importantly, there is emerging research that suggests that semantic memory impairment might appear before MCI is diagnosed (Reisberg et al., 2008) and is present in individuals with confirmed diagnosis of MCI (Fleming et al., 2014). However, results from the current study do not support previous research findings. For the semantic variables, only thematic actions were significantly different between participants with cognitive impairment and healthy controls.

For the current study, a binary logistic regression was conducted and correctly identified 87.5% of the participants as cognitively impaired or controls by discourse features alone. However, 58% of the participants with cognitive impairment were classified as severely impaired per the DRS-2 and should be easily identified as cognitively impaired. More importantly, there were no group differences for lexical items or thematic elements. Study results suggest error production and thematic action production may quantitatively distinguish between healthy and impaired populations, but lexical and thematic element production do not help distinguish between the groups. Future research should try to distinguish between the different levels of impairment for AD.

Conclusion

The purpose of this study was (1) to determine if a multilevel discourse analysis could help us understand how the discourse of individuals with a cognitive impairment fit into the overall CI model of discourse and (2) determine if differences in discourse could successfully distinguish between the groups. The findings from the current study demonstrated that (1) participants with cognitive impairment produced significantly different discourse than healthy controls, (2) these differences are correlated with episodic, semantic, or working memory, and (3) discourse features, such as micro- and macrolinguistic processes, may be able to accurately identify the presence of cognitive impairment.

However, there were several limitations to the study that need to be considered in future investigations. The groups were a small sample which may have limited the potential differences on measures due to low power for the MANOVA. Moreover, the regression models were not corrected, suggesting the possibility of a type I error. Future studies should include a larger sample size. With a larger N, additional linguistic variables could be investigated. This may include separating error types at the surface level, or it could include structural level variables, such as number of complete episodes produced.

Future investigations should consider the breakdowns associated with discourse processing and select variables that magnify the disruptions but minimize the possibility of linguistic support. This is more important since researchers have demonstrated that high verbal abilities may hide declines in cognition on measures of cognitive impairment (Sunderman, Maki, Rubin, Lipton, Landau, & Biegon, 2016).

Alzheimer's disease is known for its heterogeneity of cognitive and linguistic impairments. The participants in this study may have had a severe impairment as indicated by the DRS-2, but their scores ranged from normal to impaired on the episodic, semantic, and working memory measures. Doung et al (2005) suggested that other factors may also contribute to the heterogeneity of individuals with AD. These factors include age, education, gender, and socio-economic status, and discourse type. As mentioned above, discourse type may have facilitated lexical access in individuals with AD.

While Kintch and van Dijk (1978) suggested that the situational level is associated with long-term memory, recent evidence has suggested that a recent edition to the Baddeley working memory model might be implicated in storing the situational level of discourse (Baddeley, 2000). Future research should measure this component's role within the CI Model, especially with AD where participants present with working memory deficits (Bayle, 2003). Semantic memory degradation should also be investigated more closely in regard to discourse. The finding in the current study show a possible transmission deficit from the semantic level to the situational level. A more thorough understanding of semantic memory deficits, as well as targeted discourse measures, may determine the exact nature of the action/verb deficit found at the situational level of discourse.

There are several clinical implications for a multilevel discourse analysis in individual with AD. First, studying the cognitive systems that underlie discourse in individuals with AD may improve screening methods within a clinical setting. For example, a breakdown in coherence may indicate that a participant with a cognitive impairment has progressed into the moderate-to-late stages. Second, studying discourse may allow the development of general guidelines that may improve the general public's ability to recognize cognitive impairment. For example, in stroke, the acronym F.A.S.T. is used to improve the general public's responsiveness to stroke. The acronym stands for: Facial drooping, Arm weakness, Speech difficulties, and Time. A similar thing may be produced for different cognitive systems, especially language. Third, knowledge of how language begins to breakdown within AD may improve communication between individuals with AD and their caregivers. For example, reduction in working memory suggest that caregivers should use short sentences with few propositions. To fully develop and understand how discourse is disrupted in AD as the disease progressive from the early stages to later stages, a longitudinal study is required.

References

Ackerman, P.L. & Cianciolo, A.T. (2002). Ability and task constraint determinants of complex task performance. Journal of Experimental Psychology: Applied, 8(3), 194-208.

Adlam, A.L.R., Bozeat, S., Arnold, R., Watson, P., & Hodges, J.R. (2006). Semantic knowledge in mild cognitive impairment and mild Alzheimer's disease. *Cortex*, 42, 675-684.

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders: DSM-5. Washinton, D.C.: American Psychiatric Association.

Arroyo-Anllo, E.M., Beauchamps, M., Ingrand, P., Neau, J.P., & Gil, R. (2013). Lexical priming in Alzheimer's disease and aphasia. European Neurology, 69, 360-365. DOI: 10.1159/000347223

Ash, S., Moore, P., Vesely, L., Grossman, M. (2007). The decline of narrative discourse in Alzheimer's disease. *Brain and Language*, 103, 248-249.

Atkinson, R.C. & Shiffrin, R.M. (1968). Human memory: A proposed system and its control processes. *The psychology of learning and motivation*, 2, 89–195.

Baddeley A. (2000). The episodic buffer: a new component of working memory? *Trends Cogn Sci*. 4(11), 417-423. doi:10.1016/S1364-6613(00)01538-2.

Bayles, K.A. (2003). Effects of working memory deficits on the communicative functioning of Alzheimer's dementia patients. *Journal of Communication Disorders*, 36, 209-219.

Bayles, K. A., & Tomoeda, C. K. (1993). *Arizona Battery for Communication Disorders of Dementia*. Austin, TX: PRO-ED.

Beeson, P.M., Holland, A.L., & Murray, L.L. (1997). Naming famous people: an examination of tip-of-the-tongue phenomena in aphasia and Alzheimer's diease. *Aphasiology*, 11(4-5), 323-336.

Benton, A.L., Hamsher, S.K., & Sivan, A.B. (1983). *Multilingual Aphasia examination* (2nd Ed). Iowa City, IA: AJA Associates.

Beukelman, D. R., & Mirenda, P. (1998). *Augmentative and alternative communication: Management of severe communication disorders in children and adults* (2nd ed.). Balitmore, MD: Brookes Publishing.

Brosseau, J., & Cohen, H. (1996). The representation of semantic categories in aging. *Experimental Aging Research, 22*(4), 381-391. doi:10.1080/03610739608254018

Brown, S. C., & Craik, F. I. M. (2000). Encoding and retrieval of information. In E. Tulving, & F. I. M. Craik (Eds.), *The oxford handbook of memory*. Oxford, UK: Oxford University Press.

Bschor, T., Kuhl, K.P., Reschies, F.M. (2001). Spontaneous speech of patients with dementia of the Alzheimer's Type and Mild Cognitive Impairment. *International Pschogeriatrics*, 13(3), 289-298. DOI: http://dx.doi.org/10.1017/S1041610201007682

Budson, A.E. (2014). Memory dysfunction in dementia. In A.E. Budson & N.W. Kowall (Eds.). *The Handbook of Alzheimer's disease and Other Dementias*, (pp. 313-335), Malden, MA: Blackwell Publishing Ltd.

Cameron, R.M., Wambaugh, J.L., Wright, S.M., & Christina, L.N. (2006). Effects of a combined semantic/phonologic cueing treatment on word retrieval in discourse. *Aphasiology,* 20(2-4), 269-285.

Chafe, W.L. (1994). *Discourse, consciousness, and time: The flow and displacement of conscious experience in speaking and writing.* Chicago, IL: University of Chicago Press.

Chapman, S.B., Ulatowska, H.K., King, K., Johnson, J.K., & Mclntire, D.D. (1995). Discourse in early Alzheimer's diease versus normal aging. *American Journal of Speech-Language Pathology*, 4, 124-129.

Chapman, S.B., Zientz, J., Weiner, M., Rosenberg, R., Frawley, W., & Burns, M.H. (2002). Discourse changegs in early Alzheimer disease, mild cognitive impairment, and normal aging. Alzheimer Disease and Associated Disorders, 16(3), 177-186.

Craik, F. I. M., & Rose, N. S. (2012). Memory encoding and aging: A neurocognitive perspective. *Neuroscience & Biobehavioral Reviews, 36*(7), 1729-1739. doi:10.1016/j.neubiorev.2011.11.007

Cree, G. S., & McRae, K. (2003). Analyzing the factors underlying the structure and computation of the meaning of chipmunk, cherry, chisel, cheese, and cello (and many other such concrete nouns). *Journal of Experimental Psychology: General, 132*(2), 163-201. doi:10.1037/0096-3445.132.2.163

D'Ath, P, Katona, P, Mullan, E, Evans, S, & Katona, C (1994). Screening, detection and management of depression in elderly primary care attenders, 1: The acceptability and performance of the 15-item GDS (GDS-15) and development of a shorter version. *Family Practice, 11*, 260-266.

Davis, C., Heidler-Gary, J., Gottesman, R.F. et al. (2010). Action versus animal naming fluency in subcortical dementia, frontal dementias, and Alzheimer's disease. *Neurocase*, 16(3), 259-266.

Davis, H., & Silverman, S. (1978). *Hearing and deafness*. New York, NY: Rinehart & Winston.

De Lira, J.O., Ortiz, K.Z., Campanha, A.C., Bertolucci, P.H.F., & Minett, T.S.C. (2011). Microlinguistic aspects of the oral narrative in patients with Alzheimer's disease. *International Psychogeriatric*, 23(3), 404-412.

Dell, G. S., Schwartz, M. F., Martin, N., Saffran, E. M., & Gagnon, D. A. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological Review, 104*(4), 801-838.

DePaola, T. (1978). *Pancakes for breakfast.* China: South China Printing Company.

Doung, A., Giroux, F., Tardif, A., & Ska, B. (2005). The heterogeneity of picture-supported narratives in Alzheimer's disease. *Brain and Language*, 93, 173-184.

Dijkstra, K., Bourgeois, M.S., Allen, R.S., & Burgio, L.D. (2004). Conversational coherence: Discourse analysis of older adults with and without dementia. *Journal of Nuerolinguistics*, 17, 263-283.

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behavior Research Methods,39, 175-191.

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. Behavior Research Methods, 41, 1149-1160.

Fergadiotis, G., & Wright, H. H. (2011). Lexical diversity for adults with and without aphasia across discourse elicitation tasks. *Aphasiology, 25*(11), 1414-1430. doi:http://dx.doi.org/10.1080/02687038.2011.603898

Fergadiotis, G., Wright, H. H., & Capilouto, G. J. (2011). Productive vocabulary across discourse types. *Aphasiology, 25*(10), 1261-1278. doi:http://dx.doi.org/10.1080/02687038.2011.606974

Folstein MF, Folstein SE, White T, Messer MA (2010) *MMSE-2: Mini-mental state examination 2nd Edition*. Psychological Assessment Resources, Inc., Lutz, FL

Fleming, V.B. & Harris, J.L. (2008). Complex discourse production in mild cognitive impairment: detecting subtle changes. *Aphasiology*, 22(7-8), 729-740.

Foster, P.S., Drago, V., Yung, R.C., Pearson, J., Stringer, K., Giovannetti, T., Libon, D., & Heilman, K.M. (2013). Differential lexical and semantic spreading activation in Alzheimer's disease. *American Journal of Alzheimer's Disease and Other Dementias*, 28(5), 501-507.

Garrard, P., Maloney, L.M., Hodges, J.R., & Patterson, K. (2005). The effects of very early Alzheimer's disease on the characteristics of writing by a renowned author. *Brain*, 128(2), 250-260.

Gayraud, F., Lee, H.R., & Barkat-Defradas, M. (2011). Syntactic and lexical context of pauses and hesitations in the discourse of Alzheimer's patients and healthy elderly subjects. *Clinical Linguistics & Phonetics*, 25(3), 198-209.

Gee, J.P. & Handford, M. (Eds.). (2012). *The Routledge handbook of discourse analysis. New York, NY: Routledge*

Glosser, G. (1993). Discourse production patterns in neurologically impaired and aged populations. In H.H. Brownell & Y. Joanette (Eds.). *Narrative discourse in neurologically impaired and normal aging adults* (pp. 191-211). San Diego, CA: Singular.

Glosser, G. & Deser, T. (1990). Patterns of discourse production among neurological patients with fluent language disorders. *Brain and Language*, 40, 67-88.

Glosser, G. & Deser, T. (1992). A comparison of changes in macrolinguistic and microlinguistic aspects of discourse production in normal aging. *Journal of Gerontology*, 47, 266-272.

Gonnerman, L.M., Andersen, E.S., Devlin, J.T., Kempler, D., & Seidenberg, M.S. (1997). Double dissociation of semantic categories in Alzheimer's disease. *Brain and Language*, 57, 254-279.

Goodglass, H. & Wingfield, A. (1997). Word-finding deficits in aphasia: Brain-behavior relations and clinical symptomatology. In H. Goodglass & A. Wingfield (Eds), *Anomia*: *Neuroanatomical and cognitive correlates*. San Diego, CA: Academic Press.

Goodglass, H. & Kaplan, E. (1972) *The assessment of aphasia and related disorders*. Philadelphia, PA: Lea and Febiger.

Graesser, A.C., Gernsbacher, M.A., & Goldman, S.R. (1997). Cognition. In T.A. van Dijk (Ed.), *Discourse as Structure and Process*. Thousand Oaks, CA. Sage Publications Inc.

Grossman, M., Murray, R., Koenig, P., Ash, S., Cross, K., Moore, P. et al. (2007). Verb acquisition and representation in Alzheimer's disease. *Neuropschologia*, 45(11), 2508-2518.

Grudman, M. et al. (2004). Mild cognitive impairment can be distinguished from Alzheimer's disease and normal aging for clinical trials. *Arch. Neurol., 61(1), 59-66.*

Halliday, M.A.K. (1985). *An Introduction to functional grammar.* London, England: Edward Arnold.

Hazlett, K. E., Figueroa, C. M., & Nielson, K.A. (2015). Executive functioning and risk for Alzheimer disease in the cognitively intact: family history predicts Wisconsin Card Sorting Test Performance. *Neuropsychology*, 29(4), 582-591

Heath, S.B. (1986). Taking a cross-cultural look at narratives. *Topics in Language Disorders*, 7, 84-95.

Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtiss, G. (1993). Wisconsin Card Sorting Test manual: Revised and expanded. Odessa FL: Psychological Assessment Resources. Joreskog, K., & Sorbom, D. (1993). LISRELS. Chicago: Scientific Software International.

Hier, D.B., Hagenlocker, K., & Sindler, A.G. (1985). Language disintegration in dementia: effects of sitology and severity. *Brain and Language*, 25, 117-133.

Howard, S. & Patterson, K. (1992). *Pyramids and palm trees: a test of semantic access from pictures and words*. Bury St Edmunds, UK: Thames Valley Test Company.

Hudon, C., Belleville, S., Souchay, C., Gély-Nargeot, M.C., Chertkow, H., & Gauthier, S. (2006). Memory for gist and detail information in Alzheimer's disease and mild cognitive impairment. *Neuropsychology*, 20(5), 566-577.

Huppert, F.A. & Beardsall, L. (1993). Prospective memory impairment as an early indicator of dementia. *Journal of Clinical and Experimental Neuropsychology*, 15(5), 805-821.

Hutcheson, G. D., and Sofroniou, N. (1999). The Multivariate Social Scientist: an introduction to generalized linear models. Sage Publications.

Jefferies, E., Rogers, T. T., Hopper, S., & Lambon Ralph, M. A. (2010). 'Pre-semantic' cognition revisited: Critical differences between semantic aphasia and semantic dementia. *Neuropsychologia*, *48*(1), 248-261. doi:10.1016/j.neuropsychologia.2009.09.011.

Kaan, E. & Swaab, T.Y. (2002). The brain circuitry of syntactic processing: A comparison between non-preferred and ungrammatical continuations. *Cognitive Brain Research*, 17, 621-635.

Kaplan, E., Goodglass, H., Weintraub, S. (1983). Boston Naming Test. Philadelphia, PA: Lea & Febiger.

Kemmerer, D. (2015). *Cognitive Neuroscience of Language*. New York, NY: Psychological Press.

Kertesz, A. (2007). *Western Aphasia Battery-Revised.* San Antonio, TX: Pearson.

Kim, M. &Thompson, C.K. (2004). Verb deficits in Alzheimer's disease and agrammatism: Implications for lexical organization. *Brain and Language*, 88, 1-20.

Kintsch, W. (1994). The psychology of discourse processing. In M.A. Gernsbacher (Ed), *Handbook of Psycholinguistics*. San Diego, CA: Academic Press Inc.

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. New York, NY: The Cambridge University Press.

Kintsch, W. & van Dijk, T. (1978). Toward a model of text comprehension and production. *Psychological Review*, 85, 363-394.

Kintsch, W. & Welsch, D.M. (1991). The construction-integration model: A framework for studying memory for text. In S. Lewandowsky & W.E. Hockley (Eds), *Relating Theory and Data: Essays on human memory*. Hillsdale, N.J.: Lawrence Erlbaum Inc.

Kintz, S. & Wright H.H. (In press). Semantic knowledge use in discourse: Influence of age. *Discourse Processes*.

Koenig, P., Smith, E.E., Moore, P., Glosser, G., Grossman, M. (2007). Categorization of novel animals by patients with Alzheimer's disease and Cortiocobasal degeneration. *Neuropschology*, 21(2), 193-206.

Koenigh, P., Smith, E.E., Grossman, M. (2010). Categorization of novel tools by patients with Alzheimer's diease: Category-specific content and process. *Neuropsychologia*, 48, 1877-1885.

Krahn, F. (1978). The Great Ape. New York, NY: Viking Press

LaBarge, E., Edwards, D., & Knesevich, J. W. (1986). Performance of normal elderly on the Boston naming test. *Brain and Language, 27*(2), 380-384.

Labov, W. (1972). *Language in the inner city*: Studies in the Black English vernacular. Philadelphia, PA: University of Pennsylvania Press.

Lambon Ralph, M.A. (2014). Neurocognitive insights on conceptual knowledge and its breakdown. *Philosophical Transactions of the Royal Society B*, 369. Retrieved from http://dx.doi.org/10.1098/rstb.2012.0392

Lim, H.K, Hong, S.C., Jung, W.S., Ahn, K.J., Won, W.Y., Hahn, C., Kim, I.S., & Lee, C.U. (2012). Automated hippocampal subfield segmentation in amnestic mild cognitive impairments. Dementia and Geriatric Cognitive Disorders, 2(33), 327-333.

Lischka, A.R., Mendelsohn, M., Overend, T., & Frobes, D. (2012). A systematic review of screening tools for predicting the development of dementia. *Canadian Journal on Aging*, 31(3), 295-311.

Loban, W. (1976). *Language development: Kindergarten through grade twelve*. Urbana, IL: National Council of Teachers of English.

Longacre, R.E. (1996). *The grammar of discourse* (2nd Ed.). New York, NY: Plenum Press.

Luzzatti, C.,Willems, K., & DeBleser, R. (1991). Aachener Aphasie Test (Versione Italiana). Firenze, Italy:Organizzazioni Speciali.

Maintenant, C., Blaye, A., & Paour, J. (2011). Semantic categorical flexibility and aging: Effect of semantic relations on maintenance and switching. *Psychology and Aging, 26*(2), 461-466. doi:10.1037/a0021686.

Marini, A., Andreetta, S., del Tin, S., & Carlomagno, S. (2011a). A multi-level approach to the analysis of narrative language in aphasia. *Aphasiology*, 25(11), 1372-1392.

Mandler, J.M. (1984). *Stories, sripts, and scenes*: *Apsects of schema story*. Hilldale, NJ: Erlbaum.

Marini, A., Boewe, A., Caltagirone, C., & Carlomagno, S. (2005). Age-related differences in the production of textual descriptions. *Journal of Psycholinguistic Research,* 34, 439-463.

Marini, A., Caltagirone, C., Pasqualetti, P., & Calomagno, S. (2007). Patterns of language improvement in adults with non-chronic non-fluent aphasia after specific therapies. *Aphasiology*, 21(2), 164-186.

Marini, A., Andreetta, S., del Tin, S., & Carlomagno, S. (2011a). A multi-level approach to the analysis of narrative language in aphasia. *Aphasiology*, 25(11), 1372-1392.

Marini, A., Galetto, V., Zampieri, E., Vorano, L., Zettin, M., & Carlomagno, S. (2011b). Narrative language in traumatic brain injury. *Neuropsychologia*, 42, 2904-2910.

MacWhinney, B. (2000). *The CHILDES project: Tools for analyzing talk* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

MacWhinney, B.(2014). *The CHILDES project: T*ools for analyzing talk (3rd ed). Mahwah, NJ: Lawrence Erlbaum Associates

Mattis, S. (2002). *Dementia Rating Scale – 2*. Lutz, FL: Psychological Assessment Resources, Inc.

McCully, E. A. (1984). *Picnic*. New York, NY: Harper Collins.

McKee, A.C. & Gavett, B.E. (2014). The neuropathology of the Dementing Disorders. In A. E. Budosn & N.W. Kowall (Eds.), *The Handbook of Alzheimer's Disease and Other Dementias* (336-368). Malden, MA: John & Wiley & Sons.

Mesulam, M.M. (2003). Primary progressive aphasia – A language based dementia. *Archives of Neurology*, 66(10), 1210-1215.

Old, S.R. & Naveh-Benjamin, M. (2008). Age-related changes in memory: Experimental Approaches. In S.M. Hofer & D.F. Alwin (Eds), *Handbook of Cognitive Aging: Interdisciplinary perspectives*, (pp. 151-167), Thousand Oaks, CA: Sage Publications, Inc.

Ostberg, P., Fernaeus, S.E., Hellstrom, A., Bogdanovic, N., & Wahlund, L.O. (2005). Imapired verb fluency: A sign of mild cognitive impairment. *Brain and Language*, 95, 273-279.

Peterson, R.C., Smith, G.E., Waring, S.C., Ivnik, R.J., Tangalos, E.G., & Kokmen, E. (1999). Mild cognitive impairment: Clinical characterization and outcome. *Arch. Neurol.* 56(3), 303-308.

Reilly, J., Troche, J., & Grossman, M. (2014). Language processing in Dementia. In A.E. Budson & N.W. Kowall (Eds.). *The Handbook of Alzheimer's disease and Other Dementias*, (pp. 336-368), Malden, MA: Blackwell Publishing Ltd.

Rider, J. D., Wright, H. H., Marshall, R. C., & Page, J. L. (2008). Using semantic feature analysis to improve contextual discourse in adults with aphasia. *American Journal of Speech-Language Pathology*, *17*, 161-172.

Rönnlund, M., Nyberg, L., & Bäckman, L. (2005). Stability, growth, and decline in adult life span development of declarative memory: Cross-sectional and longitudinal data from a population-based study. *Psychology and Aging*, *20*(1), 3-18. doi:10.1037/0882-7974.20.1.3

Salmon, D.P., Thomas, R.G., Pay, M.M., Booth, A., Hofstetter, C.R., Thal, L.J., & Katzman, R. (2002). Alzheimer's disease can be accurately diagnosed in very mildly impaired individuals. *Neurology*, 59(7), 1022-1028.

Schank, R.C. & Abelson, R.P. (1977). *Scripts, plans, goals, and understanding*. Hillsdale, NJ: Erlbaum.

Schneider, W., & Korkel, J. (1989). The knowledge base and text recall: Evidence from a short-term longitudinal study. *Contemporary Educational Psychology. 14,* 382-393.

Shoa, Z., Janse, E., Visser, K., & Meyer, A.S. *(2014).* What do verbal fluency tasks measure? Predictors of verbal fluency performance in older adults. *Frontiers in Psychology*, 5, 772.

Ska, B. Doung, A., & Joanette, Y. (2004). *Discourse impairments. In R.D. Kent (Ed.). The MIT encyclopedia of communication disorders, (pp. 302-304), Cambridge, MA: The MIT Press.*

Smith, S., Faust, M., Beeman, M., Kennedy, L., & Perry, D. (1995). A property level analysis of lexical semantic representations in Alzheimer's disease. *Brain and Language, 49, 263-279.*

Snowden, D.A., Kemper, S.J., Mortimer, J.A. (1996). Linguistic ability in early life and cognitive function and Alzheimer's disease in late life. *The Journal of the American Medical Association*, 275, 528-532.

Spaniol, J., Madden, D. J., & Voss, A. (2006). A diffusion model analysis of adult age differences in episodic and semantic long-term memory retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 32*(1), 101-117. doi:10.1037/0278-7393.32.1.101

Stemmer, B. (1999). Discourse abilities in neurologically impaired populations: A quest for action. *Brain and Language*, 68, 402-418.

Sundermann, E.E., Maki, P.M., Rubin, L.H., Lipton, R.B., Landau, S. & Biegon, A. (2016) Female advantage in verbal memory: Evidence of sex-specific cognitive reserve. *Neurology*, 10. DOI: http://dx.doi.org/10.1212/WNL.0000000000003288

Tabachnick, B. G., & Fidell, L. S. (2012). *Using multivariate statistics* (6th ed.). Needham Heights, MA: Pearson Education Company.

Tomoeda, C.K., Bayles, K.A., Trosset, M.W., Azuma, T., McGeah, A. (1996). Cross-sectional analysis of Alzheimer disease effects on oral discourse in a picture description task. *Alzheimer Disease and Associated Disorders*, 10(4), 204-215.

Tun, P.A. & Wingfield, A. (1994). Speech recall under heavy load conditions: Age, predictability, and limits on dual-task interference. *Aging, Neuropsychology, and Cognition*, 1, 29-44.

Ulatowska, H. K., & Olness, G. S. (2004). Discourse. In R. D. Kent (Ed.), *The MIT encyclopedia of communication disorders* (pp. 300-302). Cambridge, MA: The MIT Press.

Vigliocco, G., Vinson, D.P., Druks, J., Barber, H., & Cappa, S.F. (2011). Nouns and verbs in the brain: A review of behavioural, elctrophysiological, neuropsychological and imaging studies, 35, 407-426. DOI: 10.1016/j.neubiorev.2010.04.007.

Wechsler, D. (1997). *Wechsler Memory Scale*, 3rd Ed. San Antonio, TX: Psychological Corporation.

Whatmough, C., Chertkow, H., Murtha, S., Templeman, D., Babins, L., & Kelner, N. (2003). The semantic category effect increases with worsening anomia in Alzheimer's type dementia. *Brain and Language*, 84(1), 134-147.

Wingfield, A. & Stine-Morrow, E.A.L. (2000). Language and speech. In F.I.M. Craik & T.A. Salthouse (Eds.). *The handbook of aging and cognition* (2nd Ed), (pp. 359-416), Mahwah, NJ: Lawrence Erlbaum.

Wood, R., Baxter, P., Belpaeme, T. (2011). A review of long term memory in natural and synthetic systems. *Adaptive Behavior*, 20(2), 81-103.

Wright, H. H., & Capilouto, G. J. (2009). Manipulating task instruction to change narrative discourse performance. *Aphasiology, 23*, 1295-1308.

Yoon, C., Feinberg, F., Hu, P., Gutches, A. H., Hedden, T., Chen, H. M., Park, D. C. (2004). Category norms as a function of culture and age: Comparisons of item responses to 105 categories by American and Chinese adults. *Psychology and Aging, 19*(3), 379-393.

Zwaan, R.A. & Radvansky, G.A. (1998). Situation models in language comprehension and memory. *Psychological Bulletin*, 123(2), 162-185.

Table 1

Participants Demographic Information

	Groups	
	Impaired (N = 12)	**Control (N = 12)**
Age	77.33 (9.04)	74.00 (5.48)
Gender (M:F)	6:6	5:7
Race		
African-American	6	4
White	6	8
Education	12.00 (3.08)	14.58 (2.11)
GDS[1]	N/A	0.83 (1.75)
MMSE[2]	N/A	28.55 (1.21)
DRS-2[3]	4.25 (3.36)	N/A

[1]Geriatric Depression Scale; [2]Mini-Mental State Exam; [3]Dementia Rating Scale - 2

Table 2

Test of Between-Subject Effects

		Mean (SD)	*F*	*p*-value	η2
% of Microlinguistic Errors	Impaired	9.17 (4.46)	12.075	.003	.389
	Control	3.96 (1.66)			
% of Living Things	Impaired	36.88 (7.91)	1.057	.317	.053
	Control	34.17 (2.77)			
% of Light Verbs	Impaired	25.02 (10.97)	1.691	.209	.082
	Control	20.02 (5.42)			
% of Macrolinguistic Errors	Impaired	32.73 (21.86)	9.351	.006	.330
	Control	10.70 (6.53)			
Thematic Elements	Impaired	29.91 (15.68)	4.782	.041	.201
	Control	42.70 (10.264)			
Thematic Actions	Impaired	24.75 (19.84)	17.648	.0005	.482
	Control	57.00 (10.47)			

Table 3

Component Matrix

Semantic Test	**Component 1**
Pyramid and Palm Tree Test	.757
Category Fluency for Animals	.914
Category Fluency for Tools	.928
Boston Naming Test	.961

Table 4

Pairwise T-Test Between Groups

	Group	Mean (SD)	t-score	p-value
Age	Impaired	77.33 (9.04)	1.092	.298
	Control	74.00 (5.48)		
Education	Impaired	12.00 (3.07)	-2.034	.067
	Control	14.58 (2.11)		
Lexical Diversity (MATTR*)	Impaired	0.89 (0.04)	-2.045	.066
	Control	0.91 (0.02)		
# of Words	Impaired	1157 (1139)	0.348	.735
	Control	1036 (322)		
# of Utterances	Impaired	138 (136)	0.667	.519
	Control	110 (36.85)		
Time (mm:ss)	Impaired	14:28 (13:50)	1.464	.171
	Control	8:08 (3:09)		
Nouns	Impaired	212.17 (299.91)	.148	.885
	Control	199.25 (66.25)		
Verbs	Impaired	115.25 (77.28)	-.006	.996
	Control	115.47 (35.35)		

*MATTR: Moving Average Type Token Ratio

Table 5

Cognitive Results for Individuals with A Cognitive Impairment

ID	DRS-2	Clinical Rating	Diagnosis	MMSE	PPTT	BNT	Anim als	Tools	Semantic Factor	WMS-III Episodic memory	WMS-III Working Memory
001	9	Borderline	N/A	21	44	9	15	10	.2502	93	79
002	2	Severe	AD	N/A	49	9	6	8	.0382	77	81
003	1	Severe	AD	N/A	46	7	8	5	-.3864	62	83
005	2	Severe	AD	N/A	36	3	2	1	-1.7595	N/A	N/A
006	3	Severe	AD	N/A	40	6	7	3	-.9716	51	66
007	1	Severe	AD	N/A	22	3	0	0	-1.3537	N/A	53
008	2	Severe	AD	N/A	44.5	13	14	13	.7235	73	63
009	5	Moderate	AD	N/A	49	11	13	9	.5428	93	99
010	9	Borderline	N/A	24	50	15	21	16	1.6675	109	108
011	7	Mild	AD	N/A	46	8	12	8	.0411	88	99
012	9	Borderline	N/A	24	49	14	22	9	1.1445	107	99
013	1	Severe	AD	N/A	48	12	7	5	.0633	N/A	81
Mean	4.25	N/A	N/A	N/A	43.62	9.17	10.58	7.25	-8.3E-06	83.67	82.81
(SD)	(3.36)				(7.96)	(3.99)	(6.85)	(4.71)	(.99)	(41.36)	(29.07)

Table 6

Pearson Correlation Matrix

	1	2	3	4	5	6	7	8	9	10
Semantic Scores	-	-	-	-	-	-	-	-	-	-
Episodic memory	.874**	-	-	-	-	-	-	-	-	-
Working Memory	.734**	.794*	-	-	-	-	-	-	-	-
DRS-2	.648**	.847**	.681*	-	-	-	-	-	-	-
% Microlinguistic	-.729**	-.676*	-.671*	-.151	-	-	-	-	-	-
% Living Things	-.815**	-.491	-.518	-.148	.724**	-	-	-	-	-
% Light Verbs	-.416	-.849**	-.312	-.047	.533**	.305	-	-	-	-
% Macrolinguistic	-.655*	-.868**	-.777**	-.143	.697**	.450*	.471*	-	-	-
Thematic Elements	.592*	.087	.019	-.120	-.365	-.599**	-.167	-.295	-	-
Thematic Actions	.801**	.772*	.691*	.070	-.591**	-.482*	-.392	-.823**	.646**	-

Note: * < .05; ** < .01

Figure 1

Adapted Construction Integrative Model of Discourse

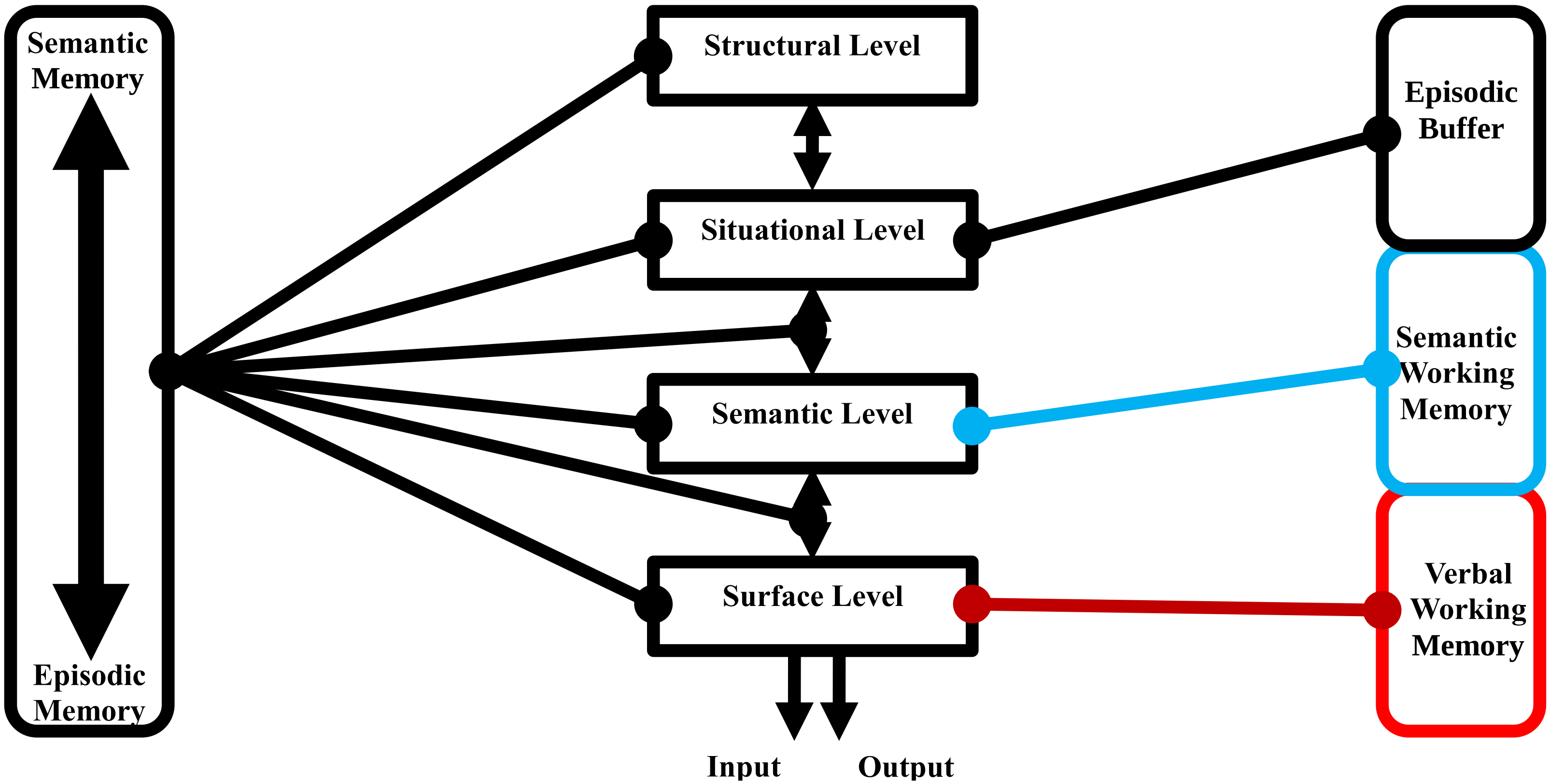


Figure 2

Cognitive Scores Converted to Z-score

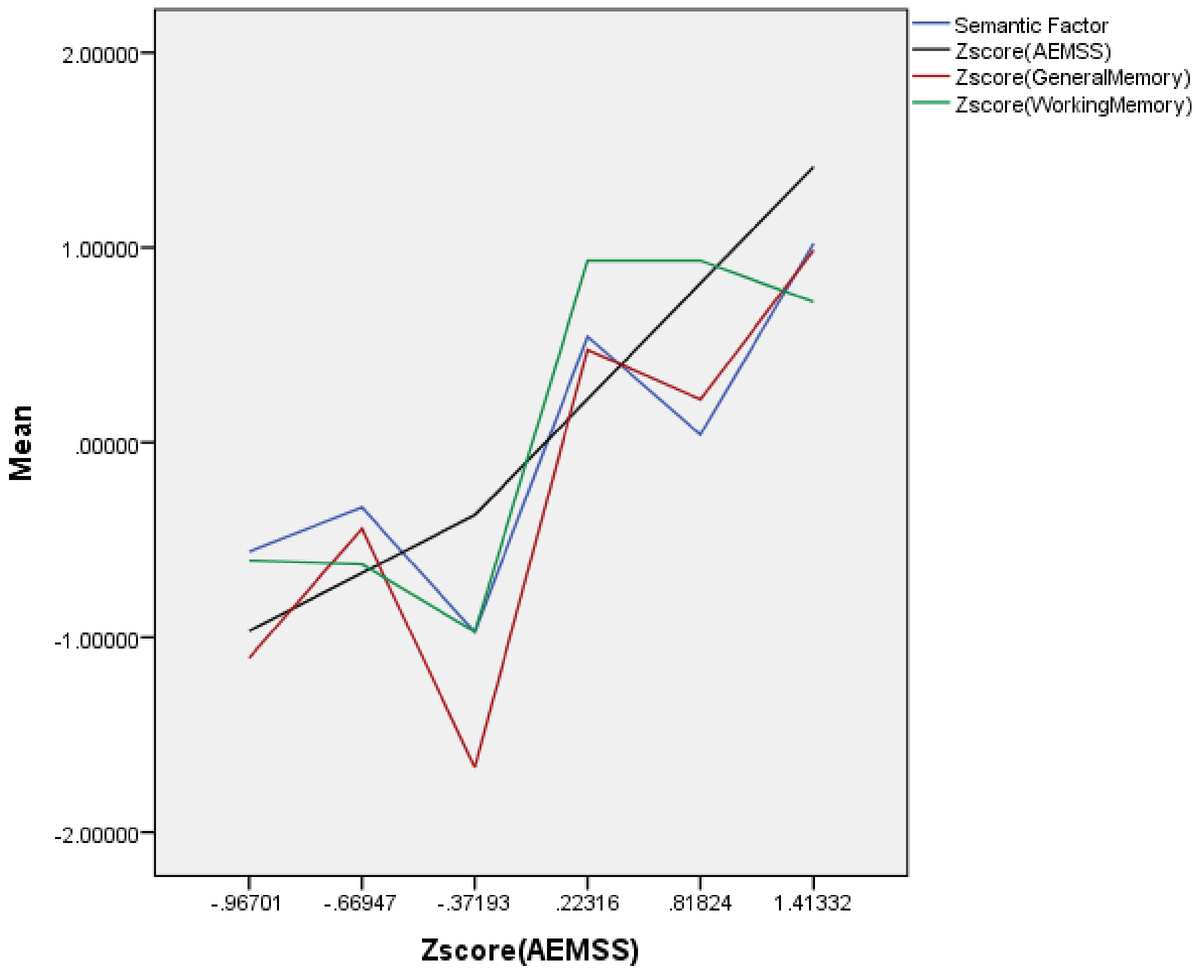


Figure 3

Percentage of Microlinguistic Errors (y) by DRS-2 Impairment Score

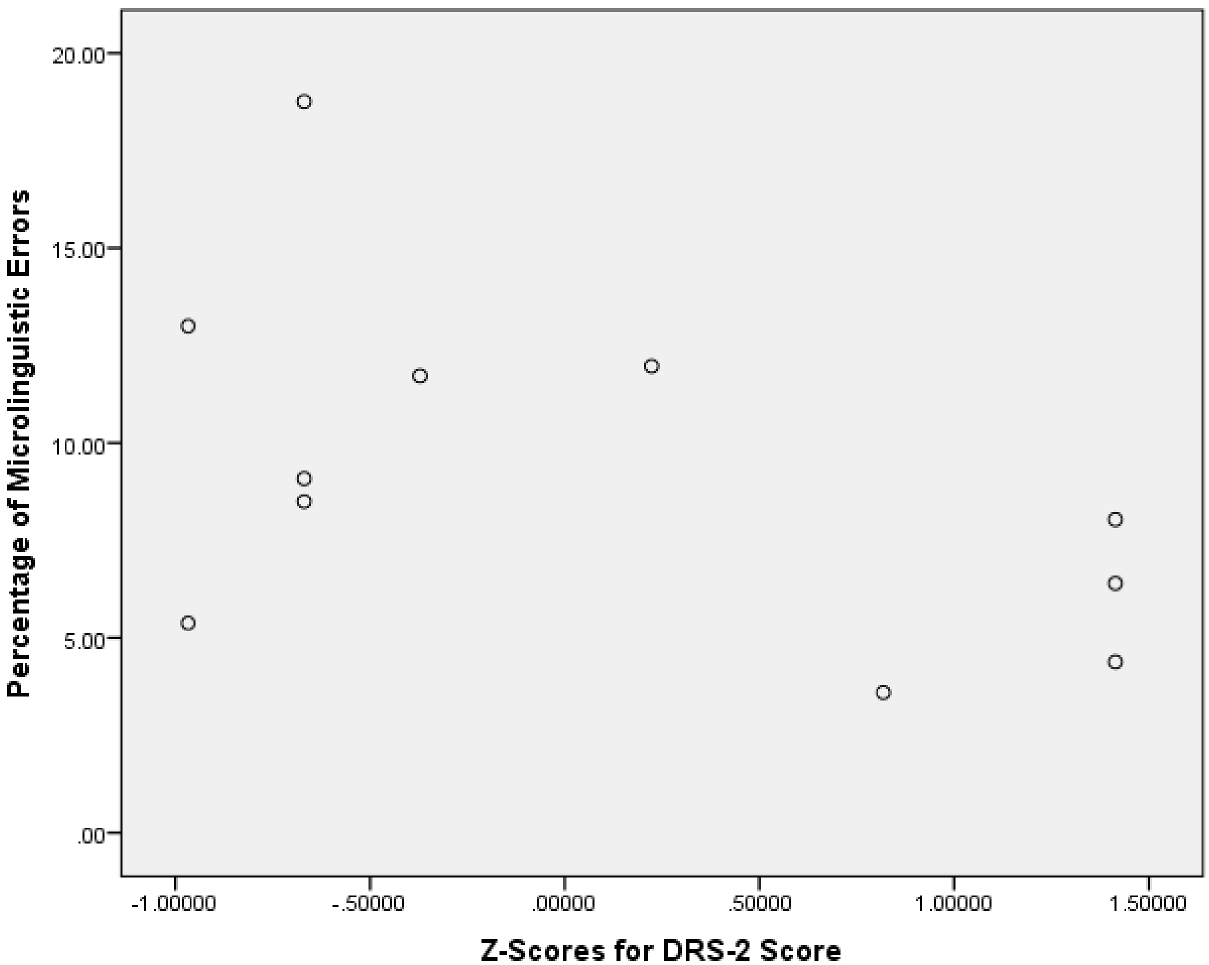


Figure 4

Percentage of Macrolinguistic Errors (y) by DRS-2 Score

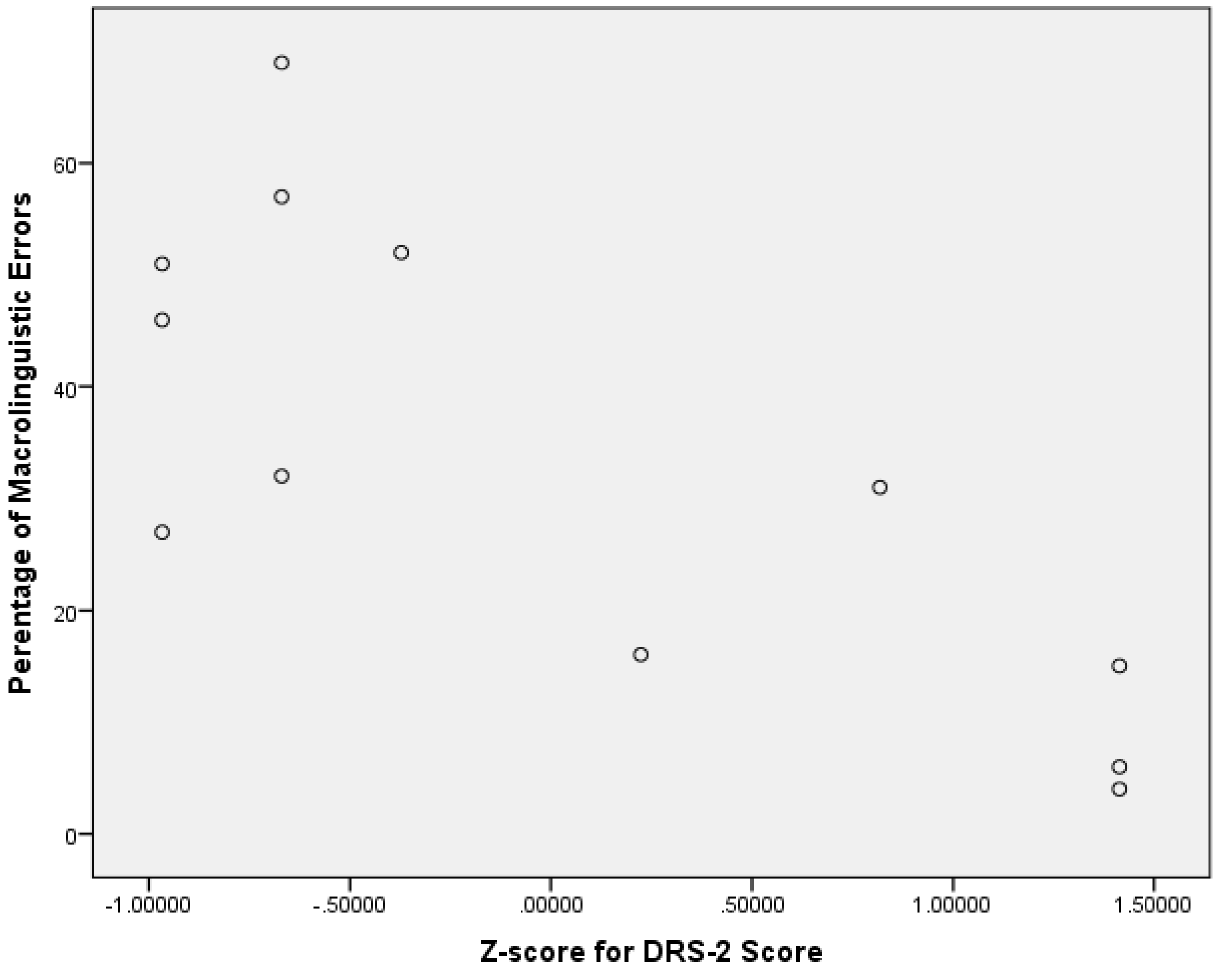
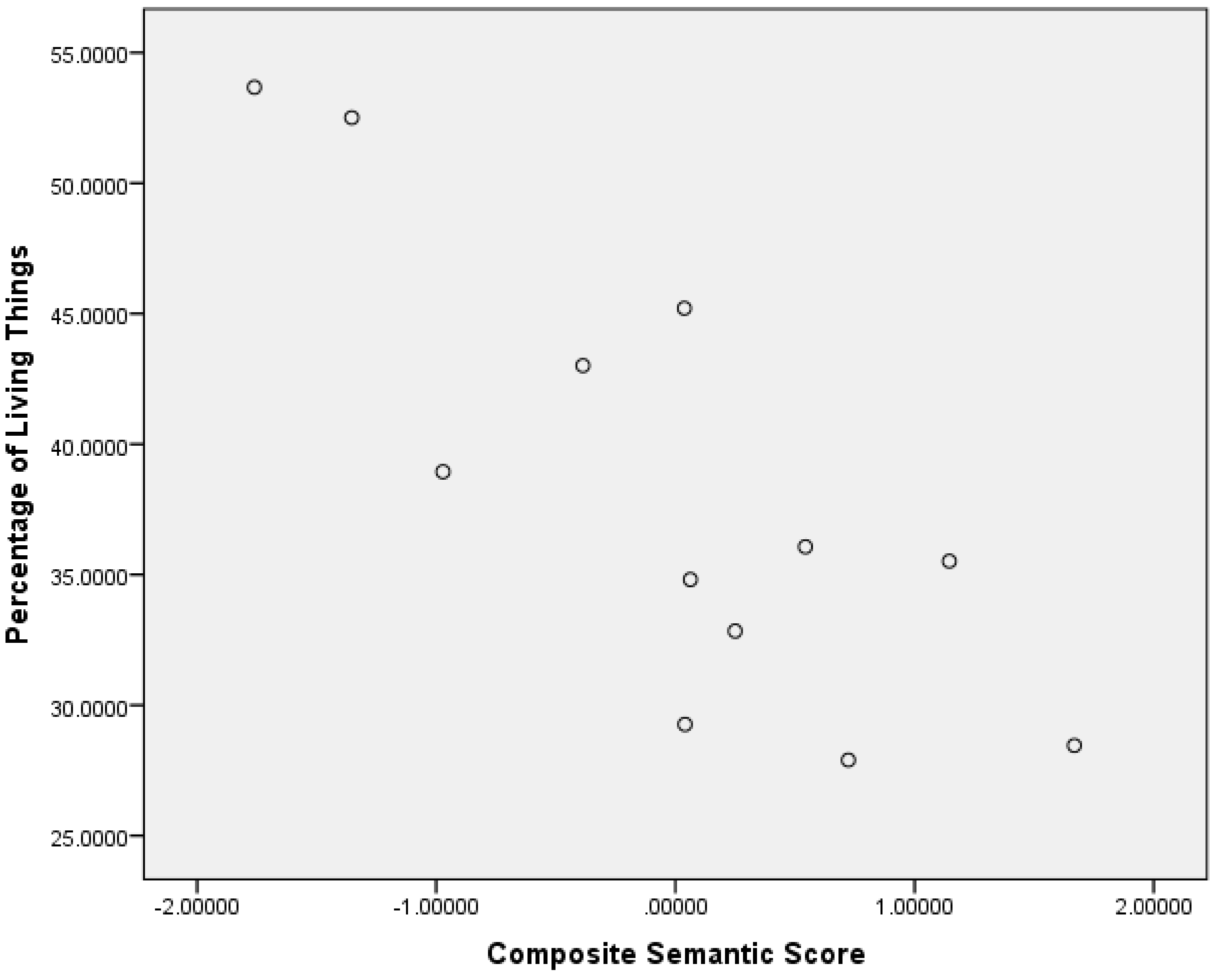


Figure 5

Scatterplot of percent living things (y) and semantic score (x)



APPENDIX A: IRAB APPROVAL LETTER

EAST CAROLINA UNIVERSITY
University & Medical Center Institutional Review Board Office
4N-70 Brody Medical Sciences Building· Mail Stop 682
600 Moye Boulevard · Greenville, NC 27834
Office **252-744-2914** · Fax **252-744-2284** · **www.ecu.edu/irb**

Notification of Amendment Approval

From: Biomedical IRB
To: Heather Wright
CC:

Date: 11/28/2016
Re:
UMCIRB 13-002423
Discourse and Cognition in Adults with Brain Injury

Your Amendment has been reviewed and approved using expedited review for the period of 11/26/2016 to 2/4/2017. It was the determination of the UMCIRB Chairperson (or designee) that this revision does not impact the overall risk/benefit ratio of the study and is appropriate for the population and procedures proposed.

Please note that any further changes to this approved research may not be initiated without UMCIRB review except when necessary to eliminate an apparent immediate hazard to the participant. All unanticipated problems involving risks to participants and others must be promptly reported to the UMCIRB. A continuing or final review must be submitted to the UMCIRB prior to the date of study expiration.The investigator must adhere to all reporting requirements for this study.

Approved consent documents with the IRB approval date stamped on the document should be used to consent participants (consent documents with the IRB approval date stamp are found under the Documents tab in the study workspace).

The approval includes the following items:

The Chairperson (or designee) does not have a potential for conflict of interest on this study.

IRB00000705 East Carolina U IRB #1 (Biomedical) IORG0000418
IRB00003781 East Carolina U IRB #2 (Behavioral/SS) IORG0000418
https://epirate.ecu.edu/App/Doc/0/DCKTE2SBSNU4J06F080QA98CCD/fromString.html

APPENDIX B: MULTILEVEL ERROR ANAYLSIS

Multilevel Error Analysis (Marini et al., 2005)

<u>Microlinguistic Measures</u>

False Starts: When the word is not finished (the word is left unfinished)

Example: I **&wa** want to the store.

Phonological Paraphasias: The substitution of a word with another word or non-word that preserves at least half of the segments and/or number of syllables of the intended word

Example: The mice wanted to **heat [: eat]**

Neologisms: A substitution of a word for a gibberish word

Example: she had all her **gɹæstɪdʒɪz@u**

Lexical Fillers: When a word or phrase adds no meaning to the story.

Example: the mouse ran **I think** into the forest *

Repetitions: When a word or phrase is repeated

Example: He felt a **little little** scared

Semantic Paraphasias: The substitution of a word on the basis of a meaning between the two words

Example: The mice got into the **van [: truck]**

Passe-partout words: The substitution of a word for a general referent (*something, someone, somehow)*

Example: There is **something** on the table

Substitution of Function Words: When a function word is changed for another function word

Example: The girl fell **into** the truck

Substitution of bound Morphemes: Typically the incorrect tense or plurality.

Example**:** They will **eats** the sandwiches and cupcakes.

Ambiguous Referent: When the listener cannot tell what 'he'/'she'/'it' refers.

Example: and the truck keeps going but **_____** doesn't even know that she has fallen off .

<u>Macrolinguistic Measures</u>

Filler Utterances: When a filler extends to the whole utterance. Often this will be cases of the participant giving their own commentary on the story.

Example: **What a beautiful day the mice are having**

Repetitions of Utterances: When an utterance is repeated

Example: **I ran into the tree. I ran into the tree.**

Conceptually Incongruent Utterances: When an utterance or phrase does not make sense within the context of the story.

Example: the mice abandoned the baby because they deeply hated her face.

Tangential Utterances: A phrase or utterance that is off-topic/doesn't relate to the stimulus.

Example: The mouse went to the store. **I need bread for my dinner party on Friday**

APPENDIX C: THEMATIC UNITS FORM

Picnic

Essential Elements		Essential Actions	
mice/family		**going on** *a picnic*	
bigger/adult mice		**load/pack/get** in *truck*	
smaller/children mice		**driving/going/moving up** *the road*	
little/baby mouse		*little mouse* **falls out**	
truck		**left behind/abandoned/didn't notice**	
picnic/lunch		**arrive/unload/set-up** at the *picnic site*	
road/path/mountain/hill		*smaller/children mice* **play**	
grass field/picnic area		*little mouse* **crying/sad/lonely**	
berries/raspberries		*little mouse* **stands up/looks around**	
		little mouse **finds/sees** *berries/raspberries*	
		adult mice **calls/beckons for dinner**	
		little mouse **eats** *berries*	
		adult mice **realize little mouse is missing**	
		mice/family **search/look for** *little mouse*	
		mice/family **pack up/load up/go to** *truck*	
		little mouse **lying down/sick**	
		mice/family **driving/searching road/calling**	
		little mouse **hears/heads towards** *road*	
		family/mice **reunite/find/see each other**	
		family/mice **excited/happy to reunits**	
		family/mice **have a picnic**	
ESSENTIAL TOTAL	0		0
Detailed Elements		**Detailed Actions**	
house		*truck* ***hits/bounces***	
grass/grasses/field		*adult mouse* **carries** picnic *basket/blanket*	
tress/forest		*smaller/children mice* **pick flowers**	
flowers		*smaller/children mice* **play ball**	
blue sky/clouds		*smaller/children mice* **walk to/stand on** *pier*	
pink doll		*smaller/children mice* **rolls a tire**	
baseball bat/glove/baseball		*smaller/children mice* **jump in lake**	
thermos		*adult mice* **plays banjo**	
picnic basket		*adult mice* **takes pictures/uses camera**	
picnic blanket		*adult mice* **watch/sit on picnic blanet**	
hat/cane		*smaller/children mice* **eat watermelon**	
glasses		*smaller/children mice* **jump in lake**	
bump/rock in road		*smaller/children mice* **play with sailboat**	

truck bed		*adult mice* **pours milk**	
banjo		smaller/children mice **come/sit in line**	
lake/pond		*family/mice* **look/search under rocks**	
pier		*family/mice* **look/search in tall grass**	
silverware		*family/mice* **look/search pond**	
salad		*smaller/children mice* **crying**	
watermelon		*Little mouse* **leaves pink doll behind**	
milk		family/mice **jump/somersault/hug**	
sandwiches		*little mouse* **returns to pink doll**	
cheese			
milk jug			
bread			
sailboat/boat			
ants			
DETAIL TOTAL	0		0
ELEMENT/ACTION TOTAL	0		0
<u>TOTAL</u>	**<u>0</u>**		

Pancakes for Breakfast

<u>Essential Elements</u>		**<u>Essential Actions</u>**	
woman/old lady		*woman/old lady**wakes up/rises/gets out of bed***	
pancakes		*woman/old lady* **thinks about pancakes**	
recipe/cook book		*woman/old lady* **reads/gets** *recipe/cook book*	
eggs basket		*woman/old lady* **sifts/mixes flour/ingrediants**	
chicken coop/hen house		*woman/old lady* **realizes no eggs**	
eggs		*woman/old lady* **goes to chicken coup**	
milk pitcher		*woman/old lady* **collect eggs**	
cow		*woman/old lady* **realizes there is no milk**	
pail/bucket of milk/milk		woman/old lady **goes out to the barn**	
churn		woman/old lady **milks the cow**	
butter		woman/old lady **churns/makes milk into butter**	
syrup		woman/old lady **realizes there is no maple syrup**	
aroma		woman/old lady **buys maple syrup**	
neighbor's house		woman/old lady **thinks of pancakes on way home**	
Neighbors\husband and wife\people		woman/old lady **enters house and drops syrup**	
		dog and cat **destroyed/ruined the kitchen/ingredient**	
		woman/old lady **thinks she has lost her pancakes**	
		woman/old lady **smells an aroma**	
		woman/old lady **goes to neighbor’s house**	

		woman/old lady **eats pancakes at neighbors**	
		woman/old lady, cat, and dog **take a nap by the stove**	
ESSENTIAL TOTAL	0		**0**
Detailed Elements		**Detailed Actions**	
house		**Sun rises**	
sunrise		cat and dog **watch/sit by her**	
snow		woman/old lady **washes up**	
trees		woman/ old lady **puts on her apron**	
fence		woman/old lady **gets book from shelf**	
bed		woman/old lady **gets necessary items for pancakes**	
cat		woman/old lady **puts on her bonnet**	
dog		dog **watches through the window**	
candle/candle holder		woman/old lady **gets the milk pitcher**	
picture/frame/photo		woman/old lady **puts on shawl/grabs bucket**	
washbasin/sink		cat **watches her milk the cow**	
towel/clothes rack		woman/old lady **returns inside**	
window		woman/old lady **pour milk into pitcher**	
apron		cat **watches her /licking its lips**	
bookshelf		woman/old lady **removes the cream puts it in bowl**	
cookie jar/tea cups/tea pot/jars		woman/old lady **puts cream into the churn**	
kitchen		woman/old lady **removes butter into bowl**	
pots and pans		woman/old lady **goes to cupboard**	
table		woman/old lady **wears/puts on red shawl and hat**	
mixing bowl		woman/old lady **goes to neighbor for syrup**	
sifter		woman/old lady **break the eggs**	
flour		woman/old lady **mix the batter**	
backing powder		woman/old lady **pour the batter**	
Ice box/Refrigerator		woman/old lady **flip the pancakes**	
egg basket		cat **licking the milk**	
bonnet		dog **eating the eggs**	
chickens\hens		neighbors **open the door**	
door		neighbors **are cooking pancakes**	
shawl		woman/old lady **eats most of their pancakes**	
stool			
cream			
clock			
cupboard			
hat			
purse/pocketbook			

maple tree			
spatula			
heater			
chair/walking chair			
hay			
stove			
DETAILED TOTAL	0		
ELEMENT/ACTION TOTAL	0		0
TOTAL	**0**		0