

EVALUATION OF A READING COMPREHENSION STRATEGY PACKAGE TO
IMPROVE READING COMPREHENSION OF ADULT COLLEGE STUDENTS
WITH ACQUIRED BRAIN INJURIES

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DISSERTATION ABSTRACT

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Title: Evaluation of a Reading Comprehension Strategy Package to Improve Reading Comprehension of Adult College Students with Acquired Brain Injuries

Adults with mild to moderate acquired brain injury (ABI) often pursue post-secondary or professional education after their injuries in order to enter or re-enter the job market. An increasing number of these adults report problems with reading-to-learn. The problem is particularly concerning given the growing population of adult survivors of ABI. Combat-related brain trauma and sports concussions are two factors contributing to increases in traumatic brain injuries, while higher incidences of stroke in young adults and better rates of survival after brain tumors are contributing to increases in non-traumatic brain injuries. Despite the rising need, empirical evaluation of reading comprehension interventions for adults with ABI is scarce. This study used a within-subject design to evaluate whether adult college students with ABI with no more than moderate cognitive impairments benefited from using a multi-component reading comprehension strategy package to improve comprehension of expository text. The strategy package was based on empirical support from the cognitive rehabilitation

literature that shows individuals with ABI benefit from metacognitive strategy training to improve function in other academic activities. Further empirical support was drawn from the special education literature that demonstrates other populations of struggling readers benefit from reading comprehension strategy use. In this study, participants read chapters from an introductory-level college Anthropology textbook in two different conditions: strategy and no-strategy. The results indicated that providing these readers with reading comprehension strategies was associated with better recall of correct information units in two free recall tasks: one elicited immediately after reading the chapter, and one elicited the following day. The strategy condition was also associated with better efficiency of recall in the delayed task and a more accurate ability to recognize statements from a sentence verification task designed to reflect the local and global coherence of the text. The findings support further research into using reading comprehension strategies as an intervention approach for the adult ABI population. Future research needs include identifying how to match particular reading comprehension strategies to individuals, examining whether reading comprehension performance improves further through the incorporation of systematic training, and evaluating texts from a range of disciplines and genres.

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CHAPTER I

INTRODUCTION

Adult survivors of acquired brain injury (ABI) often enroll in post-secondary or professional education after their injuries in order to establish, resume, or change career paths (Ackerman, DiRamio, & Mitchell, 2009; Kennedy, Krause, & Turkstra, 2008; Stewart-Scott & Douglas, 1998). An increasing number of these adults are facing educational failure because they have problems with academic reading activities (Kennedy et al., 2008; MacLennan & MacLennan, 2008; Sohlberg, Fickas, & Griffiths, 2011).

In an electronic survey about college students' experiences after traumatic brain injury, 83% of the respondents reported having difficulty with academics since their injuries (Kennedy et al., 2008). In particular, these individuals struggle with skills needed for reading comprehension (Kennedy et al., 2008; Schmitter-Edgecombe & Bales 2005; Sullivan, Griffiths, Sohlberg & Fickas, submitted). Thirty-four out of the thirty-five respondents in the Kennedy and colleagues survey cited needing to review material more than they needed to prior to their injuries (2008). More than half indicated being overwhelmed or having difficulty paying attention when studying, and not understanding assignments (Kennedy et al., 2008).

The problem is further compounded by the fact that the incidence of both traumatic and non-traumatic acquired brain injuries in young and middle-aged adults is growing (Faul, Xu, Wald, & Coronado, 2010; Gilchrist, Thomas, Xu, McGuire, &

Coronado, 2011). Multiple factors are contributing to this growth, including recreation and sports concussions, combat-related injuries, rising rates of stroke and meningitis in young adults, as well as improved survival rates overall from acquired neurological issues (Adler, Possemato, Mavandadi et al., 2011; George, Tong, Kuklina, & Labarthe, 2011; Gessel et al., 2007; Gilchrist et al., 2011; Harrison, 2010; Hoge et al., 2008).

Responding to the needs of this population requires overcoming several barriers in the knowledge base. A primary barrier is the lack of consensus about the processes involved in reading comprehension for proficient readers (McNamara & Magliano, 2009; RAND Reading Study Group, 2002; Sadoski & Paivio, 2007). The RAND Reading Study Group (RRSG, 2002), comprised of fourteen reading experts representing a range of disciplines and research methodologies, convened to develop a reading research agenda that would ultimately lead to effective methods to improve reading comprehension of students. The group determined that despite a large body of research on the process of reading comprehension, “those research efforts have been neither systematic nor interconnected,” and as such, was “insufficient in providing a basis to redesign reading comprehension instruction” (2002; pg 2).

To help facilitate an organized, more cohesive, and practical approach to reading comprehension research, the RRSG offered a characterization of reading comprehension that builds on the “sizeable but sketchy” knowledge base to remind researchers about the multiple factors that must be considered. They first defined reading comprehension “as the process of simultaneously extracting and constructing meaning through interaction

and involvement with written language” (RRSG, 2002, pg. 11). The group emphasized that researchers must consider the dynamic interaction between three elements: the reading activity, the text, and the reader—all of which takes place within a larger sociocultural process.

Another limitation in the knowledge base is the lack of understanding of how cognitive impairments in adults with ABI contributes to difficulties with reading comprehension impairments (Lezak, 1995; Lezak, Howieson, & Loring, 2012; Lundberg, 1991; Sohlberg & Turkstra, 2011). The profiles of impairments within the population of adults with ABI are diverse (Lezak, 1995; Sohlberg & Mateer, 2001; Sohlberg & Turkstra, 2011). Many adults with ABI report that they can read for most purposes, but struggle with more complex reading activities such as reading to learn (Griffiths, Sohlberg, Samples, Dixon, & Close, 2010; Lezak, 2012; Salmen, 2004; Sohlberg & Turkstra, 2011). This current study focused on adults who experience these reading comprehension problems in the absence of clinically significant language impairments such as aphasia or frank visuospatial deficits.

Cognitive impairments, the hallmark sequelae after acquired brain injuries, have the potential to impact reading comprehension (Lezak, 1995; Schmitter-Edgecombe, & Bales, 2005; Sohlberg & Turkstra, 2011). Understanding the cognitive underpinnings in the proficient reader, and how impairments in these processes can affect the reading comprehension process, is important for helping readers with acquired brain injuries (Schmitter-Edgecombe, & Bales, 2005; Sohlberg & Turkstra, 2011). Common cognitive

impairments in the ABI population include deficits in focused and controlled attention, working memory, verbal learning and recall, and executive processing functions, all of which have are important for reading comprehension (Lezak, 1995; Lezak et al., 2012; Sohlberg & Mateer, 2001).

Understanding the relevant cognitive processes in proficient readers, and how impairments in these processes can affect reading comprehension, requires utilizing reliable and valid assessment tools. These tools must represent the complexity of the reading comprehension process (Fletcher; 2006; Pearson & Hamm, 2005; Sweet, 2005). Ideally, these tools will differentially measure processes that contribute to reading comprehension, such as different cognitive functions, word recognition abilities, and background knowledge (Fletcher, 2006; Pearson & Hamm, 2005; Sweet, 2005).

Unfortunately, another barrier facing reading research and intervention is the paucity of validated reading comprehension tools (Pearson & Hamm, 2005; RRSF, 2002; Sweet, 2005). Tests designed specifically for reading assessment of adult neurological population, such as the *Reading Comprehension Battery for Aphasia (RCBA)*; LaPointe & Horner, 1998) focus only on the contribution of linguistic impairments to reading, and do not evaluate comprehension beyond four paragraphs. Other tests of reading comprehension available for adult populations such as the *Nelson Denny Test of Reading* (Brown, Fisco, & Hanna, 1993) only serve the purpose of predicting academic performance, not pinpointing breakdowns in the reading comprehension process (Morse, Kieffer, & Snow, 2010). Measures grounded on theoretical models of reading

comprehension could help identify specific breakdowns in the reading comprehension process. Such information is necessary for understanding similarities and differences between adult readers with ABI and other populations, and more importantly, guide intervention research and development.

Given the aforementioned barriers—the gaps in knowledge about the reading comprehension process in proficient readers, the even sparser evidence about the cognitive underpinnings for reading comprehension, and the challenge of assessing proficient and impaired reading comprehension—the lack of research specifically evaluating reading comprehension interventions designed for adults with ABI is not surprising. In the absence of direct evidence, the foundation for developing reading comprehension interventions can start with evidence from studies that compare reading behaviors of proficient readers and poor readers (Graesser, McNamara, & Louwerse, 2003; Paris, & Myers, 1981; Perfetti, 1985). Proficient readers typically approach reading-to-learn strategically to organize, evaluate and retain information throughout the reading comprehension process; poor readers in comparison often do not demonstrate evidence of strategy use when reading-to-learn (Biancarosa & Snow, 2004; Paris & Myers, 1981).

Evidence from regular and special education supports teaching students to use a repertoire of reading comprehension strategies to improve reading comprehension performance (Berkeley, Scruggs, & Mastropieri, 2010; Biancarosa & Snow, 2004; Edmonds et al., 2009; Gajria, Jitendra, Sood & Sacks, 2007; Lee & Spratley, 2010;

Swanson, 1999). Key to successful use of reading comprehension strategies is the ability to self-monitor understanding and self-regulate the use of strategies (Graesser, 2007; Graesser et al., 2003; Lee & Spratley, 2010; Paris & Myers, 1981). Metacognitive strategy training is a well-validated approach used within cognitive rehabilitation that targets other high-level cognitive functions, including academic functions (Kennedy & Coelho, 2005; Kennedy et al., 2008; Sohlberg & Turkstra, 2011). By teaching clients to follow a series of steps that facilitate self-monitoring of understanding when engaged in learning activities, academic performance is enhanced (Butler et al., 2008, Kennedy & Coelho, 2005; Kennedy et al., 2008; Sohlberg, Ehlhardt & Kennedy, 2005; Sohlberg & Mateer, 2001).

The purpose of this study was to examine whether the use of a reading comprehension strategy package improved the reading comprehension performance of adults with ABI. The study focused on expository texts, a type of text used across all disciplines for academic learning and therefore critical to the target population attempting to return to school or training (Biancarosa & Snow, 2004; Lee & Spratley, 2010; RRSB, 2002). The development of the reading comprehension strategy package for this study was based on current reading comprehension theory and current research characterizing cognitive impairments in the ABI population. To evaluate the effect of strategy use, adults with ABI read expository text in two conditions: with reading comprehension strategies (RS) and without (NS). A within-subject design was conducted using free verbal recall and sentence verification tasks to evaluate reading comprehension performance in each condition.

The next chapter begins by providing a comprehensive characterization of the population of adults with acquired brain injuries at risk for reading comprehension problems. This is followed by a description of reading comprehension theory relevant to guiding the development of reading comprehension intervention. Next, research findings are reviewed from cognitive rehabilitation and special education literature to inform the selection of theoretically grounded reading strategies potentially useful to this population. The chapter concludes by describing the design of the RS condition and previous research conducted to pilot the intervention.

In Chapter III, the methods for the research study are detailed. This chapter begins with an account of the preliminary process completed to select, develop and validate reading materials and dependent measures used in the study. The chapter continues with a description of the experimental design and an in-depth description of procedures. Chapter IV presents the study data and the results of statistical analyses. The final chapter provides an interpretation of the results, and discussion of the implications of the findings for assisting adults with reading comprehension deficits following acquired brain injury.

CHAPTER II

REVIEW OF THE LITERATURE

Population: Adults with Acquired Brain Injury

This focus of this study is adults with reading comprehension problems after acquired brain injury (ABI). ABI can occur from a number of causes that generally fall into two categories: traumatic brain injuries (TBI) and non-traumatic brain injuries (Brain Injury Association of America of America, n.d; BIAA). Traumatic brain injuries are those sustained via external damage to the head such as from falls, sports concussions, gunshot wounds, or motor vehicle accidents (Lezak, 1995; Lezak et al., 2012; Luria, 1975). Non-traumatic injuries are those acquired from other sources of neurological damage. Examples from this category include medical issues such as brain tumors or strokes; toxicity such as from poisoning or drug overdoses; or deprivation of oxygen to the brain (i.e. anoxia) such as from near-drowning (Lezak, 1995; Lezak, et al., 2012; Luria, 1975). Additional non-traumatic neurological damage can also result from medical interventions such as chemotherapy and radiation, or surgical interventions (Butler et al., 2009; Lezak, et al., 2012).

Given the diverse mechanisms of injury, the impairment profiles of adults with ABI are also diverse. A common problem following ABI with the potential to impact reading comprehension is cognitive impairments (Lezak, 1995; Lezak, et al., 2012; Sohlberg & Turkstra, 2011). Cognitive impairments include problems with attention, working memory, and executive functions (Lezak, et al., 2012; Sohlberg & Mateer, 2001). These key cognitive functions are critical in the selection and organization of

incoming information; in the retrieval and transfer of information to and from long-term memory; and in the active manipulation, integration, and construction of information (Lezak, et al., 2012; Sohlberg & Mateer, 2001).

Individuals with impaired attention from acquired brain injury may have difficulty focusing on tasks, selecting relevant stimuli, sustaining attention over time, or alternating attention between multiple stimuli (Sohlberg & Mateer, 2001). Problems with working memory may challenge individuals' abilities to retain incoming content long enough to do something meaningful with it; working memory deficits may also involve an inability to suppress or "clear" irrelevant information ultimately exhausting available capacity (Baddeley, 2000; 2002; Lezak, 1995; Lezak et al., 2012; Sohlberg & Turkstra, 2011). Executive dysfunction may impair individuals' abilities to self-monitor thinking and behavior, and/or to self-regulate goal-directed behaviors (Kennedy & Coelho, 2005; Lezak et al., 2012; Sohlberg & Mateer, 2001).

Deficits in attention, working memory and executive processes may stem from a variety of mechanisms of injury with damage to diverse areas of the brain (Lezak et al., 2012). For the purposes of reading to learn, attention, working memory and executive functions are interdependent; they are all required for the selection and organization of incoming information; the retrieval and transfer of information to and from long-term memory; and the active manipulation, integration and construction of information (Baddeley, 2000; Lezak et al., 2012).

The reading comprehension intervention developed and evaluated in the current study aimed to compensate for the effects of cognitive impairments on reading to learn.

However, a number of other factors can and do contribute to difficulties with reading comprehension. Other impairments that occur following ABI and can affect reading include difficulties with visual recognition, visual scanning, and spatial neglect (Damasio & Damasio, 1983; Friedman, Wenn, & Albert, 1993; Hynd & Hynd, 1984; Riddoch, 1990); and impaired language, particularly semantic comprehension and word recognition (Bachman & Albert, 1988; Friedman et al., 1993). In addition to neurological impairments, reading comprehension may be impacted by ongoing somatic issues such as chronic pain, psychosocial factors such as post-traumatic stress disorder and depression (Hoge et al., 2008). Other factors such as level of background knowledge, motivation for reading or attending school, and availability of supports can also impact reading comprehension performance (Ackerman et al., 2009; Biancarosa & Snow, 2004; Lee & Spratley, 2010).

The focus of this study was on adults with acquired brain injury who currently experience problems with reading comprehension that could not be explained by the presence of linguistic or visual deficits.

Comprehension Theory: Structure Building Framework

What happens during the reading comprehension process varies depending on the characteristics of three elements: the reader, the text and the activity, and the sociocultural context where those elements interact (RRSG, 2002). This study evaluated an intervention designed to assist (a) adult readers with acquired brain injury, (b) reading expository text, (c) for the purposes of learning new content—as would be expected in post-secondary academic contexts. The RAND Reading Study Group stressed that

researchers must incorporate all three elements in their studies while also grounding research in available theory, even as the models continue to evolve (2002). Theoretical models should be logically sound and empirically validated (RRSG, 2002; Sadoski & Paivio, 2007). Particularly important for intervention research, theoretical models should also be clinically useful for framing the selection and evaluation of intervention components (RRSG, 2002; Sadoski & Paivio, 2007).

Ideally, a model would conceptualize reading comprehension of expository text, and be validated on a range of populations that included both skilled and unskilled readers. Even more, the ideal model would account for individual differences within the ABI population and take into account other important aspects of the sociocultural context that could influence reading. This ideal model would conceptualize the entire process in such a way that points of entry for intervention could be identified, and that support the rationale for why a proposed intervention might work. A single model that meets these criteria does not exist thus it was necessary to integrate theory across models.

Perhaps the most seminal reading model from the cognitive psychology literature is the construction-integration model (CI model; Kintsch, 1988, 1998). The CI model conceptualizes comprehension occurring in two phases: construction and integration (Kintsch, 1988, 1998). The construction phase of the CI model begins through bottom-up activation of propositions in long-term memory by incoming propositions that have overlapping arguments with prior knowledge. With continued incoming information, activation spreads to entire networks—or schemas—of specific content knowledge stored in long-term memory (Kintsch, 1988, 1998). Integration occurs in the CI model between

incoming content and existing background knowledge as similarities and differences either reinforce existing links or result in the formation of new links. The strength of the final activation, based on a connectionist algorithm, determines how well new content is stored in long-term memory (Kintsch, 1988, 1998).

A limitation of the CI model for intervention research is that validation has primarily focused on successful comprehenders (Kintsch, 1988, 1994, 1998). Although the model does explain why readers who have more background knowledge are better comprehenders than readers with less background knowledge (Kintsch, 1988, 1998; van Dijk & Kintsch, 1983); the model does not adequately account for differences in how good versus poor comprehenders *approach* reading, except to say that these readers have differences in background knowledge (Graesser, 2007). Despite a key assumption of the model that background knowledge includes knowledge of strategies required to accomplish different construction and integration processes, the description of how those strategies are employed is vague (van Dijk, & Kintsch, 1983; Graesser, 2007).

Multiple models have evolved from the seminal framework provided by the CI model more useful for intervention research (e.g. Gernsbacher, 1991; Goldman, Varma, & Cote, 1996; Graesser, Swamer, Baggett, & Sell, 1996; Zwann & Radvansky, 1998). The structure building framework (SBF) is one example (Gernsbacher, 1991, 1997). Like many models of comprehension, the goal of comprehension in the structure building framework is to build a coherent mental representation, or structure, of what is read. Coherence describes how all of the ideas of a text fit together to form a thematic whole (Halliday & Hasan, 1976; Hasan, 1984). When readers have a coherent understanding of

an expository text, they have a logical, organized understanding of what the main idea of a text was, and how ideas were presented to support that idea (Hasan, 1998; Long & Chong, 2001; Rapp, van den Broek, McMaster, Kendeou, & Espin, 2007). A coherent understanding of the text evolves over time at two different levels: globally and locally (Graesser et al., 2003; Kintsch, 2004; Lorch, 1995). The ability develop a coherent understanding of discourse is tied to the cohesiveness of the discourse. Local coherence develops through the use of cohesive devices, such as pronouns or conjunctions, to enable recognition of the relationship between common constituents between sentences in close proximity to one another (Graesser & Forsyth, 1997; Kintsch, 2004; Kintsch & van Dijk, 1978). Global coherence develops as ideas within a text are related to the overall theme or structure of the text; that is, the global cohesiveness (Graesser & Forsyth, 1997; Kintsch, 2004; Kintsch & van Dijk, 1978). The global cohesiveness of discourse occurs through the use of *macrostructural elements*. In narrative discourse macrostructural element, also known as story grammar components—include characters, the setting, a problem, and a resolution (Coelho, 2002).

According to the SBF, reading comprehension begins through the activation of memory nodes stimulated by incoming information (Gernsbacher, 1991, 1997). The structure building process then evolves through three component processes: (a) laying a foundation structure, (b) mapping incoming information onto the foundational structure, and (c) shifting to establish new structures when incoming information is less coherent with the previous information (Gernsbacher, 1991, 1997) .

The SBF is centered upon two general cognitive processes that dominate many connectionist theories of comprehension and cognition: enhancement and suppression (Gernsbacher, 1991, 1997). In the SBF these two processes serve as mechanisms for spreading or inhibiting activation during the process of building coherent mental structures. A particular appeal of the SBF is that the model has been validated with both good and poor comprehenders. A second appeal is that it describes the comprehension process in a way that suggests points of entry for intervention. A third appeal is that converging evidence provides a strong rationale for guiding the intervention development process, including studies of poor comprehenders within the context of this model, findings from other studies that characterize similarly impaired processes in adults with brain injuries, and outcome results on interventions that target these processes so may be helpful to this population.

Characteristics of good comprehenders in the SBF. Good comprehenders are able to form a coherent structural representation of a text (Gernsbacher, 1991, 1997; Graesser et al., 2003; Halliday & Hasan, 1976; Kintsch, 2004). As noted earlier, coherence is not a property of the text; a coherent understanding is what writers bring to the writing process as they write text, and what readers develop during reading process as they read the text; cohesive devices support this process (Halliday & Hasan, 1976; Graesser & Forsyth, 1997). The SBF describes how readers accomplish this goal.

Laying a foundation. Proficient readers begin the process of constructing a coherent understanding by laying a foundation. Laying a foundation means they establish a preliminary structure about the topic of the text (Gernsbacher, 1991,1997). As readers

begin reading, the incoming information stimulates activation of related memory nodes (Gernsbacher, 1991, 1997). Through enhancement and suppression processes this activation spreads to enable retrieval of relevant background knowledge and topic-specific schema (Gernsbacher, 1991, 1997).

Evidence for laying a foundation comes from studies that show that participants slow down when they encounter the first constituent of presented content (Aaronson & Ferres, 1983; Gernsbacher, 1996; Haberlandt, 1984). For example, they read the first sentence of a paragraph slower than the second sentence (Haberlandt, 1984). This phenomenon is the *advantage of first mention* (Gernsbacher, 1988). First mentioned elements are thought to be more accessible because they were used to lay the foundation for comprehension. Readers are more likely to consider the first sentence of paragraph as conveying the main idea, even when the theme is actually specified later in the paragraph (Gernsbacher, 1988; Kieras, 1981).

Mapping ideas onto the foundation. After laying a foundation, proficient readers continue the process of developing a coherent representation of the text by mapping relevant incoming information onto currently activated, existing structures (Gernsbacher, 1991, 1997). Proficient readers accomplish this by recognizing the markers of cohesion in the text (van den Broek, Risdien, & Husebey-Hartmann; 1995; Gernsbacher, 1991, 1997). The way sentences in a text are connected through overlapping ideas and other cohesive devices help readers construct a coherent understanding of the text (Halliday & Hasan, 1976). There are many types of cohesive devices; examples include the use of causal connectors, such as *because* or the use of pronouns to refer to previously mentioned

ideas. In the SBF, recognition of cohesion particularly supports the construction of local coherence (Gernsbacher, 1991,1997). Proficient readers map adjacent ideas onto currently activated structures to further develop and expand understanding (Gernsbacher, 1991, 1997).

Evidence from mapping comes from studies that show that proficient readers read coherent information faster than they read incoherent information (Anderson, Garrod & Sanford, 1983; Gernsbacher, 1996; Haviland & Clark, 1974). Readers also read causally related clauses conjoined by causal connectors (e.g. because) more quickly than causally related clauses not connected (e.g. I bought an umbrella. It was raining outside.).

Shifting to create structures. Information that does not include local markers of coherence (i.e. cohesion devices) would not be mapped onto currently activated structures (Gernsbacher, 1991, 1997). Such information may be irrelevant; proficient readers are able to suppress irrelevant information (Gernsbacher, 1991, 1997).

On the other hand, information not related to currently activated substructures may still be related to the overall theme of a text. In this case, rather than suppressing the information, proficient readers are able to shift away from currently activated structures or substructures to begin the process of building new structures or substructures (Gernsbacher, 1991, 1997). One way proficient readers recognize that content is related to the overall theme of the chapter is through macrostructural elements (Kintsch, & van Dijk, 1978; Lorch, 1995). Macrostructures are the elements within the text that form the overall organization of the text (Graesser, & Forsyth, 1997; Kintsch, & van Dijk, 1978). For example, a table of contents and headings provides a macrostructure to orient readers

to how the content of a text is organized. Proficient readers detect macrostructural elements (i.e. global cohesion devices) and reflect on this macrostructure as they read in order to construct global coherence (Graesser & Forsyth, 1997; Long & Chong, 2001). Good cohesion is necessary but not sufficient for good coherence.

As readers encounter information that does not fit the local structure but still relates to the global macrostructure of the overall theme of a chapter, they shift to construct new structures or substructures (Gernsbacher, 1991, 1997). Evidence for shifting comes from studies that show that when readers encounter content that changes the topic or point of view, they take longer to comprehend it (Anderson et al., 1983; Gernsbacher, 1997; Olson, Duffy & Mack, 1984). Additional evidence shows that information presented just before shifting is more difficult to recall than information presented afterwards; this evidence suggests that the former structure is no longer activated and that working memory is focused on the new structure (Anderson et al., 1983; Clements, 1979).

Characteristics of poor comprehenders in the SBF. A well-validated finding of the SBF is that poor comprehenders are inefficient at suppression (Gernsbacher, 1997; Gernsbacher & Faust, 1991; Gernsbacher, Varner, & Faust, 1999). According to the SBF, poor readers particularly struggle with mapping because they have difficulty suppressing irrelevant information. Overloaded with too much information, poor readers struggle to detect cohesive markers and macrostructural elements needed to formulate a coherent representation of the text. Because they are unable to see the relationships between ideas, poor readers do not map new overlapping information onto already activated structures.

Consequently, poor readers have a tendency to “overshift” (Gernsbacher, 1997; Gernsbacher et al., 1999). Unable to integrate incoming information with either locally or globally related content, they treat all information as new information. They may lay a foundation when they encounter new information, but they never map related information onto it. With each new foundation they lay, they forget content from previously activated structures.

Although suppression of irrelevant information cannot be directly targeted through self-regulation (e.g. try to forget the image of a pink elephant), evidence from studies of poor comprehenders shows poor readers benefit from enhancement of relevant information (Gernsbacher et al., 1999). Perhaps poor readers benefit from strategies that serve to enhance relevant content so that activation of the relevant content is greater than any inappropriate activation of irrelevant content.

Studies of poor comprehenders to validate the SBF have primarily been in highly controlled laboratory studies (e.g. Gernsbacher, 1997; Gernsbacher et al., 1999). One possibility not yet tested under the model is whether readers with limited background knowledge and/or impaired planning or organization may struggle to lay adequate foundations as they begin the reading process. In this case, the problem would not be related to difficulty suppressing. Instead, an adequate foundational structure may never be activated. Perhaps readers with these issues may benefit from strategies that ensure adequate activation of a foundational structure prior to encountering text.

Characteristics of adult readers with ABI. How does the reading comprehension performance of adults with ABI fit with the SBF theoretical framework?

Although specific cognitive processes are not addressed under the SBF, inefficient suppression could be related to a number of cognitive problems such as inattention, impaired working memory, and executive dysfunctions.

The very limited research that has investigated reading comprehension and cognition in adults with acquired brain injury does suggest a possible relationship between cognitive impairments and reading comprehension performance (Laatsch & Krisky, 2006; Schmitter-Edgecombe & Bales, 2005; Salmen, 2004; Sullivan et al., in submission). A study by Schmitter-Edgecombe and Bales (2005) compared think-aloud comments of readers with severe ABI to controls produced after reading each sentence of a narrative. Compared to controls, readers with ABI were more likely to be restricted to the content of the recently read sentence. These readers did not demonstrate integration of ideas across the narrative compared to controls. Researchers hypothesized differences in working memory contributed to the difference (2005).

From the perspective of the SBF, these findings align with findings of other poor comprehenders. Similar to other poor comprehenders, readers with ABI may also have difficulty mapping, or integrating, incoming information onto activated structures. This suggestion is corroborated by another study involving readers with ABI, *Strategies to Improve Reading* (STIR) (Sohlberg et al., 2011). The STIR study included a within-subject comparison of adult readers with ABI (n=17) in two conditions: with reading comprehension strategy prompts and without. Each participant read four 500-word expository science passages on netbooks with two passages linked to the strategy condition and two to the non-strategy condition. In the strategy condition, strategy

prompts were delivered at three different points in the reading process: before reading, during reading, and after reading. Before reading, readers were presented with the four main headings from the passage, then prompted to read each heading aloud. During reading, readers were prompted to highlight key ideas. Highlighted ideas were saved into an outline form. After reading readers were presented with the outline of their highlights and prompted to write a summary of their notes. Comprehension and retention of each passage were evaluated using a sentence verification task (SVT) and a free recall task.

No significant differences were found on the dependent variables between the strategy and the no-strategy conditions (Sohlberg et al., 2011). However, a post-hoc analysis revealed that readers were variable in their response to strategy prompts (Griffiths & Sohlberg, 2012; Sohlberg et al., 2011). For the post-hoc analysis, the scores on the no-strategy SVT were subtracted from the scores on the strategy condition SVT to obtain a difference score for each participant. Difference scores were then sorted from highest to lowest. Strategy usage of the five participants with the highest difference scores—high responders, and the five participants with the lowest difference scores—low responders—were compared. Of particular interest to this study was that the low responders highlighted substantially more information than the high responders (Sohlberg et al., 2011). This observation would be consistent with the idea in the SBF that the low responders could not discern between relevant and irrelevant information so treated all information as important. Furthermore, unlike high responders, low responders wrote fewer or no summaries of their highlights when prompted to do so (Sohlberg et al., 2011). From the perspective of the SBF, summarizing information should facilitate the

integration or mapping of information onto foundational structures. Multiple factors may be involved in why low responders did not write summaries

A study led by researchers at the Portland Veteran's Administration Medical Center and the University of Oregon investigated whether a history of mild concussion and current psychological distress contribute to difficulties in text level reading comprehension (Sullivan, Griffiths, Sohlberg & Fickas, in submission). Participants completed mental health questionnaires, a battery of cognitive and reading measures, and an experimental reading task designed to differentiate between different levels of text comprehension. Particularly interesting for this study were findings that showed inattention and speed of processing predicted reading comprehension performance on the *Nelson Denny Test of Reading* (Brown, et al., 1993). This finding and interpretation would be consistent with the profile of poor comprehenders described under the SBF. Inattention might correlate with disrupted suppression mechanisms. Inattention can lead to over selection of irrelevant stimuli that can challenge the capacity of working memory and increase demands for suppression.

Laatsch and Krisky (2006) provide further support for the suggestion that readers with TBI struggle with suppression during reading. These researchers examined the neurological activity during reading comprehension of three adult subjects with a history of severe TBI against matched controls using functional magnetic resonance imaging (fMRI). Particularly relevant to the current study is that neurological activity of the subjects with TBI was greater overall than the controls, and that more areas of the brain were activated. Although it is difficult to know if the greater activation represented a

problem with suppression, the finding does document differences in levels of activation between the control participants and the three participants with ABI.

More research has been conducted with adults with ABI evaluating other discourse-level processes (Brookshire, Chapman, Song, & Levin, 2000; Moran, Kirk, & Powell, 2012; Mozeiko, Lê, Coelho, Krueger, & Grafman, 2011). Note that within the context of communication disorders and linguistics, the term *discourse* refers to a unit of communication that is longer than a sentence. As with other units of communication, discourse can be written or spoken. These different discourse abilities require similar underlying cognitive processes as reading comprehension, including attention, working memory, and executive processing (Douglas, 2010; Chapman, 1997). Brookshire and colleagues (2000) found that deficits in executive function predicted performance of individuals with ABI on a narrative production tests better than site and extent of lesion.

Ferstl, Walther, Guthke, and Von Cramon (2005) compared narrative listening comprehension abilities of four groups of adults: left hemispheric brain damage (LHB; n=18), right hemispheric brain damage (RHB: n=12), traumatic brain damage (n=34), and uninjured controls (n=49). Participants listened to two short stories and then answered yes/no questions. Four categories of questions were designed: explicit main ideas, explicit details, implicit main ideas, and implicit details. Implicit main ideas were based on the macrostructure—the overall theme and logical organization of the text. Implicit details were based on the integration of two content units within the same vicinity of the text.

Across all groups with brain damage, implicit questions were more difficult than explicit. However, the RHB and TBI groups showed more difficulty with the implicit main ideas than the LHB group. The TBI group and the LBH group had more difficulty with stated details compared to the RBH. The researchers argue the data supports dissociations between the effect of aphasia deficits (i.e. LBH) and non-aphasia deficits (i.e. RHB & TBI) on processing of narrative discourse. Ferstl et al. also analyzed response patterns against a battery of cognitive tests to identify possible correlations. They found implicit main ideas correlated with executive functions ($r=-.34$), explicit details and implicit details correlated with verbal learning and memory ($r=-.39$, $r=-.27$). Stated main ideas correlated with alertness ($r=-.21$).

Moran, Kirk, and Powell (2012) and Coelho (2002) evaluated the discourse production abilities of individuals with traumatic brain injury. Moran and colleagues compared the persuasive discourse production abilities of adolescents with and without ABI (2012). They found that when producing persuasive discourse, adolescents with ABI produced half the number of supporting reasons as the unimpaired group, but had twice as many tangential utterances (Moran et al., 2012). Coelho compared the narrative discourse abilities of adults with and without TBI using both a story retell task and a narrative generation task (2002). Similar to the Moran et al. study, the adults in the TBI group produced fewer ideas than the control group and the ideas they did produce were often not related to the story episode (Coelho, 2002). When the two types of discourse tasks were compared, the TBI group produced more words per idea (i.e words per T-unit) in the story generation task compared to the retell task, but utilized fewer story grammar

elements in the generation task (Coelho, 2002). Coelho found that measures correlated with executive function performance; he suggested that the retell task provided an organizational frame that supported participants with TBI to produce more cohesive narratives as compared to their performance in the narrative generation task (2002).

Hay and Moran (2005) conducted a study comparing children aged 9 to 15 who had a history of closed head injury with uninjured peers. Participants were presented with audio recordings of both narrative and expository discourse, and asked to retell what they heard (Hay & Moran, 2005). Participants in the ABI group also had significantly more difficulty formulating a moral to a story, or describing the aim of an expository sample. Hay and Moran found that working memory was highly correlated with quantity of words and propositions, episode structure, and number of global components produced (2005).

Collectively the research on discourse-level processes in people with brain injury supports the role that impairments in working memory and executive function play in discourse performance. In both expressive tasks and listening comprehension tasks, individuals with ABI struggled to structure discourse content. Without an apparent structural frame, they have difficulty retaining details and generating inferences in listening comprehension tasks, and generating sufficient and appropriate relevant content in expressive tasks,

Given the limited research on reading comprehension after ABI, research from other populations of other readers with cognitive differences is also helpful as a way of understanding the deficits displayed by readers with ABI (e.g. Stine-Morrow, Milinder, Pullara, & Herman, 2001; Samuelson, Lundberg, & Herkner, 2004; Shalev & Shtern,

2012). For example, readers with attention deficit and hyperactivity disorder (ADHD) have reduced performance on inferencing tasks compared to readers without ADHD (ADDA, 2009; Samuelson et al., 2004). As another example, when young adult readers were compared with older adult readers and found differences in working memory between the groups impacted comprehension at both the propositional and situational levels of understanding, but that these differences were mitigated by self-regulation abilities (Stine-Morrow, Miller, Ganage, & Hertzog, 2008).

Intervention Options: Reading Comprehension Strategies

Current evidence for interventions. The research evaluating reading comprehension intervention options for adults with cognitive impairments after ABI is extremely limited. At the time of this writing, a literature search using databases from multiple disciplines yields only two studies. The first study located was an unpublished dissertation that examined the effects of an intervention conducted with adult college students with traumatic brain injury enrolled in a remedial reading course (Mann, 2006).

The focus of the intervention was to train participants to use metacognitive strategies, and progressed over four stages: (a) thinking before reading, (b) thinking during reading, (c) thinking after reading, and (d) transfer (Mann, 2006). Unfortunately, little information was available regarding the intervention received by the control group. This limited interpretation of analyses, but the study nonetheless provides helpful descriptive information.

All students with ABI (n=39) reported problems with concentration (Mann, 2006). Sixty percent of participants with ABI had impaired visual convergence and were

referred for outside services. Progress between students with ABI was variable but students consistently endorsed the usefulness of the strategies (Mann, 2006).

The second study was a case study of a 24-year old adult who had sustained a brain injury at two years of age and never learned to read (Goddard & Rinderknecht, 2009). The intervention involved a multi-component intervention program to teach word recognition skills and comprehension at the sentence and paragraph level (Goddard & Rinderknecht, 2009). The treatment began with direct instruction to teach phonemic awareness and sound-letter correspondence, and progressed to teaching comprehension strategies including predicting what would come next in narratives and recalling the main idea of texts (Goddard & Rinderknecht, 2009). Strategies were introduced via oral comprehension tasks and later transitioned to reading tasks (Goddard & Rinderknecht, 2009). Although the initial skill level and intervention targets of the case study are different from the population of this research proposal, the results provide further support that individuals with ABI can continue to make gains in cognitive-linguistic functions long after the onset of injury.

Evidence for strategy effectiveness. Given the lack of evidence directly related to reading comprehension interventions for adults with acquired brain injury, alternative sources of empirical support were necessary to guide the development of an intervention approach. Fortunately, evidence from the fields of cognitive rehabilitation and reading education provided a basis for considering reading comprehension strategies as a potential intervention approach. Reading comprehension strategies have been defined as:

- The act of intentionally thinking, extracting, and constructing meaning through interaction and involvement with text (Durkin, 1993; RAND Reading Study Group, 2002).
- Specific procedures that readers use to become aware of comprehension attempts during reading (National Reading Panel, 2000).
- A cognitive or behavioral action that is enacted under particular contextual conditions with the goal of improving comprehension,” (Graesser, 2007; pg. 8).

Contributions from cognitive rehabilitation literature. Metacognitive strategy training is a well-validated intervention approach for improving high-level cognitive functions, including academic functions (Cicerone & Giacino, 1992; Kennedy & Coelho, 2005, Kennedy et al., 2008; Lawson & Rice, 1989; Sohlberg et al., 2005; Sohlberg & Mateer, 2001). Metacognition—the ability to think about thinking—includes (a) monitoring and being aware of one’s own thoughts and (b) responding to that awareness to initiate, improve and/or complete specific tasks (Dunlosky & Metcalfe, 2009; Sohlberg & Turkstra, 2011). The goal of metacognitive strategy training is for individuals to improve their ability to self-monitor their own thoughts, and to help regulate their approach to how they learn or use information to reach a goal (Kennedy & Coelho, 2005, Kennedy et al., 2008; Sohlberg, Ehlhardt & Kennedy, 2005; Sohlberg & Turkstra, 2011).

Metacognitive strategies can be task-specific or task-general (Kennedy & Coelho, 2005; Sohlberg & Turkstra, 2011). Task-specific metacognitive strategies focus on the ability to perform a particular task, often within a particular context (Sohlberg & Turkstra, 2011). Task-specific strategies target overcoming functional barriers that

interfere with task performance (Sohlberg & Turkstra, 2011). For example, students may struggle to complete homework for a number of reasons: they may be easily distracted, cannot remember the assignment directions, and/or do not monitor time well. Teaching students to use a multi-step routine customized to student needs such as using a checklist before studying with reminders to turn off the television, gather materials and generate a study goal can help them overcome functional barriers (Sohlberg & Turkstra, 2011). A few case studies have investigated using multi-step routines with adults with ABI to target academic reading; results overall indicate students endorse effectiveness of strategy routines (Griffiths et al., 2010; Kennedy & Krause, 2011). Consistent utilization outside of therapy tends to be variable; although individual differences such as motivation and external stressors seemed to affect utilization, a common complaint was that using the strategies was time-consuming (Griffiths, et al., 2010; Kennedy & Krause, 2011).

Task-general metacognitive strategies focus on managing underlying impairments, such as problems with attention, executive functions, and memory that may interfere with performance on a wide range of tasks (Kennedy & Coelho, 2005; Sohlberg & Turkstra, 2011). For example, executive function impairment can disrupt organizational abilities and ultimately interfere with the ability to manage a range of tasks that depend on these abilities, such as reading and answering email (Sohlberg & Turkstra, 2011). Goal management training (GMT) is a task-general intervention approach that improves poor organizational skills by training individuals with executive impairments to use the same six step process in order to complete goal-directed tasks: stop, define main task, list steps, learn steps, execute task, and check results (Levine et al., 2000). The

literature documents that GMT leads to improvements in executive processes (Rath, Simon, Langenbahn, Sherr & Diller, 2003; Levine et al., 2000). Similarly, strategies that include mental imagery and elaborated rehearsal have been shown to enhance memory and learning of verbal material (Butler et al., 2008; Kaschel et al., 2002; Bussman-Mork, Hildberandt, Giesslemann, & Sachsenheimer, 2000).

Application of task-general strategies as an approach for academic reading for adults with ABI has not been reported, but strategies have been used as part of an overall academic support program in concert with task-specific strategies (Kennedy & Krause, 2011; MacLennan & MacLennan, 2008). Kennedy and Krause reported outcomes of training two college students with TBI to use self-regulated study and learning strategies over two academic semesters (2011). Strategies included both task-general and task-specific strategies organized around three themes: studying and learning, time management, and relating to others. For example, to improve self-regulation of time completion for a variety of study tasks, students were introduced to a “plan, do, review” strategy. To target student specific studying and learning needs, a range of strategies were trained including note-taking strategies while reading and self-testing using created notes. Although individual differences were noted, both students ultimately endorsed the usefulness of most strategies, reported increased usage of strategies outside of therapy, and either improved academic standing or increased academic load (Kennedy & Krause, 2011).

MacLennan and MacLennan (2008) presented three case studies to describe a college simulation experience they developed for veterans enrolled in a rehabilitation

program at the Minneapolis VA Medical Center. Their program included twelve lectures and assigned readings that focused on brain injury education and learning study strategies. MacLennan and MacLennan reported on a student who successfully transitioned to a Master's program and continued to use and endorse four strategy components when studying and reading (2008). These included: (a) breaking study time into smaller blocks and studying when most alert; (b) previewing and outlining reading assignments prior to reading; (c) iterative and frequent review of notes; and (d) use of spaced retrieval to enhance recall of difficulty material (MacLennan & MacLennan, 2008).

Contributions from regular and special education. Similar to the cognitive rehabilitation field, educational research has also supported the use of strategies to improve reading comprehension. Several meta-analyses provide compelling evidence for the use of reading comprehension strategies to improving comprehension in readers with learning disabilities (Berkeley et al., 2010; Manset-Williamson & Nelson, 2005; Gajria et al., 2007; Rosenshine & Meister, 1994).

Gajria et al. (2007) reviewed research findings of interventions studies specifically intended to target the ability of students with learning disabilities to comprehend expository text. They reviewed 29 articles that met the following criteria: published in English between 1978 to 2005; focused on interventions for comprehending written expository text; included school-aged children or adolescents identified as learning disabled; and used an experimental or quasi-experimental design that included at least one measure of expository text comprehension. In total, the studies included 1,450

participants. Twenty-four of the articles focused on cognitive strategy instruction. Strategies included teaching students to identify different types of text structures; to identify the main idea of a passage; to summarize what was read; to generate and answer questions about the text; or to develop cognitive maps of content. Effects sizes for each study were calculated using the difference between the mean posttest score of the intervention group divided by the pooled standard deviation (Cohen's *d*; Cohen, 1988). If an article did not report means and standard deviations then effect sizes were calculated using the *F* or *t*-test scores were provided. The meta-analysis of results indicated an overall effect size for cognitive strategy instruction was 1.83 (SD = 1.05, $n = 1.05$, $n = 15$).¹ Within the different types of strategies reviewed, identifying the main idea or generating main idea sentences by paraphrasing or summarizing were particularly effective strategies ($d = 2.56$, $SD = 1.09$, $n = 6$). Text strategy instruction was also highly effective ($d = 2.33$, $SD = 0.07$, $n = 2$). Although effect sizes for cognitive mapping ($d = .96$, $SD = 0.07$, $n = 2$) and questioning were not as high ($d = .91$, $SD = 0.62$, $n = 3$), they still were considered large. Gajria et al.'s meta-analysis provides support for the effectiveness in teaching students with learning disabilities cognitive strategies to improve reading comprehension of expository text (2007).

Berkeley et al.'s meta-analysis (2010) provides additional support. Question/strategy interventions included main idea strategy instruction with self-monitoring training; elaborative interrogation; guided identification of story themes; text-structure analysis; and peer-assisted learning strategies that included identification of

¹ .80 or greater were considered large, at or near .50 moderate, and .20 small (Cohen, 1988).

main idea, relevant information and summarization of content. Like Gajria et al. (2007), Berkeley et al also focused on students with learning disabilities ($n = 1,734$), although the way learning disability was defined differed between the two. Gajria et al. did not include studies of students with reading disabilities, however they did not exclude studies if students had an additional disability besides learning. Berkeley et al. also did not limit their review to expository text. Their review included 40 articles published during the period of 1995 to 2006. Effect sizes for question/strategy instruction were moderate to large, depending on whether criterion ($d = .75$, $SD = .17$, $n = 22$) or norm-referenced ($d = .48$, $SD = .29$, $n = 8$) measures were considered.

Although reported effect sizes between the two analyses vary, both ultimately provide strong evidence to suggest the reading comprehension strategies may be effective for improving reading comprehension performance of struggling readers with learning disabilities. Evidence regarding metacognitive strategy training in cognitive rehabilitation makes the approach particularly compelling for use with adults with acquired brain injury. However, additional evidence was needed to help guide strategy selection.

Evidence to guide strategy selection. While some interventions have focused on utilization of a single strategy, for example teaching students to identify and state the main idea in their own words (Ellis & Graves, 1990), increasing evidence supports the use of multiple strategies (Gajria et al., 2007). Eight of the articles reviewed in the Gajria et al, study combined multiple strategies. For example, three studies combined a self-monitoring strategy with another reading comprehension strategy, such as identifying the

main idea or summarizing the text (Jitendra, Hoppes, & Xin, 2000; Malone & Mastropieri, 1992).

Others have focused on teaching students or patients to use different strategies at different points in the reading process. The RRSB stressed that the, “reader, text, and activity are interrelated in dynamic ways that vary across pre-reading, reading post-reading” (pg. 12). Clinically, multi-component reading strategy routines are commonly used to help readers recall different steps to complete at different points in the reading process; for example, K-W-L (Carr & Ogle, 1987); SQ3R: Survey, Question, Read, Recite, Review; and PQRS: Preview Question, Read, Summarize, and Test (West, 1995; Wilson & Glisky, 2009). Englert and Mariage evaluated a strategy package they called POSSE that included the following component: predicting ideas, organizing ideas, searching/summarizing main ideas based on text structure, and then evaluating comprehension (1991). Results indicated that 4th, 5th and 6th graders with LD performed better when provided with strategy package as compared to a control group who received traditional instruction. In particular, they recalled for more ideas ($d = 1.90$), recalled more main ideas ($d = 1.13$), had better overall organization of recalls ($d = .94$), and demonstrated better awareness of knowledge ($d = .85$).

The most well supported reading strategies tend to facilitate performance in the following three areas: (1) anticipating content; (2) actively selecting and organizing content while reading; and (3) synthesizing and integrating content. Several strategies from the first set are designed to activate background knowledge or to help readers anticipate text content and structure before they begin their reading (Berkeley et al, 2010;

Biemans, Deel & Simons, 2001; Gajira, 2007; Manset-Williamson, & Nelson, 2005; Pressley et al., 1995). For example, previewing content prompts allows readers to identify the general topic of a text and the organization of the discussion before reading begins (Rowe & Rayford, 1987; Spires & Donley, 1998; Stevens, 1982).

A second set of strategies are designed to facilitate active manipulation of the content during the reading process (Berkeley et al., 2010; Biemans, Deel & Simons, 2001; Gajria et al. 2007; Mastropieri, Scruggs, & Graetz, 2003; McNamara, 2004; Palinscar & Brown, 1984). Strategies might include selecting key ideas, identifying the main idea and paraphrasing content (Jitendra et al., 2000; Meyer & Poon, 2001; Mothus, 1997).

A third group of strategies help to further synthesize and integrate information with prior knowledge for later recall (Berkeley et al., 2010; Manset-Williamson & Nelson, 2005; Gajria et al., 2007). Strategies may include summarizing content during or after the reading process, or thinking about and testing one's own understanding and recall of content (Jitendra et al., 2000; Palinscar & Brown, 1984; Souvignier & Mokhlesgerami, J., 2006) .

Development of Reading Comprehension Strategy Package

Based on the available research, a reading comprehension strategy package (RS) was developed for this study that electronically delivered reading strategies at three different phases in the reading process: pre-reading, during reading, and post-reading . Below, each phase is described along with strategy components implemented in that phase. The design of the strategy package aligns with SBF, with the ultimate goal to help

readers develop a cohesive, coherent knowledge structure. The suggested theoretical mechanism behind the strategies is that they support the participants' ability to lay a global foundation for understanding the text, facilitate detection and mapping of coherent content through active manipulation and summarizing of the text, and reinforce construction of local and global coherence. For this study, strategy supports and content were delivered electronically. Electronic delivery allowed for consistent delivery of supports and is also a medium commonly utilized in college settings.

Note that design of the reading comprehension strategy package and the dependent variable measures used in the current study was adapted from the design implemented for the STIR study, described earlier in the section on poor comprehenders (Sohlberg, Fickas, & Griffiths, 2011). Strategy instructions were modified for the current study to ensure participants limited use of highlighting to key concepts, and increased use of summarizing; instructions are described in more depth below. In addition, reading materials selected for the current study were longer (approximately 2,700 words) than those used in the STIR study (approximately 500 words) to ultimately help prevent ceiling effects, a problem in the STIR study thought to be associated with the shorter passages.

Pre-reading phase strategy. The first phase of the package was the pre-reading phase. The strategy in this phase guided readers through previewing the chapter content. Readers were presented with a list of headings from a given chapter. Readers were instructed to read each heading aloud and then to click on it. Clicking on it revealed the sentence from the text that immediately followed that heading. Readers were instructed to

read along as this sentence was read aloud by the computer via text-to-speech. Readers continued in this manner through all of the headings.

The purpose of the first strategy was to facilitate the laying of an initial foundation for text comprehension. The preview strategy capitalized on the *advantage of first mention* by exposing readers to the overall organization and the scope of topics in the chapter before they began reading (Gernsbacher & Hargreaves, 1992). As such, readers would already have some familiarity with the content when they encountered it in the actual text. A logically organized foundation based on the global structure of the text should support formation of a coherent line of thought.

Reading phase strategies. After the pre-reading phase, participants clicked to advance to the reading phase. The reading phase displayed the full chapter in the left side of the window. The chapter was divided into sections, with each heading demarcating the beginning of a section. Throughout the reading process, a table of contents formed by the headings remained within view on the right side of the screen. Participants could navigate through the chapter by clicking on the headings in the table of contents, or by scrolling through the text as they read.

Participants were instructed to highlight one or two key ideas in each paragraph as they read. They were further instructed to write at least one, but no more than two, notes about what they just read. These highlights and notes were automatically copied into a tool called *My Notebook*. As they reached the end of a section, participants were prompted to open this notebook. They were instructed to read each of their highlights and notes aloud, and to decide whether to retain or discard each by clicking on a checkmark

or an *X*. After reviewing their highlights and notes, they were then instructed to write a three to five sentence summary of each section. After writing the summary, they returned to reading the next section of the chapter.

The purposes of the strategies at this active reading phase were to enhance processing and integration of relevant content to form a locally and globally coherent understanding of the text. The user interface, navigation tools and guided sequence of activities through the text all served to boost readers' awareness of the global organization of the text. To mitigate attention to irrelevant information, participants' usage of highlighting and note-taking tools while reading was constrained. Actively annotating content while reading (e.g. highlighting with note taking), regularly reviewing and updating annotations were intended to help readers detect relevant and related information needed to form a locally coherent understanding as information read. Reviewing highlights and notes at the end of section was intended to facilitate detection of coherence across the section; selecting or discarding highlights and notes helps update understanding based on most relevant content. Iteratively summarizing information at the end of each section reinforced development of a coherent understanding and facilitates integration of that understanding with global structure before readers must shift to a new section.

Review phase strategies. After reading all sections of the chapter, readers were presented with the summaries they wrote for each section. They were instructed to read each summary and then test their ability to recall each by "hiding it." They were then instructed to click on each hidden summary to reveal it again in order to evaluate how

well they did. They will continue to test themselves with each of the summaries they wrote.

The purposes of the strategies during the review phase were to facilitate further integration of content and to reinforce a cohesive, coherent recollection of what they read. The review strategy gave readers the opportunity to review condensed versions of the entire chapter in order to facilitate connections between sections needed for a stronger globally coherent representation of the chapter.

Research Questions

The purpose of this study was to evaluate whether using a multi-component, theoretically grounded reading comprehension strategy package (RS) improves reading comprehension performance of individuals with a history of mild to moderate acquired brain injury. Research questions were:

1. Do readers with ABI comprehend better when provided with the RS than in a no-strategy control condition (NS) as measured by the quantity, efficiency, and coherence of immediate free recall of chapter content? Do readers with ABI retain information better when provided with the RS compared to the NS control condition as measured by quantity, efficiency, and coherence of delayed free recall of chapter content?
2. Do readers with ABI perform better when provided with the RS compared to the NS control condition as measured by overall accuracy and response patterns on a sentence verification task?

CHAPTER III

METHODS

Experimental Design

Twenty-four adults with a history of acquired brain injury (ABI) were recruited to participate in a within subject group comparison. Participants read two different expository chapters drawn from an introductory college textbook on world prehistory and archeology (Chazan, 2011) under two different conditions: (a) the experimental or reading strategy (RS) package condition, and (b) the control or no-strategy (NS) package condition. Two types of measures were used to assess reading comprehension performance: free recall tasks (immediate and delayed), and a sentence verification task.

Research Procedures

Recruitment. Students currently or previously enrolled in Coastline Community College's (CCC) Acquired Brain Injury program were invited to participate in the study. The program facilitates return to college and work for adults recovering from ABI. Students attend three courses delivered concurrently over one academic year: a psychosocial adjustment course, a cognitive retraining course and a computer skills course. All participants enrolled in the study were prescreened by faculty at CCC to ensure they met the inclusion and exclusion criteria as described below. One enrolled participant met criteria at the time of enrollment, but began an outpatient program for depression partway through the study; she was paid for her participation but ultimately did not complete the study. See Tables 1 and 2 for a summary of demographic characteristics.

Inclusion criteria.

1. Medically documented history of concussion or brain injury,
2. At least six months post-injury,
3. Between 18 and 55 years of age,
4. Able to communicate verbally for most daily needs at independent level,
5. Fluent English speaker; English acquired before age of seven,
6. Earned a high school diploma, GED or above,
7. Enrolled or planning to enroll in academic community college course,
8. Able to use a personal computer mouse to click and scroll and use a keyboard to type,
9. Able to hear speech presented in person and via computer (hearing aid acceptable),
10. Able to read text on a computer screen (corrective glasses acceptable),
11. Able to read for most daily needs (e.g., street signs, menus, and bills) and comprehend 3-4 paragraph length materials at 12th grade level, although may have difficulty recalling what was read.

Exclusion criteria.

1. No diagnoses of dyslexia or learning disabilities prior to injury,
2. No difficulty learning to read as a child,
3. No difficulty reading for academic or work purposes prior to injury,
4. No substance abuse or psychiatric issues in prior 12 months that required hospitalization or a full-time outpatient program,
5. Does not work or have any background in the fields of anthropology or archeology.

Table 1

Summary of Participant Characteristics

Demographic Characteristics (n=24)					
Age and Gender			Race		
Age Range (<i>M</i> =36, <i>SD</i> =11)	Male (n=11)	Female (n=13)	Category ^b	# of participants	
19-30	6	5	Asian	1	
31-42	2	3	Black	0	
43-55	2	4	Hispanic	2	
			Pacific Islander	1	
			White	15	
			Other/not reported	5	
Education Completed		Occupation			
Level	# of participants		Category ^b	Prior	Current ^e
High school/GED	8		Mgmt, business, science & arts	13	2
Some college	8		Sales & service	6 ^c	2
2 year degree	1		Nat'l resource. construct., & maint.	1	2
4 year degree	5		Production, transport. & material moving	1	0
Graduate degree	2		Military specific	1	0
			Not working	2 ^d	17
Current College Enrollment					
Additional courses in progress	ABI program students				
	Matriculated ^a (n=19)	Graduated (n=5)			
0	9	1			
1	8	0			
2	1	1			
3-4	0	2			

Note. ^aCurrent ABI students all take three courses specific to ABI program. ^bRace and Occupation categories based on 2010 Census standards (Federal Register, 1997; U.S. Census, 2011). ^cTwo also enrolled as students at time of injury. ^dBoth enrolled as students at time of injury. ^eAll participants also enrolled as students except for one participant working in sales & service.

Table 2

Summary of Type and Time Post-Onset of Acquired Brain Injuries

Injury Type	Time Post-Injury ($M=6.75, SD=6.43$)		
	1-2 years	3-5 years	6+ years
TBI (n=13)			
Combat	0	0	1
MVA	1	5	5
Sports	1	0	0
Non-TBI (n=11)			
CVA	3	3	2
Infection/Toxicity	2	0	0
Tumor	0	0	1

Note. TBI=Traumatic brain injury, MVA=motor vehicle accident, CVA=cerebral vascular accident (i.e. stroke).

Research sessions. Participants completed a total of six research sessions: Three sessions were completed as part of condition one, and three were completed as part of condition two (See Table 3). Each condition consisted of one two-hour session, one ninety-minute sessions, and one thirty-minute session. All sessions were completed in classrooms at the CCC ABI program campus.

Sessions one and four: Condition orientation and skills assessment. The initial sessions for each condition (i.e., sessions one and four) had two purposes: (1) administrations of a battery of language, cognitive, and reading assessments, and (2) orientation to the user interfaces developed for each particular condition. The assessment battery was completed as a part of a separate study designed to profile cognitive,

language and reading abilities of college students with ABI who complain of reading comprehension problems. The battery included measures of attention, executive processing, speed of processing, verbal learning and recall, and working memory capacity, as well as standardized reading comprehension tests and a reading behaviors survey. Note results will be reported in a separate paper.

The condition orientations were completed to ensure participants were competent navigating the user interface designed for each particular condition. As described in Chapter II, “Development of Reading Strategy Package,” content was delivered electronically. In the RS condition, strategy instructions and supports were integrated into the reading interface. Otherwise, user interfaces for both conditions were similar, with text presented within a scrollable window on a 32-inch computer screen, using identical fonts and similar navigation features.

Orientations were conducted in small groups in a classroom with each participant seated in front of a computer screen. The researcher controlled the display of individual screens from a computer at the front of the room, and would toggle control of the display to allow participants to complete guided practice steps. The researcher followed a script generated for orientations that followed a model, lead, and test format based on principles of systematic instruction (Sohlberg, & Mateer, 2001).

For both conditions, participants were trained to typical digital reading tools found in PDF readers and web, such as scroll bars, clickable buttons, and click-and-drag text selection.

In the experimental condition, participants were also trained to follow the instruction steps displayed as part of each reading comprehension strategy. This aspect of the training included a brief description of the rationale and purpose for the strategy, demonstration of the expected actions to be taken, and guided practice. After instruction of the features of the user interface, the researcher tested each participant individually with a competency checklist to ensure he or she used program features and followed displayed instructions accurately.

Once participants passed the test for using the program, they were instructed to continue to use the program for a total of forty minutes. Reading material for the orientations was drawn from a book already familiar to the cohort from the Coastline program, with selected content counterbalanced across training conditions. Hence participants had the opportunity to learn and practice using an upcoming condition's program with familiar content before actually using it with the study content.

Partway through the practice time using the interface for each condition, the researcher took each participant separately to a nearby private, quiet area to administer individual tests from the battery. After completing the individually administered tests, each participant returned to the group area to resume practice time. See Appendix A for a full list of the tests.

Sessions two, three, five and six: Reading and study sessions. Participants completed the experimental and control conditions in the remaining four sessions. Each condition occurred over two consecutive sessions: two and three, and then five and six, and were scheduled within a week of the condition orientation. The order of presentation

of conditions was counterbalanced across participants. Half of the participants completed the control condition in sessions two and three, and the experimental condition in sessions five and six. The other half of participants completed the experimental condition in sessions two and three and the control condition in sessions five and six. See Table 3 for session schedules.

Table 3

Schedule for Sessions

	One	Two	Three	Four	Five	Six
:10	Program orientation	Program review	Delayed free recall	Program orientation	Program review	Delayed free recall
:20		Read			Read	
:30	Program practice		SVT	Program practice		SVT
:40						
:50						
:60	Cognitive, language, and reading testing			Cognitive, language, and reading testing		
:70						
:80						
:90		Immediate free recall			Immediate free recall	

Note. SVT=Sentence verification task

Participants focused on reading one chapter in each condition. Two chapters, A and B, were drawn from *World Prehistory and Archeology*, an introductory college anthropology textbook described in more detail in the Materials section below (Chazan,

2011). Order of presentation of chapters was counterbalanced, with half of participants reading Chapter A first, and half reading Chapter B first. Pairing of chapters with conditions was also counterbalanced across participants. Half of the participants read Chapter A in the control condition and Chapter B in the experimental condition; the other half read Chapter A in the experimental condition and Chapter B in the control condition. Counterbalancing was used to control for order of condition effects, order of chapter effects, and chapter content effect. The counterbalancing resulted in four different permutations, which was repeated eight times. See Table 4 for an example of the counterbalancing.

Table 4
Counterbalancing of Condition and Chapter

Participant	Sessions 3 & 4		Session 5 & 6	
	Chapter	Condition	Chapter	Condition
1	A	RS	B	NS
2	B	NS	A	RS
3	A	NS	B	RS
4	B	RS	A	NS

Note: RS: Experimental strategy condition, NS: Control no-strategy condition

Participants followed a similar schedule of tasks during each condition. See Table 3 for session schedules. First, participants were guided to review the reading user interface for the given condition introduced in the prior orientation session. They were given the opportunity to ask any clarifying questions about the interface, and to practice using it for at least five-minutes.

Participants were then told that they would continue to read on the computer but would read a chapter they had never read before that was drawn from an introductory college textbook on archeology. They were advised they would have sixty minutes to read and study the chapter, and that afterwards they would be asked by the researcher, “tell me everything that you learned from the chapter you just read.” The researcher remained in the room throughout both conditions.

Free recall tasks. Immediately following the reading task, participants completed the first free recall task. Free recalls were elicited using three prompts, that were given consecutively: (1) “tell me everything that you learned from the chapter that you read,” (2) “thinking about the chapter you read, tell me what you think are three of the biggest ideas,” (3) “tell me what you think the main purpose of the chapter was.”

The researcher maintained an attentive but neutral expression and allowed the participant to continue talking until they paused for more than 15 seconds or gave a concluding statement (e.g. “that’s it”). Then the researcher would say, “Take some time to think to see if you remember anything else.” Responses after each prompt were considered complete when the participant either ended any additional content with a concluding remark, or paused for more than 30 seconds. At the time the researcher would move on to the next prompt until all were given, and then would confirm the following day’s session appointment. Responses were recorded using a media program on the computer and later transcribed.

Sentence verification task. After the free recall task, participants were instructed they would be completing a true/false test. They were advised that they would be

presented with a series of sentences and would have to decide whether each sentence was true or false based on information from the chapter they just read. Three types of sentences were presented, with ten of each type: paraphrases, local cohesion inferences and global cohesion inferences. Development and validation of the sentence verification task (SVT) is described in the Methods section below and in more depth in Appendix D.

Materials

Selection of reading content. Expository texts are used across all disciplines for academic learning (Biancarosa et al, 2004; Lee & Spratley, 2010; RRSB, 2002). Despite their common use, selecting and/or developing expository texts for reading comprehension assessment introduces challenges not encountered with narrative texts. As indicated earlier, narratives share a predictable organizational pattern, or *story grammar*; for example, narratives typically involve characters in a setting, who through some event are faced with a problem or a challenge (Mandler, & Goodman, 1982). Expository text structures are more variable and do not follow a consistent structural outline (Biber, 1985; Mosenthal, 1989). A number of factors can influence the structure of expository text, including discipline-specific conventions, the assumed level of background knowledge of the reader, as well as the skills, abilities and background knowledge of the writer (Biber, 1985; Lee & Spratley, 2010). All of these factors can influence comprehension; hence, if a comparison is to be made between the RS and NS conditions, these factors must be controlled.

The selection of text for this study focused on the social sciences and humanities to limit discipline-specific procedural content that require cognitive skills beyond

reading, such as mathematical formulas or computer programming steps. Given that discipline-specific conventions and background knowledge requirements increase as course level advances, an introductory level textbook was chosen. Introductory social science and humanities texts tend to share similar structural patterns that can be categorized using broad-based expository text typology schemes, such as description, sequence, comparison, cause-effect, and problem solution (Mosenthal, 1985) and persuade, transfer information, entertain/edify, and reveal self (Biber, 1989). To help control for the effects of writing style and text format, chapter selection was made from one textbook written by the same author. The selected textbook also needed to present chapters in a somewhat modular manner; that is, chapters needed to be able to be understood independently of the rest of the content from the textbook. Finally, selected text needed to be ecologically valid. Criteria used to evaluate ecological validity included: currently in publication in paper form, currently used in introductory college courses, and typical textbook layout in terms of organization and use of pedagogical devices. Potential textbooks were reviewed by at least three members of the research team with final selection made in a team meeting.

The selected textbook was *World Prehistory and Archeology*, written by Dr. Michael Chazan, a practicing anthropologist who teaches at the University of Toronto. See Appendix B for copies of the chapters. The book, currently published in its second edition by Pearson Publishing (2011), is used in the University of Oregon's introductory anthropology course. The book is divided into four sections: (1) "the past is a foreign country," (2) "human evolution," (3) "perspectives on agriculture," and (4) "the

development of social complexity.” Each section begins with a four to five page overview of the section, and contains between two and five chapters. Including the sections, appendices, glossary, references and index, the book is 445 pages long; pedagogical devices include bolded vocabulary terms; sidebar content to reinforce or extend content such as pictures and figures, and end of chapter questions. Considerations for text selection included that the two selections be equivalent in terms of level of difficulty and overall text structure, and that they contain approximately 3,000 words to allow participants to finish reading and studying the chapters within 60 minutes.

Evaluation of selected text. When potential text selections that met criteria were identified, a number of discourse analysis procedures were utilized to compare content within the chapters to ensure equivalency in length, complexity, and general organization. Passage mapping, a process for identifying important information and the relations among them, was conducted by the researcher and a research assistant following procedures outlined by National Assessment of Educational Progress (NAEP, 2009; Section C1). The maps reflect the relations among three levels of ideas: central, major, and supporting; classify dominant organizational patterns, such as description, cause/effect, or problem/solution; identify text features, such as headings and figures; and describe aspects of writing style used to convey ideas. For the purpose of evaluating text equivalency, section headings within each selected chapter were considered organizing elements, and then each evaluator determined the dominant organizational patterns of each section.

Inter-rater reliability was calculated by comparing the proportion of agreement for dominant organizational patterns identified for each section of both chapters, and was 92.6%. For the purposes of assessing chapter equivalency, the chapters needed to be similar in their dominant organizational patterns. By far the overall dominant organizational patterns for both chapters were description and comparison, with 100% inter-rater agreement on these aspects. Minor differences were noted regarding dominant organizational patterns within portions of certain sections; for example, one rater identified a pattern as cause/effect that the other identified a problem/solution pattern. Chapter A was modified to improve equivalency by deleting selected paragraphs and adding a heading. See Appendix B for the chapters, and Appendix C for a sample passage map.

To further evaluate chapter equivalency, content was further evaluated using *Coh-Metrix* (McNamara, Louwerse, Cai, & Graesser, 2005) an automated text analyzer that computes over 50 text metrics. These metrics describe different semantic and syntactic aspects of the text, describe the cohesiveness of the text, and provide a rating of text difficulty. See Table 5 for selected characteristics for each chapter.

Table 5
Chapter Characteristics

	Chapter A	Chapter B
Quantity		
Total words	2762	2769
# of different words	840	851
Sentences	144	138
Chapter sections	6	6
Complexity		
Syllables per word	1.85 (<i>SD</i> = 1.17)	1.99 (<i>SD</i> = 1.16)
Lexical density ¹	30.4%	30.7%
Sentence length in words	18.92 (<i>SD</i> =8.05)	20.21 (<i>SD</i> =8.87)
Cohesiveness		
Incidence of pronouns	139.76	154.28
Sentence to sentence cohesion ²	.24 (<i>SD</i> = .19)	.25 (<i>SD</i> =.19)
Readability Grade Level		
Gunning-Fox index ³	12.7	13.2

Note: ¹ Number of content words (nouns, adjectives, verbs, adverbs)/total number of words; ² Measured through latent semantic analysis and ranges from -1 to 1 (McNamara et al., 2005); ³Text readability metric

Independent Variable

Reading comprehension strategy intervention was the independent variable and had two levels: reading strategy condition (RS) and no-strategy condition (NS). As previously described in Chapter II, the RS condition divided the reading process into three phases: pre-reading, reading, and review. In the pre-reading phase, readers were

guided to preview the text through presentation of chapter headings and initial sentences of each section. In the reading phase, participants were asked to highlight information and take notes as they read each section, then summarize each section before continuing to the next. In the review section, readers were presented with their section summaries, asked to read each one aloud, “hide” them by clicking on them, then tested themselves by trying to recall each one.

In the control condition, readers read text presented within a standard PDF reader window. They were instructed to read the chapter, using the scroll bar or tools to navigate the chapter. As indicated above, they were provided with access to a word processing program in an adjacent tab to the program and advised they were free to take notes as they read.

Fidelity of condition implementation. Session instructions for both conditions were developed by the researcher and the research advisor to insure consistency of implementation. Two of eight group-training sessions were videotaped; the researcher and the research advisor discussed the sessions to insure fidelity to developed scripts. Both reading conditions for each individual were also videotaped. Researcher/researcher assistant instructions given during individual sessions were transcribed by an offsite research assistant; the researcher reviewed 20% of transcripts to ensure fidelity using a checklist to compare stated with planned instructions with 100% fidelity observed.

Dependent Variables

As described in Chapter I, a barrier facing reading research and intervention is the paucity of validated reading comprehension assessment tools (Pearson & Hamm, 2005;

RRSG, 2002; Sweet, 2005). No standardized, or otherwise validated reading comprehension measures exist for use with adults with acquired brain injuries that target that target comprehension of expository text. Given the absence of standardized and validated measures, measures were developed based on procedures drawn from the experimental literature. Reading comprehension performance was also measured in multiple ways to increase reliability of findings through corroboration. Two types of assessment tasks were ultimately administered to measure reading comprehension performance: free recall tasks, and a sentence verification task, described below.

Free recall tasks. Participants completed two free recall tasks: one immediately after reading the chapter, and one the following day. Eliciting and analyzing verbal discourse produced during or after individuals read written text is increasingly used to assess reading comprehension (Gillam, Fargo, & Robertson, 2009; Laundauer, McNamara, Dennis, & Kintsch, 2007; Magliano, Weimer-Hastings, Millis, MuNoz, & McNamara, 2002; Millis, Magliano, & Todaro, 2006; Wolfe & Goldman, 2005). As described in Chapter II, eliciting and analyzing verbal discourse has also been used to assess listening comprehension in adults with acquired brain injury (Coelho, 2002, 2007; Coelho, Liles, & Duffy, 1991).

Methods to elicit and analyze discourse samples after the assessment process vary substantially depending on the purpose of the assessment, the nature of the original text, and the type of prompt used to elicit the sample (Coelho, 2002). Despite the variation, methods typically involve asking participants to read, or listen/watch a video of a short story or expository topic. Discourse samples typically fall into two categories: *think-*

aloud productions, elicited during the comprehension process, and *free-recall* productions, elicited after the comprehension process. Because elicitation of discourse during the comprehension process alters the comprehension process, it was not appropriate for the purposes of this study.

Discourse samples are then transcribed and analyzed to identify patterns that reflect the construct under study. For this study, a benefit from using the strategies should be reflected in participant's ability to recall more correct information with better efficiency. Theoretically, a more coherent mental structure should facilitate better understanding and retention of more information as the structure allows information to be grouped; this improvement should be reflected in an increase in the quantity of correct information units. A more coherent mental structure should also bolster organization of content, and better organization of content should facilitate better efficiency and cohesiveness of recall. Based on the aspects of the free recalls that were hypothesized to improve, the following four dependent variables were selected as measures to extract from the discourse samples:

1. Quantity of recall: Total correct information units (CIUs)
2. Efficiency of recall: Correct information units per minute (CIUs/min)
3. Local cohesion: Sentence to sentence LSA (LSA_{ss})
4. Global cohesion: Paragraph to paragraph LSA (LSA_{pp})

The first two measures were calculated via manual coding procedures described by Nicholas and Brookshire (1993), and the last two were calculated via an automated text analyzer, following procedures of Laundauer, McNamara, Dennis, and Kintsch (*Coh-*

Metrix, 2007). Manual coding included counting the total number of *correct information units* (CIUs) produced, and noting the total time the participant spent retelling (CIUs/minute). CIUs are defined as words that are intelligible in context, and are accurate and relevant in relation to the topic. Words do not have to be used in a grammatically correct manner. See Appendix E for the manual coding procedures used.

Cohesiveness contributes to the coherence of discourse, and as such, cohesiveness is often used as a proximal measure of coherence (Laundauer et al., 2007). Latent semantic analysis was used to obtain measures of discourse cohesion (McNamara et al., 2005). Cohesiveness was evaluated at two levels: locally, using sentence-to-sentence latent semantic analysis, and globally, using paragraph-to-paragraph latent semantic analysis.

Fidelity of scoring. The primary researcher and two research assistants transcribed discourse samples. The primary researcher supervised the transcription process, and watched 100% of the video samples to insure reliability of transcriptions. Manual coding was conducted independently for 50% of the transcripts by the primary researcher and a Master's level research assistant, with results then compared. Inter-rater reliability of accuracy was calculated using Cohen's Kappa with a criterion level of .90 (Stevens, 2009). To resolve discrepancies in counts or accuracy of categorization, a third research assistant was consulted to make a final judgment. The researcher ensured all transcripts were pre-processed according to instructions provided by *Coh-Metrix* (McNamara et al., 2005). A research assistant then submitted the transcripts through *Coh-Metrix*. Analyzed samples resulted in permanent records of results.

Reliability. Reliability of immediate and delayed free recall results were measured by calculating Pearson's product moment correlation for each chapter's total scores for dependent variables. Results were significant for all dependent variables (CIUs: $r = .582$, $p = .001$; CIUs/minute: $r = .671$, $p = .012$; LSA_{ss}: $r = .81$, $p = .0001$; LSA_{pp}: $r = .74$, $p = .005$).

Sentence verification task. The sentence verification task (SVT) is a widely used paradigm in reading research (Pearson & Hamm, 2005; Royer, 1987). Sentence verification tasks (SVTs) involve having participants read a series of sentences and then making a binary decision about them (e.g. true/false). SVTs are typically devised to distinguish between different levels of comprehension. For this study, three item types were generated: paraphrase, local coherence inferences, and global cohesion inferences. The primary researcher and two research developed sentence verification items assistants following procedures adapted from Royer and colleagues (Royer, 1987; Royer & Cunningham, 1981). A pilot study was conducted prior to using the measure in this study to evaluate the reliability and validity of the SVTs. Forty-two volunteers from an undergraduate course in Communication Disorders and Sciences participated in the pilot study. Results indicated a significant correlation between total scores from the Chapter A items, and the Chapter B (Pearson's $r = .816$, $p < .05$). See Appendix D for a detailed description of the development of the SVT and the pilot study given prior to using the measure in this study.

Fidelity of scoring. The SVT test was delivered via a survey software program, which allowed participants' responses to be recorded and totals calculated. Item scores

were verified by hand-scoring each response, with 100% overlap between computer and hand-scored results.

Reliability. Reliability of SVT results was evaluated using two measures. Cronbach's alpha was used to measure the internal consistency of items within each sentence type. Internal consistency is a necessary requirement in order to interpret any differences between scores of the three sentence types; if internal consistency is inadequate than differences are more likely to be due to random error than to underlying constructs of the sentence types. An alpha result between .70 and .80 is considered adequate internal consistency, between .80 and .90 good, and above .90 is very good (Cronbach, 1975). Paraphrase items were judged borderline between adequate and good ($\alpha = .789$). Local items and global items were judged to be good ($\alpha = .854$, $\alpha = .862$). Pearson's product moment correlation was used to measure the consistency between total scores for Chapters A and B; if total scores are not statistically correlated, then differences in study results are more vulnerable to differences between the two chapters rather than the two conditions (Wilson, 2005). Results were significant ($r = .611$, $p = .0001$).

CHAPTER IV

RESULTS

This study was designed to evaluate the effects of a multi-component, theoretically grounded reading comprehension strategy package (RS) on the reading comprehension performance of individuals with a history of mild to moderate acquired brain injury. Research questions sought to determine potential differences in performance in the strategy (RS) versus no-strategy conditions (NS) on three measures: immediate free recalls, delayed free recalls, and sentence verification tasks. This section presents the findings relative to the research questions under the headings Immediate Free Recalls, Delayed Free Recalls, and Sentence Verification Tasks. All analyses were conducted using SPSS 19.0.

Immediate Free Recalls

Results from the immediate free recall tasks were analyzed by conducting within-subject analysis of variance for each dependent measure: (1) total correct information units (total CIUs; Appendix E), (2) efficiency of recall (CIUs/minute), (3), local cohesion (LSA, sentence to sentence), and (4) global cohesion (LSA, paragraph to paragraph). Alpha was adjusted to reduce risk of Type I error given multiple tests ($\alpha = .05/4$). Strategy condition was used as the independent variable (RS, NS); strategy order (1st, 2nd) and chapter (A, B) were included as additional fixed variables to account for order and chapter effects.

Significant differences were noted within subjects for the RS and NS conditions when comparing total correct information units $F(1,26)=32.31, p=.001, \eta^2=.193$. No significant differences were found with the efficiency variable or the local and global cohesion variables. Results of the analysis are reported together with delayed free recall results in Table 6.

Delayed Free Recalls

Within-subject analysis of variance was also used to analyze the results of the delayed recall free recall task for each original dependent variable as reported above (total CIUs, CIUs/minute, LSA_{ss} , LSA_{pp}), with strategy condition as the independent variable, and with strategy order and chapter order as additional fixed variables. Alpha was adjusted to reduce risk of Type I error ($\alpha = .05/4$).

Significant differences were noted within subjects for the RS and NS conditions when comparing total correct information units $F(1,26)=29.43, p=.001, \eta^2=.215$, and when comparing correct information units per minute $F(1,26)=8.12, p=.005, \eta^2=.234$. No significant differences were found with the local and global cohesion variables. A significant difference in efficiency of recall was noted when comparing conditions in the delayed free recall tasks, but was not noted when comparing the conditions in the immediate free recall task. Results of the analysis are reported with the immediate free recall results in Table 6.

Table 6

Results from Immediate and Delayed Free Recall Tasks

		No Strategy		Strategy		<i>F</i>	<i>P</i>	η^2
		Mean	SD	Mean	SD			
CIUs	I	65.33	30.04	76.67	36.52	32.31	.001*	.193
	D	32.00	19.55	55.67	29.43	32.31	.001*	.215
CIUs/min	I	28.58	4.63	30.38	3.00	1.46	.235	.013
	D	23.33	11.48	35.27	8.43	8.12	.005*	.234
LSA _{SS}	I	.26	.09	.25	.17	1.31	.212	.002
	D	.29	.09	.30	.17	.31	.580	.014
LSA _{PP}	I	.31	.04	.35	.11	2.35	.165	.310
	D	.31	.11	.32	.15	1.21	.265	.013

Note. I=Immediate, D=Delayed; CIUs=total correct information units; CIUs/minute=efficiency of recall; LSA_{SS}=sentence-to-sentence latent semantic analysis for local cohesion; LSA_{PP} = paragraph-to-paragraph latent semantic analysis for global cohesion. Distribution of data for each variable was unimodal; LSA measure distributions were notable for a negative skew, consistent with ratio measures. No significant interaction effects with fixed variables were identified. * $p < .0125$.

To further investigate the possible factors that might contribute to the differences in efficiency of recall between the immediate and delayed free recall tasks, a preliminary post-hoc analysis was initiated to identify factors that might elucidate these differences. One observation noted when initially reviewing videos is that participants seemed to pause more in the strategy condition during the process of recalling. The objective of the post-hoc analysis was to compare the total number of pauses and the total pause time each participant had during each of the free recall tasks. A pause was defined as five or more seconds of silence. Although the videotaped recordings for all participants will need

to be reviewed to complete the post-hoc analysis, below the findings from a review of the first three participants are presented in Table 7.

Table 7
Comparison of Number of Pauses and Duration in Free Recalls for Three Participants

Participant	Immediate				Delayed			
	NS		RS		NS		RS	
	#	secs	#	Secs	#	secs	#	secs
101	0	0	4	91	1	28	2	37
102	0	0	1	12	1	5	1	7
103	1	5	3	28	0	0	2	10

Note. #= total number of pauses produced during free recall, secs=total duration of pauses in seconds.

Sentence Verification Tasks

Results of the sentence verification tasks were analyzed by conducting a MANOVA that included the three different sentence types from the sentence verification task. As with the previous analyses, the independent variable was strategy condition; strategy order and chapter were included as additional fixed variables to account for possible order and chapter effects. Using Wilk's test of multivariate significance, strategy condition was statistically related to the weighted multivariate combination of DV measures, $\Lambda = .414$, $F(3,15) = 7.07$, $p = .003$, $\eta^2 = .586$. Univariate ANOVAs on each of the three measures comprising the multivariate composite revealed participants scored better on the local cohesion statements and the global cohesion statements in the strategy condition compared to the no-strategy condition. No difference was found between

means on the paraphrase statements. No significant interaction effects with fixed variables were identified. Results of the univariate analyses are reported in Table 8 below.

Table 8

Results from Sentence Verification Task

	No Strategy		Strategy		<i>F</i>	<i>p</i>	η^2
	Mean	SD	Mean	SD			
Paraphrase	5.81	1.94	6.52	1.75	2.25	.152	.113
Local	4.71	1.34	6.57	1.69	17.25	.001*	.504
Global	5.67	1.74	7.10	1.64	62.00	.029*	.250

Note. Ten points possible for each DV. * $p < .05$.

CHAPTER V

DISCUSSION

The purpose of this study was to evaluate whether using a multi-component, reading comprehension strategy package (RS) improves reading comprehension performance of individuals with a history of mild to moderate acquired brain injury. This study is the first experimental evaluation to demonstrate that adult college students with acquired brain injury benefit from using reading comprehension strategies to improve performance on reading comprehension measures. This study also identified research methods effective for evaluating reading comprehension of expository text in adults with ABI.

Grounded in the structure-building framework (SFB), the hypothesis of this study was that the reading comprehension strategy package would support readers to build a coherent mental representation, or structure, of what they read. In turn, a coherent structure would facilitate better performance on the reading comprehension measures administered after participants read the academic text. Two types of measures were used: free recall tasks given at two points in time—immediately after reading each chapter and then again the following day, and sentence verification tasks given after the delayed recall task in each condition. The findings from the two free recall tasks are discussed first, followed by a discussion of the findings from the sentence verification tasks. This section then reviews the limitations of this study, and considers implications for future research.

Effects of Strategy Use on Quantity, Efficiency and Coherence of Recall

Research Questions 1 and 2 asked whether readers with ABI would comprehend better when provided with the reading strategies compared to no strategies as measured by the quantity, efficiency, and cohesiveness of immediate and delayed free recall of chapter content. Readers recalled more information when provided with the reading comprehension strategies. In both the immediate and delayed free recall tasks, participants produced more correct information units (CIUs) in the RS condition than the NS condition. In the RS condition of the immediate free recall task, participants produced on average 11.34 more CIUs; the effect of the strategies accounted for 19.3% of the variance in total number of CIUs produced. In the RS condition of the delayed free recall task, participants produced on average 23.68 more CIUs, with the effect of the strategies accounting for 21.5% of the variance.

Although readers recalled on average 1.8 more correct information units per minute in the RS condition of the immediate free recall as compared to the NS condition, this difference was not significant. However, efficiency of recall was significantly different between conditions in the delayed free recall condition; readers recalled on average 11.94 correct information units per minute in the RS condition, with strategies accounting for 23.4% of the variance. That is, after a 24-hour delay, readers produced more information in less overall time if they had been provided with reading comprehension strategies during the reading session. No significant differences were noted in the free recall variables used as measures of local and global cohesion for either the immediate or delayed conditions.

Overall the results provide partial support for hypotheses 1 and 2. The increased CIUs in both the immediate and delayed recall strategy condition confirmed that quantity of information recalled is enhanced by the multi-component strategy package. Readers' efficiency of recall, however, was only better in the strategy condition for the delayed free recall; no apparent improvement in efficiency was suggested when comparing the conditions in the immediate free recall. A few possibilities might account for these discrepancies in results: (1) perhaps the reading comprehension strategy package facilitated improvement across some, but not all aspects of reading comprehension, (2) perhaps some measures were not sensitive to the differences in performance in the RS and NS conditions, (3) perhaps research design issues, such as a low number of participants, or other sources of random error, limited detection of differences.

The reading comprehension strategy package was designed because of theoretical support suggesting reading comprehension strategies improve participants' abilities to form a coherent mental structural of the text. As previously discussed in Chapter II, identifying measures that reliability reflects improvements in mental structures is challenging. Theoretically, a more coherent mental structure should facilitate better understanding and retention of more information as the structure allows information to be grouped; this improvement should be reflected in an increase in the quantity of correct information units. The results support this theoretical rationale.

A more coherent mental structure should also bolster organization of content, and better organization of content should facilitate better efficiency of recall. The results from the RS condition of the delayed free recall task partially support this theory. The

preliminary, post-hoc exploration of three participants presented in Table 7 might help elucidate why efficiency did not seem to improve in the immediate free recall task. The pattern of differences suggested by these three participants showed that they paused more often and for a longer periods of time in the immediate free recall of the RS condition as compared to the NS condition. A similar pattern is noted when comparing the two delayed free recalls; however, when compared to their immediate free recalls, pauses were not as frequent or for as long in the delayed recall. Although all participants free recalls need to be reviewed and analyzed to determine is this pattern represents a significant difference, a few possibilities are suggested from the reading and cognitive rehabilitation literature. From the perspective of the SBF, a framework was constructed during the reading process, and as such, a more stable mental representation is available after reading (Gernsbacher, 1999). The difference in pause behavior in the immediate free recalls may be that access to a stable mental representation in the RS condition supports longer contemplation of what was learned. Increased time spent contemplating as suggested by increased pauses may be a better reflection of effect of reading comprehension strategies than improved efficiency of recall.

An improvement in efficiency in the delayed free recall may reflect better integration of and access to content compared to the immediate free recall. Kintsch (1998), Magliano, Millis, Ozuru and McNamara (2007), and others emphasize that the reading comprehension process continues after the physical reading activity ceases.

In particular, further integration of content continues:

Once the net is constructed, the integration process takes over: Activation is spread around until the system stabilizes (Kintsch, 1988; pg. 168).

In the SBF, integration occurs through a mechanism of enhancement that increases the activation of contextually relevant information (Gernsbacher, 1996). The increased activation of information within the framework may allow quicker retrieval of that content in the delayed free recall.

Although readers recalled more CIUs in both recalls, and were more efficient in the delayed free recall, they did not demonstrate better cohesiveness of recall. A more coherent understanding of chapter content with strategy use should be reflected through a more cohesive discourse sample as measured by latent semantic analysis at the sentence-to-sentence level, and paragraph-to-paragraph level (Coelho et al., 2005; Davis & Coelho, 2004; Laundauer et al., 2002). Several possible explanations may account for the lack of significant difference between RS and ST conditions for the LSA measures. First, the measures may not be sensitive enough to detect differences in discourse cohesion between the free recalls in the strategy and no-strategy conditions. Related, LSA measures may not be the best proximal indicator of coherent understanding for this study design. LSA has been used successfully when comparing iterative productions from the same individual on the same topic, but may not be as helpful when comparing two productions from the same individual but on different topics (McNamara et al., 2006). Third, the ABI population has known deficits in discourse production that include poor use and organization of structural elements (Coelho, 1999; Moran et al., 2011).

Discerning between coherence of understanding and discourse generation deficits may be difficult through evaluation of cohesion indicators; evaluating coherence of understanding through free recalls in the ABI population may be too unreliable.

Despite the lack of difference on the LSA measures, the significant findings on the CIU and CIU/minute variables with the modest, but respectable effect sizes provides positive support that individuals with ABI can benefit from reading comprehension strategies to improve quantity and efficiency of recall.

Effects of Strategy Use on Accuracy and Type of Recall

Research Question 3 asked whether readers with ABI would perform better when provided with the reading strategies as measured by overall accuracy and response patterns on the sentence verification task. On the sentence verification tasks, readers performed better when provided with reading strategies. The results showed a significant relationship between the strategy condition and how participants performed on the sentence verification tasks. This relationship was demonstrated when the paraphrase, local and global statements were considered as a composite, and accounted for 58.6% of the variance in scores. When the three statement types in the sentence verification task were considered individually, strategy condition accounted for 50.4 % of the variance in the local cohesion scores, and 25.0% of the variance in the global cohesion scores. Strategy condition did not have a differential influence on the scores of the paraphrase items.

The rationale for the expectation that participants would improve their accuracy of response on the sentence verification tasks stems from the Structure Building

Framework. The design of test items as described in Chapter III and Appendix D was based on the SBF conceptualization that text understanding evolves over time at two different levels: globally and locally (Gernsbacher, 1991, 1997; Graesser et al., 2003; Kintsch, 2004; Lorch, 1995). Global coherence develops as ideas within a text are related to the overall theme of the text (Gernsbacher, 1991, 1997; Graesser & Forsyth, 1997; Kintsch, 2004; Kintsch & van Dijk, 1978). Local coherence develops as common constituents between sentences in close proximity are recognized (Gernsbacher, 1991, 1997; Graesser & Forsyth, 1997; Kintsch, 2004; Kintsch & van Dijk, 1978). The positive outcome on the local cohesion and global cohesion sentence types provides support that reading comprehension strategies are associated with an improvement in accuracy in recognizing concepts that reflect these two different levels of a coherent understanding.

The lack of significant change on the paraphrase items was unexpected. As noted in Chapter III, the internal reliability of these items was on the borderline between adequate and good, less than the other two categories of item types. One possible artifact of the test items is that the paraphrase items may have included more details compared to the local and global cohesion statements, which could have made them more challenging. The reading strategy package used in this study did not specifically target recall of facts and details.

As an overall measure of better understanding, the findings are encouraging. The findings are a promising suggestion that RS improve not only quantity and efficiency of comprehension, as measured by the free recall task, but also the coherence of understanding. Perhaps, as suggested above, the selected free recall measures do not

detect changes in coherence of understanding, but a task like the sentence verification task may be a sensitive indicator. Certainly, in this early stage of research, inferences regarding what aspects of the actual comprehension process were measured must be made cautiously and tentatively. The measure is experimental, and further validation is needed to claim the purported constructs are adequately represented.

Study Limitations

The purpose of the current study was to evaluate whether using a multi-component, reading comprehension strategy package (RS) improves reading comprehension performance of individuals with a history of mild to moderate acquired brain injury. While the results are promising, the limitations of the study highlight the need for more research in order to adequately address the reading comprehension impairments of adults with acquired brain injury. The current study encourages future research and provides direction for the design of studies. Study limitations and suggestions are organized according to methodology and population issues.

Methodological issues. The research design was developed to control for many known, potentially confounding variables. For example, to control for the effects of differences in aspects such as text structure and background knowledge on comprehension, the study only used expository text drawn from one textbook from one discipline area. While the design did help constrain variability due to these potential effects, the restrictions limit the ability to generalize the findings to other text structures and genres.

The study was also conducted in collaboration with a community college based acquired brain injury program located on one campus site. The benefit of this collaboration was the high level of ecological validity; the intervention developed for this study is targeted to adult college students with ABI. However, the limitation to one site may have introduced variability unique to that location and population; this issue further limits generalization of findings.

In Chapter II, the lack of validated reading comprehension tools was identified as one of the barriers facing reading research and intervention (Pearson & Hamm, 2005; RRSF, 2002; Sweet, 2005). The dependent variables used for this study were experimental. The evaluation of the measures reported in Chapter III provided support that they possessed a generally, “good” level of reliability, and as previously noted, standardized measures were not available. Still, as experimental measures, they are more vulnerable to error than standardized measures would have been, need to be interpreted with caution, and as discussed above, may not be sensitive to clinically significant differences in individuals.

An additional methodological limitation was that the researcher was the primary interventionist, and was not blind to the conditions. A bias toward the strategy condition may have inadvertently influenced delivery of instructions. To prevent this from happening, parallel scripts were established to constrain delivery of instructions in both conditions, and all sessions were recorded. In addition, an instructor from the CCC ABI program was trained and delivered 10% of the reading sessions. Nonetheless, replicating the study with trained instructors will be important to further validate the findings.

Within-population variability. The goal of this study was to evaluate whether adult college students with ABI would benefit from using reading comprehension strategies. As a group, this benefit was demonstrated. However, not all participants benefited, and some seemed to benefit more than others.

In Chapter II, the inherent variability of the ABI population was addressed. Narrowing the inclusion criteria used in this study for the purposes of research might have limited the variability somewhat; however, the clinical population seeking help for reading comprehension issues after ABI is diverse. Clinical researchers need to find the commonalities within the population, while also responding to the diversity.

In this study, the constraints of the research design required implementing the reading comprehension strategies in a manner that does not necessarily match best clinical practices. For example, all individuals received all reading comprehension strategies. Other supports that may benefit readers besides strategies, such as text to speech, were not available to avoid confounding interpretation of improved outcomes. However, the clinical reality is that not all clients need, or benefit from, the same reading comprehension strategies and supports. A more clinically effective approach will be to match strategies and supports to particular needs and abilities. The findings from this study provide a basis for further evaluating individual differences.

An equally important clinical practice that was not included as part of this study is systematic training of the strategies. Given the focus of the research question and the constraints of the research design, systematic instruction was not provided. The positive response to systematic instruction within the ABI population is well established

(Sohlberg & Mateer, 2001; Sohlberg & Turkstra, 2011). Quite possibly the benefit of reading comprehension strategies noted by the findings of this study would have been greater had systematic instruction and practice using the strategies been included as a component of the intervention. The inclusion of systematic instruction with reading comprehension strategy training will be important to validate.

Extending the Findings to Future Research

In this section, three of the research needs suggested by the findings of this study as well as by other issues that arose through the process of conducting this study are discussed. These needs include: (1) continued clinical research to develop and evaluate reading comprehension interventions for adults with ABI, (2) more basic research to better understand reading comprehension in adults with ABI, and (3) further development and evaluation of technology tools that might support or facilitate improvement in the reading comprehension abilities of adults with ABI.

Clinical intervention research. The findings of this study validate further investigation into the use of reading comprehension strategies as an intervention approach for adults with ABI who complain of problems with reading after their injury. Given that jobs after college increasingly require knowledge in science, technology, engineering, and medicine (Lee & Spratley, 2008), evaluating reading comprehension performance and response to strategies in alternative disciplines are particularly important. Evaluating the impact of reading comprehension strategies with participants from a range of settings is also crucial to discern between generalizable effects and setting specific effects.

Besides additional validation studies regarding the impact of a general reading comprehension strategy package, clinical intervention research is needed to incorporate and evaluate clinical best-practices including systematic training and matching particular strategies to individuals. The knowledge needed to do this requires two approaches. Through a series of single case research studies, the effects of particular strategies or sets of strategies on the reading comprehension performance of different individuals faced with different reading demands can be evaluated. The findings of these studies would need to be considered in light of findings learned from basic research approaches conducted to determine whether individuals with ABI can be characterized into different ability profiles. Methods for generating this basic knowledge are discussed in the following section.

For both future group studies and single case studies, evaluating the impact of reading comprehension interventions requires assessing reading comprehension. Assessment is also important for developing clinical treatment plans specific to clients' needs and abilities (Sohlberg & Mateer, 2001; Sohlberg & Turkstra, 2011). Given the lack of validated and reliable measures, intervention research will need to include developing or adapting tools drawn from related applied fields or the experimental literature. The results from this study validate use of free recall and sentence verification tasks as methods for assessing the impact of reading comprehension interventions. Within free recall tasks, use of total correct information units and efficiency of recall were sensitive to differences between strategy and no-strategy conditions. Further evaluation of other discourse measures such as causal coordinator to participle ratios (Griffiths, &

Sohlberg, 2012) may provide additional insights into the differential impact of interventions.

Basic research. As discussed in Chapter II, more knowledge is needed to better understand the reading comprehension process in both proficient and impaired readers, and the cognitive underpinnings for reading comprehension. Increasing the understanding of reading comprehension in adult readers with ABI will contribute both to the clinical literature base for this population as well as to the general knowledge base about reading comprehension. Although not the focus of this dissertation, several cognitive, language, and other reading measures were given to the participants in the current study to help establish profiles of this population. Using these measures to comprehensively describe this population will begin the process of understanding the impact of acquired cognitive impairments on reading comprehension.

These data can be used to further explore whether underlying clusters of characteristics can be used to identify category profiles within this population, and whether certain characteristics or clusters of characteristics can predict how well individuals benefit from use of reading comprehension strategies. As indicated earlier, being able to characterize and profile the reading abilities of adults with ABI will be important for being able to select appropriate interventions for individuals.

Generating additional sources of data to contribute to the general knowledge base can happen in conjunction with clinical research studies. As with clinical intervention research, valid and reliable assessment methods are needed for research conducted to

illuminate the nature of reading comprehension and reading comprehension problems in adults with ABI.

Evaluation and development of technology tools. Technology tools were instrumental in the delivery of the reading comprehension strategy package, as well as for the analysis of the results. Both reading conditions were delivered via a web-based program. For the purposes of this dissertation, technology was employed to insure consistent delivery of conditions, as well as to track details about participant usage. In the strategy condition, prompts and instructions to complete strategy steps were provided electronically. In clinical situations, without technology, clients must either remember to do these steps, or remember to look at an external aid such as a written checklist to do the steps, or be reminded by another person to do them, practices some clients report as cumbersome or limiting (Griffiths et al., 2010). Technology can help ease the burden of remembering without increasing dependency on another person.

The results of this study provide empirical support for exploring how technology can be employed to support readers' use of reading comprehension strategies. Using technology to directly provide prompts and reminders is one possibility; use of technology as external reminders is an intervention approach with strong empirical support within cognitive rehabilitation (Kennedy et al, 2008).

The capacity to track and analyze copious amounts of data "behind the scenes" while readers continue to read also provides tremendous potential for further customizing reading comprehension supports. For example, tracking and analyzing student behavior in order to provide customized feedback is a growing area within education and has

potential for reading comprehension with the ABI population (Biancarosa, & Griffiths, 2012; Sohlberg & Turkstra, 2011). The data tracking capacity of technology has implications for use in overall assessment of reading comprehension as well.

Summary

This study evaluated whether adult college students with mild to moderate ABI benefited from using a multi-component, reading comprehension strategy package to improve comprehension of expository text. The results indicated that providing these readers with reading comprehension strategies was associated with better recall of correct information units in both immediate and delayed free recalls, improved efficiency of recall in the delayed free recall, and a more accurate ability to recognize statements from a sentence verification task designed to reflect local and global coherence. The findings support further research into using reading comprehension strategies as an intervention approach for the adult ABI population. Future research will need to include identifying how to match particular reading comprehension strategies to individuals, and evaluating the impact of reading comprehension strategies with this population using texts from a range of disciplines.

APPENDIX A

COGNITIVE AND LANGUAGE AND READING ASSESSMENTS

Note the results of the comprehensive battery were not directly related to the research questions and are not reported as part of this dissertation. The assessments were completed over two sessions (one and four), as outlined in Table 3 in the Chapter III.

Below is a list of the assessment measures given as part of the battery.

Session 1: Cognitive Assessment

Attention and working memory

Woodcock Johnson III: Visual matching (Timed: 2 minutes x 2)

Woodcock Johnson III: Numbers reversed (5 minutes)

Paced Auditory Serial Addition Test (PASAT)

Verbal learning and recall

California Verbal Language Test (10 min, 5 min)

Woodcock Johnson III: Memory for words (5 minutes)

Executive processing

Woodcock Johnson III: Planning subtest (10 minutes)

Cognitive efficiency

Woodcock Johnson III: Decision speed (Timed: 3 minutes)

Speed of Comprehension Test (SCOLP) (Timed portion - 2 minutes; untimed portion – 10 minutes)

Session 4: Language and Reading Assessment

Comprehension skills

Woodcock Johnson III: Verbal comprehension (10 minutes)

Woodcock Johnson III: Story recall (15 minutes)

Woodcock Johnson III: Understanding directions (5 minutes)

Expressive skills

Woodcock Johnson III: Rapid picture naming (Timed : 2 min)

Discourse task (10 minutes)

Word recognition skills

TOWRE-2 (Timed: 2 minutes, 2 minutes)

Vocabulary knowledge

Woodcock Johnson III: Reading vocabulary (10 minutes)

Reading comprehension

Woodcock Johnson III: Passage Comprehension (15 minutes)

Background knowledge

Woodcock Johnson III: Academic knowledge (10 minutes)

Metacognitive Awareness of Reading Strategies Inventory (10 minutes)

APPENDIX B

SAMPLE PASSAGE MAP

Title: Development of Social Complexity

Genre: Informational—Expository—Anthropology Textbook

Text Features: Headings & subheadings, images with captions, map with caption
vocabulary words written in bold-faced print in text with definitions in the margins,
chapter summary, key terms, review questions.

Author’s Craft: denotation (definitions), paraphrase (of different anthropologists' beliefs), comparing & contrasting.

Central Idea: Understanding how political and social complexity change as societies grow, including factors that lead to the emergence of centralized authorities, can help us understand sources of inequality.

Dominant Organizational Patterns: Describes, then compares and contrasts different frameworks used by anthropologists to study political and social complexity.

Major and Supporting Ideas/Role in Organization in Chapter:

Organizing Element

Type: Heading—Defining Social Complexity

Organizational pattern of section: Introduce topic

Major Idea(s):

- Although centralized government is a fairly recent phenomenon in the history of human society, centralized government is now a global phenomenon that shapes the way we live.

Supporting Idea(s)

- With few exceptions, the world is divided into sovereign entities governed by central authorities.
- Early archeologists assumed the emergence of centralized government was an improvement for civilization.
- Lewis Henry Morgan and V. Gordon Childe believed centralized government and complex social structures were the next step toward progress after the development of agriculture.
- Modern archeologists see the development of political complexity as a process that requires explanation and cannot simply be viewed as a natural result of progress.
- Political and social complexity increases social inequality while reducing personal autonomy.
- The legitimacy of centralized government was likely established through a combination of consensus and coercion.

Organizing Element

Type: Heading—Categorizing Political Complexity

Organizational pattern of section: Describe; compare/contrast

Major Idea(s):

- Anthropologists have developed different schemes to model commonalities in the ways political complexity develops.

- Morton H. Fried and Elman Service both see political complexity as a move from kin-based to non kin-based governments.
- Fried defined societies based on how prestige is marked, while Elman Service defined societies based on how power is exerted.

Supporting Idea(s):

- Morton H. Fried (1967) defined four different types of societies based on how prestige is marked:
 - Egalitarian – Status based on combination of skill, age, and gender; production and exchange kin-based, reciprocal
 - Ranked – Status based on hierarchy of a single attribute (e.g., birth order); those with prestige status oversee distribution but do not consume more; prestige carries little political power.
 - Stratified – Status linked to access to resources; access to resources creates disparities in power; disparities in power lead to exploitation, for example, forced labor. Organization based in kin and communities of people.
 - States – Status organized on a supra-kin base with increased centralized power, enforced by boundaries, legal system, military/police, taxation, and conscription. Increased control of access to resources.
- Elman Service (1971) defined four different types based on how power is exerted:
 - Bands: similar to Fried's egalitarian
 - Tribes, similar to Fried's ranked societies;

- Chiefdoms – Intermediate level of social complexity with central authority based on heredity. Defer to religious authority.
- States – Central authority accepted through monopolization and controlled use of force.

Organizing Element

Type: Heading—Defining Cities

Organizational pattern of section: Describe; compare/contrast

Major Idea(s):

- V. Gordon Childe characterized urban areas based on visible traces in archeological record, but other anthropologists point out these features are not well-defined and may be present in rural towns and villages.

Supporting Idea(s):

- V. Gordon Childe proposed ten criteria which have visible traces in the archeological record, urban centers, surplus production and storage, taxes to a deity or king, monumental architecture, a ruling class, writing systems, exact and predictive sciences, sophisticated art styles, foreign trade, and specialist craftsmen.
- Henry Wright & Gordon Johnson distinguished between three different levels of settlement sizes as a more reliable way to characterize societies, with different size settlements reflect different administrative structures.

- Norman Yoffee (2005) noted the rise of cities was also the birth of the origin of rural towns and villages.

Organizing Element

Type: Heading—A Comparative Approach to State Formation

Organizational pattern of section: Description & Compare/Contrast:

Major Idea(s):

- Utilizing a comparative approach to describe state formation has advantages but also disadvantages that can lead to misleading conclusions.

Supporting Idea(s)

- A comparative approach does not account for unique differences in a society's social structure or evolution;
- Emergence of inequality in societies does not follow just one course.
- Societies in northwest coast of North America maintained hunter-gatherer lifestyle, typically associated with egalitarian societies, yet had complex social hierarchy that included slavery.
- Individual differences may be better represented on a continuum.
- A comparative approach does allow anthropologists to compare/contrast regularities across societies.
- Transition to state societies took place independently in a number of regions.

- States may be divided into primary states (which form without external neighboring influences) and secondary states (which form with influence from neighboring state societies).
- Empires are formed when states' aggressive expansion campaign unites several heterogeneous groups under one ruler.

Organizing Element

Type: Heading—Ecology and Society

Organizational pattern of section: Compare/Contrast:

Major Idea(s):

- Some theories propose a single factor caused state formation while others suggest multiple factors contributed.

Supporting Idea(s):

- Karl Wittfogel proposed the reliance on agriculture required organization of large groups of workers to build irrigation, which created a hierarchical government and thus, state formation.
- Robert Carneiro proposed state formation developed as through a dynamic interaction between geography, population increase, and competition for limited resources.

Organizing Element

Type: Heading—The Source of Power

Organizational pattern of section: Compare/Contrast:

Main Idea(s)

- As societies get larger, inequality arises as power becomes institutionalized.

Supporting Idea(s):

- Development of specialized craft skills; writing and math systems; as well as control of information and resources were sources of power in early state societies.
- Power may also have identified in those with connections to the gods, or from symbols of power (e.g., thrones, scepters) that may have inspired fear, awe, or loyalty.

Chazan, M. (2011). Part IV: The development of social complexity. In M. Chazan's

World Prehistory and Archeology: Pathways Through Time, pp. 246-253.

New Jersey: Pearson Education, Inc.

APPENDIX C

DEVELOPMENT AND VALIDATION OF SVT

The researcher and research assistants developed the sentence verification tests (SVTs) using the following procedure adapted from Royer (1975). The original text from each chapter was divided into T-units during the process of equating passages. Two researchers coded each T-unit as either autonomous or non-autonomous. Autonomous T-units could be understood independently of the rest of the text; for example: “Mankind are the only beings who may be said to have gained an absolute control over the production of food.” Non-autonomous c-units required reference to the text to be understood; for example: “This led to an increase in the food supply, which in turn supported an increase in population, resulting in the development of settled villages.”

Paraphrase sentences were developed based on autonomous T-units. Almost all content words within the T-units were replaced with synonyms. Using the example above, a sample of a paraphrase sentence is: “*Humans* are the only *creatures* who may be said to have *achieved complete power* over the *creation* of food.” Local cohesion statements were developed based on non-autonomous T-units. Content words within the T-units were also replaced with synonyms but in addition were made explicit by integrating nearby content containing the implied information: “*The transition from hunting and gathering to farming* led to a an *increase* in the food supply, which in turn *sustained a growing population, leading to the emergence* of settled villages.” Global cohesion statements were developed based on the chapter maps generated earlier. As part of that process, two to three statements were generated for each section of the text that summarized the key ideas of that section. Construction of those statements typically

involved synthesizing several sentences into an overarching idea. For example, based on section three of the Chapter A, a global statement was: *Today's anthropologists question whether agriculture is really a better way of life than hunting-gathering.*

Two versions of each item were developed for each sentence type: a true sentence and a false sentence. True sentences were developed first. False sentences were then constructed based on the each true statement. False sentences were developed by first trying to replace at least one content word with an antonym. If an antonym was not available, content words were replaced by a competing concept from the text. For example: Humans *like many other creatures* are said to have achieved complete power over the creation of food.

The first and second researchers each produced half of the paraphrase items for each passage. The first and third researchers both produced local coherence items and global coherence items. All items were then pooled together. The researchers then independently read each item and rated each as either clear or unclear. Occasionally, substituting content words with synonyms resulted in awkward sentences; the purpose of the review was to eliminate unclear items.

The test items were piloted by asking thirty undergraduate volunteers to read the chapters and then complete the sentence verification tasks, consisting of sixty test items per chapter. In addition, four volunteers completed the sentence verification task without reading the chapter to help eliminate items that could be easily answered based on background knowledge only. See Table C.1 for a summary of results. Mean scores showed a lower performance overall for Chapter B compared to Chapter A for all

volunteers. Accuracy rates of items from each chapter were reviewed and compared to identify items that could be eliminated. To improve validity, items that had an accuracy rate of 100% by the volunteers who did not read the chapters were eliminated from both tests. Items that were missed by 90% or more of the volunteers were also reviewed to eliminate items that may have been unclear.

Remaining items were categorized by their original type: paraphrase, local cohesion and global cohesion to compare performance between statement types. Accuracy of paraphrase items was significantly higher for both chapters compared to both cohesion items; however, no difference was noted between local and global cohesion items. The two cohesion items were both constructed to reflect inferences generated at different levels of the text: locally based on nearby text and globally based on the overall text.

To equate difficulty, the distributions of accuracy of individual items from both chapters were compared (See Table C.2). For the Chapter A, items answered correctly by 80% of the volunteers (who read the chapter) were eliminated to increase the difficulty of that test. Items from the Social Complexity chapter answered correctly by 20% or fewer of the volunteers were also eliminated to decrease the difficulty of that test. Finally, remaining items were reviewed to eliminate redundant questions and to ensure an equal number of paraphrase and inference items were represented. Ultimately thirty items were selected for each chapter, ten from each category. For the analysis, number of accurate response for each item type was calculated.

Pilot Study and Validation

Before the dissertation study, a pilot study was conducted to evaluate the SVTs to ensure they were valid and reliable. Tools are considered valid to the degree they measure what they purport to measure and reliable when they yield consistent results under similar conditions (American Educational Research Association (AERA), American Psychological Association (APA), & National Council on Measurement in Education (NCME), 1999; Shipley & McAfee, 2009).

The foundation for the validity of the tests was established by developing a type of instrument that is widely used and has already been validated in the research community to evaluate reading comprehension, and that aligns with the theoretical constructs that undergird this study. The foundation for reliability was established by drawing from existing operationalized procedures for developing items (Royer, 1975), and by evaluating the fidelity of item development through ongoing consultations with research team members.

The objectives of the pilot study were to further establish reliability by insuring the total scores and subtest scores by sentence type were: (1) characterized by normal distributions, (2) equivalent in overall level of difficulty, and (3) equivalent in the distribution of test items by difficulty, sentence type and content location in the chapters. Additional objectives were to further establish validity by: (1) comparing performance on the tests to external measures known to correlate with reading comprehension ability, and (2) insuring performance on the tests were not passage independent (i.e. participants who read the chapter would do better than those who did not).

Pilot methods. To meet these objectives, currently enrolled undergraduate students were recruited to read the two test chapters and take each sentence verification test, as described in more depth in the two sections below. Results on the two tests were initially evaluated by examining the distributions of scores and by comparing participants' performance as measured by percent accurate to provide preliminary support for equivalency and identify problems. Next, results were evaluated by comparing the accuracy and distribution of individual test items across the two tests. Item accuracy was considered an approximation of level of difficulty. Item sets were reduced to improve equivalency of distribution and to shorten the overall tests. Correlations between the two trimmed tests were calculated. As a final step, a regression analysis was conducted to evaluate whether results on a vocabulary measure given as part of the pilot test predicted performance on the sentence verification tests.

In the following section the pilot test is described in more detail. The next section describes the participants including how they were recruited, how data was screened, and basic information about them. After these two sections, the results used to evaluate reliability and validity are presented. Finally, the conclusions of the pilot study are discussed including consideration of weaknesses of the final measures.

Pilot test description. The pilot test consisted of five sections: (1) Participant information survey, (2) a speed of comprehension test, (3) a vocabulary test, (4) the sentence verification task for chapter A, (5) the sentence verification task for chapter B. All sections of the test were delivered electronically via the survey software Qualtrics. Potential participants accessed the test via a secure link and were not supervised during the testing. The link was available during fall quarter, 2012.

The participant information survey asked basic information including age, gender, major, year in college, prior history of brain injury, loss of consciousness, or learning disability. The next two sections were adapted from the *Speed and Capacity of Language Processing (SCOLP)*; Baddeley, Emslie, & Nimmo-Smith, 1992) test. The *SCOLP* consists of two separate subtests: (1) the *Speed of Comprehension Test*, a measure of the rate of information processing, and (2) the *Spot the Word* test, a measure of word knowledge. The paper version of the test has been validated on a range of individuals from age 16 to 62 from a range of populations including adults with and without acquired brain injury.

The *Speed of Comprehension Test* subtest was a two-minute timed test that required participants to read a series of sentences and to quickly decide if, based on general world knowledge, was true or false. For example, “Rats have teeth,” would be true but “Desks wear clothes,” would be false. The *Spot the Word* subtest was an untimed test that required participants to read sixty paired items consisting of a real word and a nonsense word, and to decide which word was the real one. For example, in the pair “kitchen” and “harrick,” the word “kitchen,” would be the real word.

The sentence verification tests for chapters A and B were given in the final two sections. For each chapter participants downloaded a pdf version of the chapter and were asked to read the chapter for ten to fifteen minutes. After reading the chapter, they were asked to spend five minutes to write a few notes about what they learned from the chapter. After five minutes, they were presented with the sentence verification task that consisted of sixty true/false test items. They were given fifteen minutes to answer the questions. The process was repeated with the next chapter.

Pilot participant description. Pilot participants were recruited from a class of students taking an undergraduate introductory course in Communication Disorders and Sciences (CDS). The instructor advised students that completing the pilot test was one of different options for earning extra credit in the course. Participation was voluntary. All students were provided with a link to a secure online survey via Qualtrics to access the test. Students who opted to participate clicked a link at the end of the test that took them to a separate survey that gave them the option to enter their name for extra credit; only names given by students were given to the professor of the course. Students' performance on the test were not linked to their names.

Forty-two responses were recorded. Data were screened to ensure completeness, and to eliminate responses that suggested poor effort. Results of the *SCOLP* were also screened to identify any participants with below average vocabulary scores, or any participants with a clinically significant discrepancy between the *Speed of Comprehension* subtest and the vocabulary subtest. A difference of more than four scaled score points would suggest the possibility of a cognitive impairment (Baddeley et al., 1992).

Twelve participants' data were excluded because they did either not complete all of the tests, or left more than 25% of questions blank on one or both SVT tests. One participant's data was excluded because she answered "true" to all questions. One participant's data were excluded because she scored more than two standard deviations below average on the vocabulary test. None of the remaining participants had a discrepancy larger than four scaled score points between the two subtests of the *SCOLP*.

Data were retained for the twenty-eight participants. The sample included twenty-five women and three males. Age ranged from twenty to forty, with a mean of 23 years (SD=6 months). All were CDS majors; thirteen were juniors, one was a senior and thirteen were at the post-baccalaureate level.

Five self-identified as having a prior concussion or brain injury, six self-identified as having a prior learning disability, and two self-identified as having both a prior concussion or brain injury and a learning disability. Although participants met screening requirements, which included no evidence of cognitive impairment as measured by the *SCOLP*, group differences could still affect how participants performed on the sentence verification tasks. Therefore participants were coded as belonging to one of three groups: no impairment, ABI or concussion, and learning disability. The two individuals who reported both an ABI and learning disability were included in the ABI group. See Table C.1 for a summary of participants' scores on the *SCOLP*.

Table C.1
Summary of Speed of Comprehension and Vocabulary Scores

		Speed of Comprehension		Vocabulary	
		Raw	Scaled Score	Raw	Scaled Score
Total	28	47.64 (20.57)	10.00 (3.00)	50.21 (4.65)	11.61 (2.70)
No dx	15	46.47 (17.24)	9.83 (2.51)	51.60 (3.83)	11.93 (2.52)
ABI	7	49.57 (25.86)	10.28 (3.77)	50.00 (5.03)	12.00 (3.06)
LD	6	48.33 (25.29)	10.10 (3.68)	47.00 (5.22)	10.33 (2.81)

Note. Raw scores for speed of processing represent the number of accurately answered items within two minutes from a possible one hundred items. Scaled scores for speed of processing were derived based on the sample. Raw scores for vocabulary are the number of correctly identified words from 60 real word + nonsense word pairs. Scaled scores for vocabulary were based on published norms (Baddeley et al., 1992).

Pilot Reliability. The distribution of scores for the raw tests was roughly normal for the all score categories. See Figures C.1 and C.2. Examination of the distribution of item difficulty across the three sentence types indicated distribution was roughly equivalent across the paraphrase sentence types. However, the distributions were uneven across the other two sentence types, particularly for the local sentences.

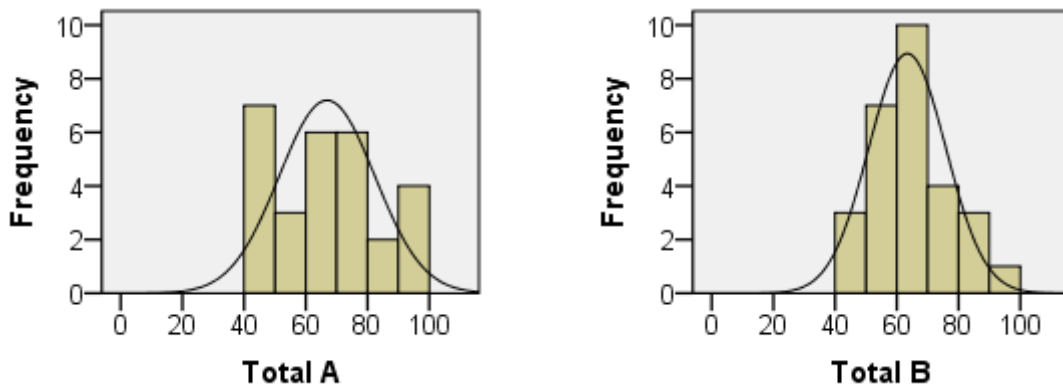


Figure C.1: *Frequency of participants' total percentage scores for chapters A and B.*

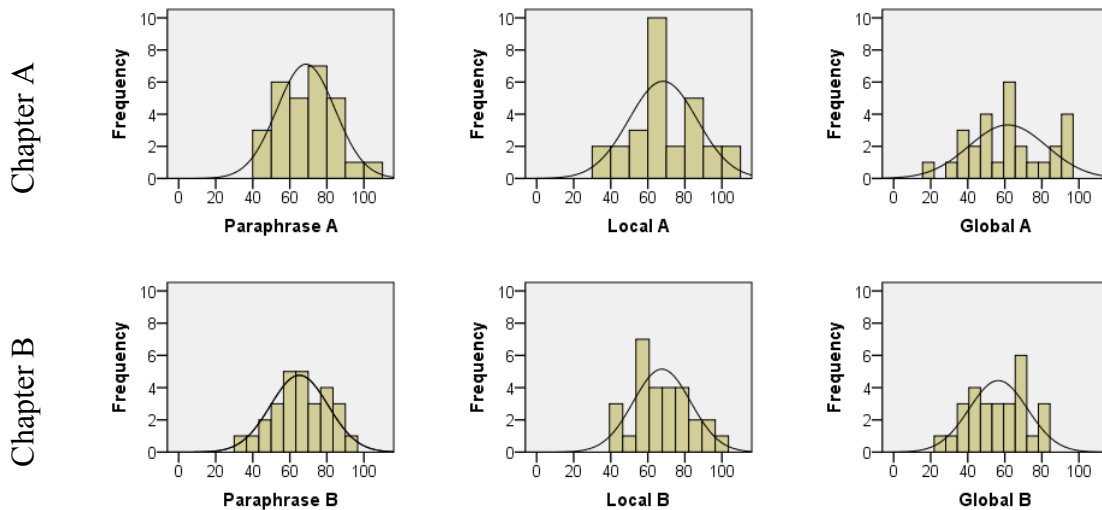


Figure C.2: *Frequency of participants' subtotal scores by sentence types for chapters A and B.*

Item trimming was conducted to improve distribution. See Table C.2 for summary of all items, with selected items underlined.

Table C.2

Map of Item Difficulty by Item Type for Each Chapter

Item difficulty	Paraphrase		Local		Global	
	A	B	A	B	A	B
.1304						
.1739						
.2174						<u>48_F</u>
.2609	<u>07_F</u>	<u>20_F</u>	<u>32_F</u>	<u>23_F</u>		
.3043				<u>06_F</u>		<u>16_T</u>
.3478	<u>29_F</u>	<u>26_F; 43_F; 49_F</u>			<u>21_F</u>	<u>46_F; 18_T</u>
.3913	<u>03_F; 06_F; 25_F; 28_T</u>	<u>02_F;</u>			<u>05_F; 17_F;</u>	
.4348	<u>02_F; 08_F; 18_F</u>	<u>25_F</u>		<u>14_F</u>	<u>35_T; 35_F</u>	<u>15_F; 47_F</u>
.4783		<u>04_F; 27_F</u>			<u>44_T; 19_F</u>	<u>10_F; 24_F</u>
.5217	<u>04_T; 06_T; 23_F; 29_T</u>		<u>11_F; 12_F; 16_F</u>	<u>07_F</u>	<u>14_F;</u>	
.5652	<u>08_T</u>	<u>01_T; 12_F; 12.2_F</u>		<u>08_F</u>	<u>21_T</u>	<u>09_F; 22_F</u>
.6087	<u>25_T</u>	<u>11_F; 43_T</u>			<u>17_T</u>	
.6522	<u>01_F; 24_F</u>	<u>21_F; 20_T</u>	<u>26_F; 33_F</u>	<u>13.2_T</u>	<u>05_T; 20_T; 20_F</u>	
.6957	<u>04_F; 09_F; 40_F; 24_T; 27_T; 30_F</u>	<u>03_F; 05_F; 12_T</u>		<u>14_T</u>		
.7391	<u>04_T; 02_T; 22_F; 28_F</u>	<u>04_F</u>	<u>11_T; 16_T; 34_F</u>		<u>19_T; 36_F</u>	<u>09_T; 10_T</u>
.7826	<u>03_T; 07_T; 40_T; 27_F</u>	<u>05_T; 11_T;</u>	<u>33_T</u>			<u>17_T; 24_T</u>
.8261	<u>18_T; 22_T; 23_T</u>	<u>02_T; 03_T; 25_T</u>	<u>31_T</u>			
.8696	<u>09_T</u>		<u>13_T</u>		<u>36_T</u>	<u>22_T</u>
		<u>04_T</u>				
.9130	<u>45_T; 15_F,</u>	<u>12.2_T; 49_T</u>	<u>26_T</u>	<u>08_T; 28_T</u>		
.9565			<u>12_T</u>	<u>06_T; 07_T; 23_T</u>		
1.000						

To determine whether there were significant correlations between Chapter A test scores and Chapter B test scores, Pearson's correlation statistic was conducted.

Correlations were significant for between chapter comparisons for total scores ($r=.816$, $p < .05$).

Finally a regression analysis was conducted to determine if vocabulary scores from the *SCOLP* predicted overall scores on the combined SVTs. The result was significant ($r=.008$, $p=.05$).

Overall, the analysis of results indicates the two sentence verification tests were grossly equivalent. Distributions of scores were normal and item difficulties were evenly distributed across chapters. The correlation results also indicated that how a participant performed on one of the sentence verification tests was significantly correlated with how that participant performed on the other test; this finding was true for overall scores and subtotals based on the three types of sentences.

See Table C.3 for a summary of scores for each test and subtest. For descriptive purposes, the table includes scores by participant category as well. Note results of ANOVAs conducted to compare performance by participant category did not indicate any significant differences.

Table C.3

Summary of Scores by Sentence Type for each Chapter by Participant Category

		All (<i>n</i> =28)		No Dx (<i>n</i> =15)		ABI (<i>n</i> =7)		LD (<i>n</i> =6)	
		A	B	A	B	A	B	A	B
Total	\bar{X}	66.9	63.4	67.0	65.4	66.4	63.8	67.0	57.8
	SD	15.5	12.5	16.3	14.2	19.8	11.3	9.3	8.73
Paraphrase	\bar{X}	68.7	65.1	68.6	69.3	68.3	58.6	69.0	62.2
	SD	15.7	16.0	16.4	14.8	19.3	19.8	11.4	10.3
Local	\bar{X}	68.2	67.6	73.8	69.5	60.5	73.5	63.3	60.0
	SD	18.5	15.9	18.3	16.3	22.9	12.8	8.2	11.4
Global	\bar{X}	61.6	56.5	56.7	54.6	67.9	65.2	66.7	51.0
	SD	21.0	15.7	18.5	19.0	29.0	4.9	15.6	11.5

APPENDIX D

FREE RECALL CODING PROCEDURE

Manual coding procedures and examples from Nicholas and Brookshire (1993).

	Steps and Rules	Example
0.0	Preliminary Steps	
0.1	Delete statements that are made before or after the speaker performs the task or suggest that the speaker is ready to begin or has finished the task and do not provide information about the chapter itself.	<p><i>I hope I can remember how I did this before.</i></p> <p><i>I'll start by saying this.</i></p> <p><i>I'm supposed to tell you about washing dishes.</i></p> <p><i>I'm ready to start.</i></p> <p><i>That's about it.</i></p> <p><i>I can't say any more.</i></p> <p><i>The end.</i></p> <p><i>That's about what our Sundays are like.</i></p>
0.2	These statements should be grammatically separate from discussion of the picture(s) or topic. The following first statements by a speaker would be included in the word count.	<p><i>In the first picture, the man is angry.</i></p> <p><i>Well first of all, there's a couple fighting.</i></p> <p><i>Okay, there's a man and a woman.</i></p> <p><i>Well now, here's a picture of a party.</i></p>
1.0	Counting Words.	
	Definition: To be included in the word count, words must be:	
	<ul style="list-style-type: none"> • Intelligible in context to someone who knows the picture(s) or topic being discussed. Context refers to what the scorer 	

	knows about the picture(s) or topic and what the scorer knows from the speaker's prior words.	
	<ul style="list-style-type: none"> Words do not have to be accurate, relevant, or informative relative to the picture(s) or topic being discussed to be included in the word count. 	
	DO NOT COUNT THE FOLLOWING	
1.11	Words or partial words not intelligible in context to someone who knows the picture(s) or topic being discussed.	<i>He went to the frampi.</i> <i>That appears to be a norble.</i> <i>He had a st . . . sn . . . steak.</i>
1.12	Nonword filler (um, er, uh). (See 1.23 and 1.24 for a rule dealing with filler words and phrases, interjections, and informal terms.)	
	COUNT THE FOLLOWING	
1.21	All words intelligible in context. Count words that contain sound substitutions, omissions, distortions, or additions if the word is intelligible in context (hiscup for hiccup). If the incorrect production results in another real word that does not appear to be the target word, it is still included in the word count (paper for pepper).	
1.22	Commentary on the task, on the speaker's performance, or on the speaker's experiences.	<i>This is pretty hard.</i> <i>I can't think of that word.</i> <i>No, that's not right.</i> <i>My wife and I used to fight like that.</i>
1.23	Filler words and phrases (you know, I mean, okay). Do not count nonword fillers. (See 1.12.)	
1.24	Interjections (oh, oh boy, wow, golly, gosh, gee, aha, hmm) and informal terms (uh-huh [affirmative], un-uh [negative], nope, yep, yeah).	
1.25	Common contractions or simplifications of words (gonna for going to, sorta for sort of, em	

	for them). Contractions (both standard [don't, he's] and colloquial [gonna, sorta]) are counted as two words.	
1.26	Each word in hyphenated words Jack-in-the-box = 4 words).	
1.27	Each word in numbers (twenty-two = 2 words, one hundred thirty-four = 4 words, nineteen fifty-five = 3 words).	
1.28	Compound words as one word (pancake, cowboy).	
1.29	Each word in proper names (Mary Smith, St. Paul, Mason City = 2 words each).	
1.30	Count acronyms as one word (VA, VFW, TWA = 1 word each).	

2.0	<i>Counting Correct Information Units (CIUs)</i>	
	Definition: Correct information units are words that are	
	Intelligible in context,	
	Accurate in relation to the picture(s) or topic,	
	Relevant to and informative about the content of the picture(s) or the topic,	
	Words do not have to be used in a grammatically correct manner to be included in the correct information count.	
	Each correct information unit consists of a single word and only words that have been included in the word count can be considered for inclusion in the correct information unit count.	
	<i>Counting CIUs</i>	

	DO NOT COUNT THE FOLLOWING	
2.11	<p>Words that do not accurately portray what is in the picture(s) or that do not seem accurate in relation to the topic being discussed, such as incorrect names, pronouns, numbers, actions, etc. If a word reflects regional usage (such as calling the midday meal "dinner" in some areas), it is counted as a correct information unit. If grammatical incorrectness would lead to misunderstanding or uncertainty about the meaning of words, the grammatically incorrect words would not be counted as correct information units. (See 3.12 for examples of grammatically incorrect words that would be counted as correct information units.)</p>	<p><i>The girl is riding her bike. (The picture shows a girl with a bike nearby which she may have been riding, but which she is not currently riding.)</i></p> <p><i>The girl is on a ladder. She fell. (The picture shows a boy on a stool who is tipping but has not fallen yet.)</i></p> <p><i>The boys and girls are arriving. (The picture shows only one boy and one girl arriving.)</i></p> <p><i>If several people are involved in an action and only one of them is mentioned, the mentioned one is still counted as a correct information unit. This constitutes an incomplete description but not an inaccurate one.</i></p> <p><i>The boy is arriving. (The picture shows a boy and a girl arriving.)</i></p> <p><i>The man drove away. (The picture shows a couple driving away.)</i></p>
2.12	<p>Attempts to correct sound errors in words except for the final attempt.</p>	<p><i>He put paper popper pepper on his food.</i></p> <p><i>She saw her with her mass . . . mack. . . mask.</i></p>
2.13	<p>Dead ends, false starts, or revisions in which the speaker begins an utterance but either revises it or leaves it uncompleted and uninformative with regard to the picture(s) or topic.</p>	<p><i>My si . . . no no not my sister . . . my fa . . . with my wife.</i></p> <p><i>He goes over to her and puts his wants to give her a hug.</i></p> <p><i>He looks out and sees that she had the car ran into the tree.</i></p> <p><i>The . . . the . . . that one oh</i></p>

		<p><i>forget it.</i></p> <p><i>In the hose in the mouse in the house</i></p> <p><i>We go to a party no I mean a movie</i></p>
2.14	If an utterance is incomplete, but some information about the picture(s) or topic has been given, count that information.	<i>The kitchen window was . . .</i>
	In this example, the words the kitchen window would be counted as correct information units (if they meet the other criteria). Even though the entire statement was not completed, the words are informative.	
2.15	Words that express some legitimate uncertainty or change in perception about characters, events, or settings in a picture are counted as correct information units (if they meet the other criteria). See 2.18 for further examples.	<p><i>Her dad or maybe a neighbor was in the tree.</i></p> <p><i>From the looks of the candles, he must be four. No there is another candle on the table so he must be five years old.</i></p>
2.16	Repetition of words or ideas that do not add new information to the utterance, are not necessary for cohesion or grammatical correctness, and are not purposely used to intensify meaning.	<p><i>The blue truck was blue.</i></p> <p><i>The restaurant was a new one.</i></p> <p><i>It was a new restaurant.</i></p> <p><i>She was cleaning washing the dishes.</i></p> <p><i>Such repetition of words or ideas can be separated by other counted words.</i></p> <p><i>The mother was very angry.</i></p> <p><i>The daughter was crying. The mother was very mad.</i></p>
	Exceptions:	
	(a) If the repeated words or ideas are necessary for cohesion, they are counted	<i>She went to the store. The store was closed.</i>
	(b) If words are repeated to achieve effect or to intensify a statement they are counted.	<p><i>The girl was very, very sad.</i></p> <p><i>They were fighting, really</i></p>

		<i>fighting</i>
	(c) If repeated words are used to expand on previous information, they are counted.	<i>He put on a shoe . . . a left shoe.</i> <i>There were some people . . . a man and a woman.</i>
2.17	The first use of a pronoun for which an unambiguous referent has not been provided. Subsequent uses of the pronoun for the same unspecified or ambiguous referent are counted as correct information units (if they meet the other criteria).	<i>She (no referent) was doing the dishes. I think she was daydreaming.</i>
	If an inaccurate referent is provided but it is clear that a pronoun refers back to it, the pronoun would be counted as a correct information unit.	
	The fox (inaccurate referent) ate some of the cake and it was hiding.	
2.18	Vague or nonspecific words or phrases that are not necessary for the grammatical completeness of a statement and for which the subject has not provided a clear referent and for which the subject could have provided a more specific word or phrase.	<i>The mother is drying one of those things.</i> <i>She gave him some stuff.</i> <i>He put something up to the tree but that one knocked it down.</i> <i>We had pancakes or scrambled eggs or something like that.</i> <i>I wash the glasses and plates and so on.</i> <i>The words "here" and "there" frequently fall into this category.</i> <i>Here we have a boy.</i> <i>This here boy is crying.</i> <i>That mother there is doing dishes.</i> <i>There is a cat here and a dog there.</i> <i>The mother is there.</i>

		<p><i>She put them over here.</i></p> <p><i>She has a bike there.</i></p> <p><i>The cookies were up there.</i></p>
2.19	The following are examples of uses of "here" and "there" that are necessary for the grammatical completeness of the statement and cannot be replaced by a more specific word. These uses of "here" and "there" would be counted as correct information units.	<p><i>There is a boy.</i></p> <p><i>Here comes the same couple.</i></p>
	The following is an example of a nonspecific word that is preceded by a clear referent and would be counted as a correct information unit.	<p><i>The boy opened the cupboard.</i></p> <p><i>The cookies were up there.</i></p>
2.20	Conjunctive terms (particularly so and then) if they are used indiscriminately as filler or continuants rather than as cohesive ties to connect ideas.	<p><i>There is a man. Then there is a woman and then a cat.</i></p>
	When used cohesively, "then" indicates the temporal order or sequential organization of things or events.	<p><i>She had lunch and then she went to the store.</i></p> <p><i>When you go into my house you see the living room first, then the dining room, then the kitchen.</i></p>
	When used cohesively, "so" indicates a casual consequence.	<p><i>He was thirsty so he drank some juice.</i></p> <p><i>The mother was after the dog so the boy was crying.</i></p>
2.21	Qualifiers and modifiers if they are used indiscriminately as filler or are used unnecessarily in descriptions of events, settings, or characters that are unambiguously pictured. The following examples concern unambiguously pictured information.	<p><i>Apparently</i> this is a kitchen.</p> <p><i>Evidently</i> the boy is on a stool.</p> <p><i>I think that</i> the cat is in the tree.</p> <p><i>It looks like</i> the man is up in the tree too.</p> <p><i>The boy is sort of crying and the dog is kind of hiding.</i></p> <p><i>Of course,</i> the woman left in a huff.</p>

2.22	When used informatively, qualifiers and modifiers suggest legitimate uncertainty on the part of the speaker about events, settings, or characters portrayed in the picture(s) or modify associated words in a meaningful way. The following examples concern ambiguously pictured information.	<p><i>Apparently this is a mother and her two children.</i></p> <p><i>I think she is his sister.</i></p> <p><i>It looks like he gave them the wrong directions.</i></p> <p><i>She must be daydreaming.</i></p> <p><i>He might be the girl's dad or maybe he's a neighbor.</i></p> <p><i>He is the father or a neighbor.</i></p> <p><i>I don't know which.</i></p> <p><i>He looks sort of sad.</i></p> <p><i>Evidently they went around in a circle.</i></p>
2.23	Filler words and phrases (you know, like, well, I mean, okay, oh well, anyway, yeah), interjections when they do not convey information about the content of the picture(s) or topic (oh, oh boy, wow, gosh, gee, golly, aha, hmm), and tag questions (It is really smashed up, isn't it).	
2.24	The conjunction "and." "And" is never counted as a correct information unit because it is often used as filler and we have found that its use as filler cannot be discriminated reliably from its uses as a conjunction.	
2.25	Commentary on the task and lead-in phrases that do not give information about the picture(s) or topic and are not necessary for the grammatical completeness of the statement.	<p><i>These pictures are poorly drawn.</i></p> <p><i>This is kind of hard.</i></p> <p><i>In the first picture . . .</i></p> <p><i>As I said the last time, she was upset.</i></p>
2.26	Commentary on the subject's performance or personal experiences.	<p><i>I can't think of the name of that.</i></p> <p><i>I can't say it.</i></p> <p><i>No, that's not right.</i></p> <p><i>My kids were always getting</i></p>

		<i>into trouble too.</i> <i>My wife and I used to fight like that. They are fighting but I don't know why.</i>
	Some statements that contain personal information may be appropriate in procedural and personal information descriptions and, in such cases, they would be counted as correct information units (if they meet the other criteria).	
	See 3.16 for embellishments that are counted as correct information units.	
	See previous page for statements that are deleted before beginning the word and correct information unit counts.	
3.00	COUNT THE FOLLOWING (if they meet all other criteria)	
	(In this section, words in bold print would be counted as correct information units.)	
3.11	All words (nouns, adjectives, pronouns, verbs, adverbs, articles, prepositions, and conjunctions) that are intelligible in context, accurate in relation to the picture(s) or topic, and relevant to and informative about the content of the picture(s) or topic.	
3.12	Words do not have to be used in a grammatically correct manner to be counted. Words that violate standard English grammar rules concerning appropriate verb tense and form, agreement in number between subject and predicate, agreement between articles and nouns, incorrect use of articles, and appropriate singular and plural forms are counted as correct information units unless these violations would lead to misunderstanding or uncertainty about the meaning of the words.	<i>The firemans are coming.</i> <i>The firemen ain't rescued them yet.</i> <i>Put some stamp on it.</i> <i>The friends is here.</i> <i>He don't look very happy.</i>
	See 2.11 for examples of words that would not be counted as correct information units.	

3.13	Production of a word that results in another English word, if the production would be intelligible as the target word in context.	<i>He is standing on a school and it is tipping over.</i>
3.14	The final attempt in a series of attempts to correct sound errors.	<i>He went to the musket . . . minuet . . . market.</i>
3.15	Informal terms (nope, yep, uh-huh, un-uh) when they convey information about the content of the picture(s) or topic.	<i>She said "Uh-huh, I'll do it."</i>
3.16	Words in embellishments that add to the events portrayed in the picture(s) or express a moral, if they are consistent with the situation or events portrayed. Words that express some legitimate uncertainty about characters, settings, or events in the pictures.	<i>He's going to get hurt and his mom Is going to be angry.</i> <i>Some days everything seems to go wrong.</i> <i>That looks like a nice way to spend a summer day.</i> <i>Sooner or later cats usually get stuck up a tree.</i> <i>Mothers sometimes get distracted and don't notice things.</i> <i>This Is the one about the accident-prone family.</i>
	However, see 2.22 for examples of extraneous commentary that may resemble embellishments, but are not counted.	
3.17	Verbs and auxiliary verbs (Is, are, was, were, to, has, have, will, would, has been, etc.) as two separate correct information units--one for the auxiliary verb and one for the main verb.	<i>His mom is going to be angry. (Each word in bold print is a correct information unit.)</i>
3.18	Contractions [both standard (won't) and colloquial (gonna)] as two correct information units.	
3.19	Each word in hyphenated words (father-in-law, good-bye).	

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