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Reading comprehension by people with chronic aphasia:
A comparison of three levels of visuographic contextual support

by

Aimee R. Dietz

A DISSERTATION

Presented to the Faculty of
The Graduate College at the University of Nebraska
In Partial Fulfillment of Requirements
For the Degree of Doctor of Philosophy

Major: Human Science
(Communication Disorders)

Under the Supervision of Professors Karen Hux and David R. Beukelman

Lincoln, Nebraska

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Reading comprehension by people with chronic aphasia:
A comparison of three levels of visuographic contextual support

Aimee R. Dietz, Ph.D.

University of Nebraska, 2007

Advisors: Karen Hux and David R. Beukelman

This repeated measures investigation evaluated the impact of three levels of visuographic context—(a) photos of high-context scenes, (b) photos of low-context scenes, and (c) no-context—on the reading comprehension of narratives by people with chronic aphasia. The researcher defined high-context scenes as photographs in which people interact with each other, the natural environment, and the central action of the scene and low-context scenes as photographs with no central action and limited-to-no interaction between the people and the natural environment. Participants included 10 medically-stable adults with chronic aphasia and concomitant reading comprehension deficits. The participants read three different narratives, each presented with high, low, or no-context. The dependent measures were: (a) responses to a self-assessment questionnaire items using a Likert Scale, (b) reading comprehension accuracy measured in percent questions correct, and (c) response time measured in seconds. Outcomes revealed that participants overwhelmingly perceived pictures as helpful during the high-context condition and moderately helpful during the low-context condition. Further, the majority of the participants reported that pictures would have assisted them during the no-context condition. Likewise, people with chronic aphasia also reported that the narrative reading tasks were easier in the

high- and low-context conditions than in the no-context condition. The results did not reveal a statistically significant difference across experimental conditions for accuracy. A potential explanation for this relates to the heterogeneity that existed within the participant pool regarding residual reading ability. Analysis of individual accuracy scores revealed a subgroup of participants who appeared to benefit from visuographic context. The results yielded significant differences for response time across the conditions. The outcomes of the current investigation suggest that contextually-rich visuographic information is supportive to at least some individuals with chronic aphasia when they perform reading comprehension tasks. The results are discussed in relation to the theoretical frameworks of the resource allocation theory of aphasia and construction-integration model of reading.

DEDICATION

Many of you may be surprised to hear that my Mom encouraged me to dance from a very young age and that I originally left Florida to continue my training. My very first dance partner was my Mom. As the song goes, “I hope you never lose your sense of wonder...I hope you never fear those mountains in the distance...and when you get the choice to sit it out or dance, I hope you dance...” (Sanders & Sillers, 2000). Throughout my life, my Mom has always taught me to keep going and maintain faith in myself. I learned the most important element of dancing from her—not to let go of key dance partners. In fact, she is responsible for several of the dance partners in my life today. My Daddy and my Dad—you know who you are—two incredible men who taught me to dance through the pain and the heartache that life inevitably brings your way; and of course how to recover when unreliable partners drop you in the middle of a routine. My *Instant Mom*, Kelly, a partner who always insisted that I expect only the best things in life, I am glad I followed her advice. My brother Alex has always reminded me to see the lighter side of life—and to remember, “Where I come from.” Thanks to his southern influence, I incorporate wisdom from my country-roots into every dance I learn.

In the beginning of our relationship, Marcus told me that I was “... the beacon in [his] journey of life.” Since then, we have stumbled our way through challenging dances, serious dances, and of course many playful dances; and we continue to waltz our way through the wonderful life we have built for ourselves. Marcus brought with him an unexpected dance partner, a beautiful little girl

named Mackenzie. She always adds a sparkling smile and fun to each performance.

I am very grateful for all of you and before I move on to the next dance, I want to thank you for teaching me the intricate, yet beautiful choreography of *Life*.

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A few years later, I had the good fortune of meeting Dr. David Beukelman at an ASHA convention in Chicago. After that convention, I visited the Department of Communication Disorders at the University of Nebraska-Lincoln (UNL). It was then that I met Dr. Karen Hux and chose UNL as my top choice for a doctoral training program. Their combined expertise in acquired neurogenic disorders as well as their applied-research nature made the decision an easy one. As I begin the next phase of my life, I aspire to develop a blend of the visionary research skills, incredible mentoring, and inspiring teaching styles that Dr. Beukelman and Dr. Hux bring to the table. They truly exemplify how the right-hemisphere relies on the left-hemisphere, and vice versa, to produce quality work. This manuscript would not be complete without expression of my gratitude for Dr. Michelle McKelvey, a true friend, whose support kept my research fire burning throughout my doctoral program.

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CHAPTER 1

Motivation

Background

Introduction to Aphasia

Aphasia is an acquired language disorder that often follows a cerebrovascular accident (CVA) in the left side of the brain. Aphasia impairs a person's ability to comprehend and produce spoken and written language. The clinical features of aphasia are not due to a sensory deficit; rather there is a disruption of auditory and visual processing, as well as verbal and written production abilities. In summary, aphasia disrupts the symbolic systems of speaking, listening, reading, and writing (Chapey & Hallowell, 2001; LaPointe, 2005; McNeil, 1983). People with aphasia have the same thoughts and ideas as they did before the CVA. However, they cannot express those ideas as fluidly. Having aphasia is analogous to visiting a foreign country and not knowing the language; you know what you want to say but do not have the words to say it aloud. Likewise, you hear people speaking and see signs displayed on streets and buildings, but you may only understand bits and pieces of what you hear and read.

Aphasia Interventions

Restoration approach. Traditionally, the aim of aphasia intervention is to restore language functions and curb the effects of aphasia (Beukelman, Fager, Ball, & Dietz, 2007; Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling, & Hux, 2006; McKelvey, Dietz, Hux, Weissling, &

Beukelman, 2007). A review of the literature revealed the effectiveness of restorative intervention strategies, especially during the acute stages of recovery (Holland, Fromm, DeRuyter, & Stein, 1996; Horner, Loverso, & Gonzalez-Rothi, 1994; Poeck, Huber, & Williams, 1989; Robey, 1998). However, there is a fundamental problem with the restoration approach; it is typically ineffective in fully restoring the linguistic system. That is, 40% of people with aphasia eventually plateau in their ability to re-establish their linguistic system and must live with aphasia as a chronic condition (Helm-Estabrooks, 1984). In short, they have a linguistic system that leaves them unable to interact fully during daily communicative activities (Beukelman et al., 2007; Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling, et al., 2006; Garrett & Lasker, 2005a; 2005b; McKelvey et al., 2007).

Compensatory approach. An alternative to the restoration approach is to compensate for the residual linguistic deficits of chronic aphasia. Clinicians often accomplish this through the implementation of augmentative and alternative communication (AAC) devices and techniques. These include the use of remnant materials, drawing, gestures, written words, and written choices as well as low-technology communication books and boards (Beukelman, Yorkston, & Dowden, 1985; Garrett, 1993; Garrett & Huth, 2002; Garrett & Lasker, 2005b; Ho, Weiss, & Garrett, 2005; Lasker, Hux, Garrett, Moncrief, Eischoid, 1997; Lyon & Helm-Estabrooks, 1987; Lyon, 1992; 1995; 1998). People with aphasia also demonstrate the ability to use traditional high-tech AAC. Typically, these devices are used to perform specific communicative functions such as answering the

phone, calling for help, ordering in restaurants or stores, giving speeches, saying prayers, and engaging in scripted conversations (Jackson-Waite, Robson, & Pring, 2003; Lasker & Beukelman, 1999; Lasker & Bedrosian, 2001). Often, the degree to which the strategy or technique bypasses the reliance on symbolic and linguistic processes dictates the level of success people with chronic aphasia experience with the aforementioned strategies (Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006; McKelvey et al., 2007).

Motivation

Visual Scene Displays

The need to minimize the high-linguistic demands of current AAC technology prompted the development of the Visual Scene Displays (VSD). The VSD is a high-technology speech generating device (SGD) prototype that employs contextually-rich visuographic images to represent meaning, facilitate co-construction of messages between people with chronic aphasia and their communication partners, and support system navigation.

Visual scene displays development. Over the past 30 months, I collaborated with members of the VSD research and technology partners during the development of the VSD. In an attempt to *bypass* the *broken* language system of people with aphasia, we built upon their relatively intact cognitive and visuospatial abilities (Fox & Fried-Oken, 1996). That is, rather than relying on words and/or iconic symbols to represent meaning, formulate messages, and navigate the AAC device, the person with aphasia communicates and navigates

the VSD using *high-context scenes* (Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006; McKelvey et al., 2007).

High-context scenes. To appreciate the notion of high-context scenes, it is helpful to break the concept into its separate components. The word *context* has two primary definitions. The first Merriam Webster® (2006) states is, "...the parts of a discourse that surround a word or passage...can throw light on its meaning." The second definition of context discusses, "...the interrelated conditions in which something exists or occurs." (Merriam-Webster® Incorporation, 2006). *Scene* is most commonly described as, "...an act presenting continuous action" (Merriam-Webster® Incorporation, 2006). Thus, high-context scenes are photographs in which people interact with each other, the natural environment, and the central action of the scene (see Figure 1.1). Typically, high-context scenes independently reveal the relationships between the people and objects within the photo (Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006; McKelvey et al., 2007).

Low-context scenes. In contrast to high-context scenes, low-context scenes require the viewer to surmise additional information about the relationship between people or objects in the photograph. There is limited-to-no interaction between the people and the natural environment; lastly, there is no central action. An example is a portrait of a person standing in front of a plain background (see Figure 1.2). Thus, low-context scenes provide limited

Figure 1.1 Example of a high-context scene

information about the situation, place, or event that prompted the photo (Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006; McKelvey et al., 2007).

Figure 1.2 Example of a low-context scene.

Visual scene displays organization. The VSD includes high-context pictures combined with *text boxes* and *speak buttons* (see Figure 1.3). The text boxes relay the *story* revealed through the high-context pictures in written text. The speak buttons, when activated (touched), produce a spoken message via synthesized or digitized speech. These spoken messages are identical or similar to the written text in the corresponding text box. During the prototype development phase of our work, we discovered that people with aphasia were reluctant to activate speak buttons if the corresponding text boxes were absent. It seemed that they were unsure of the message that the VSD speak button would produce, unless the corresponding text box was present (Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006). This finding piqued my interest, because all participants demonstrated reading comprehension deficits (alexia) on the *Western Aphasia Battery (WAB)* (Kertesz,

Figure 1.3 Example of a visual scenes display.

1982); yet, it appeared that written text facilitated use of the speak button. This prompted the question, “Do contextually-rich visuographic images facilitate improved reading comprehension by people with aphasia?”

Comprehension by People with Aphasia

Comprehension deficits of the spoken (and written) language are variable and involve multiple processes (Brookshire, 1974; Duffy & Coelho, 2001). There are at least five categories of auditory deficits experienced by people with aphasia. Each category explicitly describes which part of the acoustic signal may be misinterpreted:

1. Slow Rise Time—difficulty with the beginning of the acoustic signal.
2. Noise Build-Up—difficulty with the final portion of the acoustic signal.
3. Retention Deficit—similar to noise build-up, but milder.
4. Information Capacity Deficit—difficulty receiving and processing input simultaneously.
5. Intermittent Auditory Imperceptions—difficulty maintaining attention to the acoustic signal (Brookshire, 1974).

Researchers also suggest that the processes required for comprehension of words and sentences differ from the processes employed for comprehension of discourse. A review of the literature revealed a positive correlation between linguistic, extralinguistic (visuographic) context, and improved auditory comprehension by people with aphasia (Brookshire, 1987; Duffy & Coelho, 2001; Pierce, 1983; 1988; 1991; Pierce & Beekman, 1985; Stachowiak, Huber, Poeck, & Kerchensteiner 1977; Waller & Darley, 1978).

Auditory comprehension and context. Stachowiak and colleagues (1977) conducted a seminal study on the impact of linguistic context on auditory comprehension. The researchers examined three hypotheses relative to the effect of contextual information on auditory comprehension: (a) people with aphasia have an impaired ability to utilize context for comprehension, (b) linguistic deficits compromise contextual comprehension skills, and (c) people with aphasia can utilize verbal and contextual information to fill in linguistic-related deficits. To test the abovementioned hypotheses, the participants—people with aphasia, right-hemisphere controls, and normal controls—completed an assessment battery, including the *Token Test* (Spreen & Benton, 1969), to test word and sentence comprehension. Next, the researchers read short passages, balanced for linguistic structure, to the participants. Following each passage, the participants selected the picture from a multiple choice picture set of five line drawings that “...fit the story the best” (Stachowiak et al., 1977, p. 192). The pictorial foils included three semantic foils, a picture depicting the main idea of the story, and one showing the literal sense of a metaphorical comment used in the story.

The results revealed that the participants with aphasia performed similarly to both groups of control participants on the passage listening task. However, the results of the *Token Test* (Spreen & Benton, 1969), a *decontextualized* auditory comprehension test, unveiled significant differences among the people with aphasia, the right-hemisphere controls, and the normal controls. Together, these findings rule-out the first two hypotheses and support the notion that people with

aphasia *can* use contextual information to fill in the gaps. The authors attributed the results to the redundancy provided by the context of the passages as compared to the single words and commands from the formal assessment. In essence, single words and sentence-level reading tasks lack the context necessary for people with aphasia to infer the intended message (Stachowiak et al., 1977).

In line with Stachowiak et al.'s (1977) work, Pierce performed a line of research (1983; 1988; 1991) supporting the notion that prior and subsequent linguistic context significantly improves the auditory comprehension of syntactic and semantic information by people with aphasia. An example of prior context is, "The girl is on the ground. The girl was tripped by the boy. Who was tripped?" (Pierce, 1988, p. 579).

Pierce and Beekman (1985) demonstrated that the auditory comprehension of syntactically and semantically complex sentences by people with aphasia may be increased when provided extralinguistic, or visuographic, context. The researchers presented target sentences to participants in three different experimental conditions: (a) in isolation, (b) following a picture that depicted the sentence, and (c) after a semantically related sentence. Results yielded an interaction between comprehension severity (high-level or low-level), sentence type (simple actives, reversible passives, and reversible actives), and contextual condition (linguistic or visuographic). Overall, participants with low-level comprehension skills demonstrated improved auditory comprehension both

in the linguistic and visuographic conditions; however, statistical analyses revealed no significant differences between the two types of context.

The results of Pierce and Beekman's (1985) investigation conflict with an earlier study published by Waller and Darley (1978). Their study also compared the differential effect of linguistic versus visuographic context on auditory comprehension. Prior to hearing the paragraph, the participants listened to a summary sentence or saw a picture that depicted the main idea of the paragraph read to them. The researchers concluded that linguistic context facilitated comprehension, whereas visuographic context confounded the impact on comprehension.

The literature reveals a sequence of studies that disclose the positive impact context can have on the auditory comprehension of people with aphasia. There is, however, limited research regarding the impact of linguistic and visuographic context on *reading* comprehension by people with aphasia (Germani & Pierce, 1992; Smith, 2005).

Reading comprehension and context. Recently, several researchers reported data describing the positive impact of an intervention, Multiple Oral Reading (MOR), to improve the *oral reading* component of alexia (Beeson, 1998; Beeson and Insalaco, 1998, Mayer & Murray, 2002). Unfortunately, since 1983 (Web & Love), relatively few investigations document strategies to improve the reading *comprehension* component of alexia (Brennan, Worrall, & McKenna, 2005; Germani & Pierce, 1992; Howe, Worrall, & Hickson, 2004; Rose, Worrall, & McKenna, 2003).

Germani and Pierce (1992) conducted the first study to investigate the influence of linguistic context on the reading comprehension of people with aphasia. Based upon previous findings (Beekman & Pierce, 1985), inclusion criteria required participants to score a nine or less on the complex ideational materials subtest of the *Boston Diagnostic Aphasia Examination (BDAE;* Goodglass, Kaplan, & Barresi, 2001). Participants silently read three types of narratives: (a) predictive narratives, (b) non-predictive narratives, and (c) predictive narratives without target sentences; all presented in "...enlarged type on 8 X 11-inch cards" (Germani & Pierce, 1992, p. 314). After reading the narrative, the participants turned to the next page to find the related question. Participants pointed to the correct noun choice, from a field of two, without referring back to the narrative. Analyses of the data revealed that 75% of the participants benefited from the predictive narratives and 83% of the participants benefited from the non-predictive narratives (Germani & Pierce, 1992). These findings coincide with research relating to the positive impact of linguistic context on the auditory comprehension of people with aphasia (Germani & Pierce, 1992; Pierce & Beekman, 1985; Pierce, 1983; 1988; 1991; Stachowiak et al., 1977; Waller & Darley, 1978).

In response to the need to create *aphasia-friendly* environments—comparable to wheelchair-accessible environments for people with physical disabilities—researchers compiled aphasia-friendly text principles described as strategies that clinicians use *intuitively* to facilitate reading comprehension by people with aphasia. The four principles of aphasia-friendly text principles include

the use of: (a) simple words and sentences, (b) large print (i.e., 18-point Arial font), (c) large amounts of white space, and (d) relevant pictures (e.g., visuographic context such as: Clip Art, line-drawings, hand-drawn sketches, etc.) (Brennan et al., 2005; Howe et al., 2004; Rose et al., 2003).

The effectiveness of the abovementioned aphasia-friendly text principles are emerging in the literature. A first investigation compared the reading comprehension of health brochures presented to people with aphasia both in traditional and aphasia-friendly formats. Results revealed that participants comprehended significantly more information in the aphasia-friendly condition versus the traditional condition (Rose et al., 2003). Subsequently, researchers conducted a study to explore the individual and joint contribution of the aphasia-friendly strategies on the comprehension of written paragraphs. Data analyses revealed that people with aphasia comprehended significantly more written material employing all four approaches. Furthermore, three of the four approaches revealed significantly increased reading comprehension when used in isolation: (a) simple words and sentences, (b) large print, and (c) large amounts of white space. People with aphasia, however, did not exhibit significantly increased reading comprehension in the pictures-only condition (Brennan et al., 2005).

The authors suggest that the participants experienced difficulty relating the pictures to the text, thereby limiting their reading comprehension in the pictures-only condition (Brennan et al., 2005). This is conceivable, considering the *type* of pictures employed. Over the past decade, investigators have examined the

generalization of the use of iconic symbols—including, but not limited to, Clip Art, Blissymbols (Bliss, 1949), and Boardmaker® (Mayer-Johnson, LLC, 2004)—as a form of augmentative and alternative communication. To date, no empirical data support generalization of the use of symbols beyond structured intervention sessions (Bailey, 1983; Beck & Fritz 1998; Fox, Sohlberg, & Fried-Oken, 2001; Koul & Harding, 1998).

Statement of the Problem

A plausible rationale for unsuccessful implementation of the abovementioned *pictures* as a form of visuographic context is that, when people have aphasia, access to their linguistic system is disrupted (Chapey & Hallowell, 2001; Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006; LaPointe, 2005; McKelvey et al., 2007; McNeil, 1983, McNeil, Odell, & Tseng, 1991; Murray, 1999). Replacing language, a symbol set, with another symbol set—such as Clip Art, Blissymbols (Bliss, 1949), or Boardmaker® (Mayer-Johnson, LLC, 2004)—does not correct the underlying difficulty people with aphasia have accessing symbol systems. An alternative to the aforementioned visuographic symbol systems is to pair high-context scenes with text. As previously mentioned, integration of high-context scenes builds-upon the relatively intact visual processing and memory skills of people with aphasia (Beukelman, Hux, Weissling, Dietz, & McKelvey, 2005) and bypasses the symbolic system altogether (Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006; McKelvey et al., 2007).

Purpose of the Investigation

The goal of this dissertation was to evaluate the impact of three levels of visuographic context—(a) photos of high-context scenes, (b) photos of low-context scenes, and (c) no-context—on the reading comprehension of narratives by people with chronic aphasia.

Research Questions

Specifically, the following questions were examined:

1. What differences exist in the reading comprehension response accuracy of people with chronic aphasia when they read narrative passages presented with high-context scenes, low context scenes, and no-context?
2. What differences exist in the response time (measured in seconds) of people with chronic aphasia when they answer questions related to read passages presented with high context scenes, low-context scenes, and no-context?
3. How do people with chronic aphasia perceive the helpfulness of high- and low-context pictures when presented with narrative reading passages?
4. How do people with chronic aphasia perceive the ease of reading narrative passages presented with high-context scenes, low context scenes, and no-context?
5. How do people with chronic aphasia perceive their accuracy when responding to questions following reading narrative passages

presented with high-context scenes, low context scenes, and no-context?

6. How do people with chronic aphasia perceive their comprehension following presentation of narrative passages with high-context scenes, low-context scenes, and no-context?

Research Hypotheses

RH1. Reading comprehension response accuracy will be significantly higher for narrative reading passages presented with high-context scenes as compared to narrative reading passages presented with low-context scenes and no-context and may reveal a subgroup of participants who demonstrate increased benefit from context.

RH2. Reading comprehension response accuracy will be significantly higher for narrative reading passages presented with low-context scenes as compared to narrative reading passages presented with no-context and may reveal a subgroup of participants who demonstrate benefit from context.

RH3. Response time will be significantly faster for narrative reading passages presented with high-context scenes as compared to narrative reading passages presented with low-context scenes and no-context and may reveal a subgroup of participants who demonstrate increased benefit from context.

RH4. Response time will be significantly faster for narrative reading passages presented with low-context scenes as compared to narrative

reading passages presented with no-context and may reveal a subgroup of participants who demonstrate increased benefit from context.

RH5. High-context pictures will be perceived as more helpful than low-context pictures and no-context when reading narrative passages.

RH6. Low-context pictures will be perceived as more helpful than no-context when reading narrative passages.

RH7. Narrative reading passages presented with high-context scenes will be perceived as easier than narrative reading passages presented with low-context scenes and no-context.

RH8. Narrative reading passages presented with low-context scenes will be perceived as easier than narrative reading passages presented with no-context.

RH9. Accuracy will be perceived as higher when responding to questions for narrative reading passages presented with high-context scenes as compared to narrative reading passages presented with low-context scenes and no-context.

RH10. Accuracy will be perceived as higher when responding to questions for narrative reading passages presented with low-context scenes as compared to narrative reading passages presented with no-context.

RH11. Reading comprehension following presentation of narrative reading passages with high-context scenes will be perceived as higher than comprehension following presentation of narrative reading passages presented with low- and no-context.

RH12. Reading comprehension following presentation of narrative reading passages presented with low-context scenes will be perceived as higher than comprehension following presentation of narrative reading passages presented with no-context.

CHAPTER 2

Literature Review

This chapter includes six sections. First, computerized restorative treatment approaches, initially intended to serve as AAC, are summarized. Next is a review of the high-technology and low-technology AAC interventions employed by aphasiologists over the past several decades. Following this is a description of the multiple modality stimulation approach, which uses the written word as a *springboard* to improve the auditory and reading comprehension of individuals with aphasia. Following the multi-modal review, reading comprehension deficits associated with aphasia are explained. Then, the resource allocation theory of aphasia is described and linked to the success of the abovementioned multiple modality interventions for people with aphasia. Finally, this chapter concludes with an overview of the construction-integration model of reading comprehension. Together, the information provided in the last two sections—the resource allocation theory and the construction-integration model of reading—provide a foundation supporting the notion that visuographic context positively impacts reading comprehension by people with aphasia.

Computer-Assisted Aphasia Intervention

As noted in Chapter 1, people with aphasia typically plateau, after a certain period, during restorative intervention. That is, many people still have a diagnosis of aphasia when discharged from rehabilitation (Helm-Estabrooks, 1984). As a result, they must live with chronic aphasia; however, they are commonly ill-equipped to interact successfully during daily communicative

interactions (Beukelman et al., 2007; Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006; Garrett & Lasker, 2005b; McKelvey et al., 2007).

In an attempt to create a high-technology, dynamic display AAC device for people with aphasia, researchers developed Lingraphica® (Lingraphicare Inc., 2007), formerly known as C-VIC®. The Lingraphica® software operates on a notebook computer and generates a *personalized* intervention plan for each person with aphasia using an algorithm. The type and severity of the person's aphasia determines the course of treatment. People with aphasia interact with Lingraphica® in the following manner:

...the software provides graphic building blocks which are called 'icons' (small pictures, sometimes animated), 'windows' in which these icons can be accessed, manipulated, and displayed, and 'cursor tools' which allow the user to manipulate icons and windows in various ways (Steele, Kleczewska, Carlsons, & Weinrich, 1992, p. 186.)

A series of studies documented significant improvement in the linguistic functioning of people with aphasia of all types, severity, and stages of recovery (e.g., acute versus chronic) following completion of the Lingraphica® (Lingraphicare Inc., 2007) intervention protocol. Specifically, researchers reported improvements in the comprehension and production of syntactically complex sentences. Additionally, the investigators noted improvements in the comprehension and production of prepositional phrases, sentence production

during picture description tasks, and higher scores on standardized tests (Aftonomos, Appelbaum, & Steele, 1999; Aftonomos, Steele, Appelbaum, & Harris, 2001; Lefkos, Steele, & Wertz, 1997; Steele et al., 1992; Weinrich, McCall, Weber, Thomas, & Thornburg, 1995).

Another computer-assisted treatment is Talking Screen™ (Words+, Inc., 2007). It operates similarly to Lingraphica® (Lingraphicare Inc., 2007) and researchers report comparable outcomes (Koul & Harding, 1998). However, the authors highlighted a critical issue concerning implementation of this technology with people with aphasia: "...the question still arises as to whether this superior [syntactical] performance can be translated into a functional AAC system." (Koul & Harding, 1998, p. 22).

Shelton, Weinrich, McCall, and Cox (1996) also assert that these programs do not facilitate an improvement in the quantity, or the quality, of the conversational interactions of people with aphasia. There is little empirical evidence of generalization of learned skills into their daily communicative interactions. Reports generated by proponents of Lingraphica® (Lingraphicare Inc., 2007) further support this position; the investigators measured improvement via a pre- and post-test methodology utilizing standardized tests. The researchers did not report pre- and post-treatment measures that evaluated the quantitative and qualitative changes during communicative interactions (Aftonomos et al., 1999; 2001; Lefkos et al., 1997; Steele et al. 1992). Concerns regarding the utility of computer-assisted therapy programs to function as AAC

devices led to the relatively recent history of research and development of AAC techniques and devices for people with aphasia.

Augmentative and Alternative Communication & Aphasiology

The literature on AAC includes two categories: high-technology and low-technology AAC techniques and devices. The following summary outlines the quickly evolving field of AAC aphasiology.

High-Technology AAC

High-technology AAC includes speech-generating devices (SGDs) customized to meet the needs of AAC users. Often these devices operate on appliances that resemble notebook computers and feature *dynamic display* screens that change upon the AAC user's selection. Often, AAC developers organize the displays into a grid of *buttons* that contain written text, icons, photos, or a combination thereof. Additionally, high-technology SGDs produce speech when the AAC user makes a message selection. The output can be digitized (i.e., recorded speech) or synthesized (i.e., computerized speech). The following section focuses on two types of high-technology dynamic display systems utilized by people with aphasia: text-based systems and Visual Scenes Displays (VSDs).

Text-based systems. Jackson-Waite, Robson, and Pring (2003) presented a case study illuminating the challenges of employing high-technology, text-based AAC alternatives with a person with aphasia. The researchers aimed to build upon the residual reading and writing skills of the person with aphasia using the LightWRITER™ (Churchill, 2007), a text-based, high-technology SGD, as an

alternate form of communication. Although the patient demonstrated success in communicating treated words in a controlled environment, generalization did not occur to novel words or environments.

TalksBac is another high-tech, text-based. Unlike the LightWRITER™ (Churchill, 2007), developers designed TalksBac as a prototype designed to suit the needs of people with (non-fluent) aphasia (Waller, Dennis, Brodie, & Cairns, 1998). TalksBac is a personalized predictive software program that operates on a portable Macintosh™ computer. There are two programs: a *carer* and a *user* program. The care provider receives instruction on how to program (written) conversational topics and response options for conversation partners.

Waller and colleagues (1998) revealed that the post-treatment assessment standardized test scores of the people with aphasia remained relatively stable, while conversational interactions revealed positive qualitative and quantitative changes. Compared to the *unaided* conversations, the *aided* conversations yielded an increase in the quantity and the quality of the following types of utterances: (a) relevant, (b) elaborative/ expansion, and (c) initiations.

The carer outcomes indicated that more structured training is required for them to attain a higher level of competency. Carers demonstrated the ability to learn how to program the TalksBac; however, they struggled to identify the types of content/daily experiences that would facilitate an effective conversation topic for their loved one (Waller et al., 1998). The results of this technological development were promising; however, research beyond this pilot study never surfaced in the literature.

Visual scene displays. Recently, another research and technology team collaborated to develop Visual Scene Displays (VSDs), a high-technology SGD prototype that uses contextually-rich visuographic images to represent meaning, facilitate co-construction of message formulation between people with chronic aphasia and their communication partners, and to support system navigation. Historically, most AAC systems are organized using grids in which symbols or icons occupy individual spaces at regular intervals. This layout requires people to process the symbols individually and combine them to formulate messages. This type of organization requires a high-level of visuocognitive processing (Wilkinson & Jagaroo, 2004). Therefore, people with aphasia must formulate messages using symbols that have little implied relation and generate additional information regarding the subject. Generally, spontaneous generation of information is difficult for people with aphasia (Beukelman et al., 2007; Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006).

In contrast, people process high-context scenes with greater automaticity. While visually processing a natural scene, people quickly comprehend the overall meaning (Wilkinson & Jagaroo, 2004). Thus, employing high-context scenes as the primary mechanism for communication and navigation that builds upon the relatively intact cognitive and visuoperceptual abilities of people with aphasia (Fox & Fried-Oken, 1996). Due to the reduced cognitive demands required to process the information, the person with aphasia can easily communicate and navigate VSDs. Furthermore, the use of high-context scenes facilitates co-construction of the *gist* of the message between people with aphasia and their

communication partners. That is, pictured elements and semantic associations create a visuographic context that facilitates a shared communication space (Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006).

A preliminary study investigating the learnability of VSDs and their impact on communicative interactions was encouraging (McKelvey et al., 2007). Researchers reported a multiple baseline study that investigated the use VSDs as an AAC device for a person with chronic aphasia. Results revealed successful use of VSDs by a person with chronic aphasia to communicate two stories to multiple unfamiliar communication partners. Additionally, the person with aphasia demonstrated successful navigation of the AAC system, reduced production of distracting communicative behaviors, and improved quality of communicative interactions (i.e., increased number of turns and appropriate question-asking). This study highlights the efficient manner in which people with aphasia can learn VSDs. More importantly, learned skills generalized with minimal intervention, thus revealing the potential of VSDs to provide opportunities for people with aphasia to have multiple interactions with multiple people on multiple topics (McKelvey et al., 2007).

Low-Technology AAC

People with aphasia often use a low-technology AAC system rather than a high technology system for several reasons. Oftentimes, elderly people are less fearful of low-technology aphasia strategies. Depending upon their life experiences, some people may not feel competent to utilize a high-technology

system. On the other hand, a low-technology system may serve as a supplement to, or a back up for, their high-technology AAC system (Dietz, McKelvey, Beukelman, Weissling, et al., 2006; Hux, Weissling, & Wallace, in press; Weissling & Beukelman, 2006; Weissling, Beukelman, & Wyss, 2006).

Symbol-based systems. Beck and Fritz (1998) examined the ability of people with aphasia to learn a low-technology, icon-based symbol system. The investigators divided the people with aphasia into several groups according to the site of lesion/type of aphasia. The researchers analyzed the following independent variables: (a) concrete versus abstract messages, (b) icon length, and (c) type of aphasia. They compared the aphasic group to a control group of people with no known neurological deficits.

Examination of the findings revealed that people with aphasia could learn iconic codes within certain parameters. For example, people with aphasia learned single, concrete iconic codes at rates comparable to their normal peers. The breakdown in learning became obvious as the level of abstraction and the length of the iconic code (e.g., 2-3 icons to convey a message) increased. Performance differences within the aphasia group also surfaced. People with posterior lesions learned iconic codes less efficiently than people with anterior lesions (Beck & Fritz, 1998).

In 1983, Bailey described the ability of a person with severe aphasia to learn and use a Blissymbol (Bliss, 1949) communication board. Blissymbolics is an ideographic writing system, based upon Chinese ideograms, comprised of several thousand symbols. Each symbol represents a concept that, when

combined, generates novel concepts (Blissymbolics Communication International, n.d.). The participant was considered a good candidate for the experimental application of Blissymbols secondary to achieving high scores on the *Raven's Coloured Progressive Matrices (RCPM; Raven, 1983)* and *Koh's Block Design Test* (Yates, 1954) indicating intact non-verbal cognitive and visuo-perceptual skills. The participant's progress was tracked through repeated administrations of the *Minnesota Test for the Differential Diagnosis of Aphasia (MTTDA; Schuell, 1965)* and informal observation of use over the course of the 42-month-long training program. The participant was successful in using a communication board that contained 200 Blissymbols (Bliss, 1949) in structured situations and, according to anecdotal reports, in spontaneous conversations occurring outside of treatment (Bailey, 1983).

Ultimately, the participant requested removal of the Blissymbols (Bliss, 1949) from his communication board. He communicated that he preferred to have only the written words remain on the communication board. It appeared that after extensive training with Blissymbols that the participant learned the written words that appeared just below each Blissymbol. Although the participant did not continue to use Blissymbols as his AAC system of choice, it served as a training technique to prepare him for a text-based AAC system (Bailey, 1983).

This review of low-technology, symbol-based AAC systems highlights the need for the development of AAC strategies that tap into the relatively intact memory, visuospatial skills, and life experiences of people with aphasia. Fortunately, relatively recent reports describe low-technology interventions that

incorporate contextually and personally relevant information to provide a medium for people with aphasia to communicate with multiple people, in multiple environments, for multiple reasons (Dietz, McKelvey, Beukelman, Weissling, et al., 2006)—to exchange new information, maintain social closeness, and to communicate etiquette during communicative exchanges (Light, 1988)

Text-based systems. Garrett, Beukelman, and Low-Morrow (1989) reported a seminal case study on AAC and aphasia that described the first AAC system designed specifically for a person with aphasia. Primarily text-based, this low-tech system included the following: a word dictionary, alphabet card, new information pocket, a clues section (i.e., tips for conversational repair), and conversation control strategies (i.e., to facilitate topic shifting). To ensure success, the researchers trained the participant to use a hierarchy of communicative breakdown repair strategies. The authors reported post-treatment analysis of an interaction with an unfamiliar partner. The data revealed a decrease in the number of communicative breakdowns and a subsequent decrease in the number of turns used per breakdown sequence.

High-context visuographic systems. At this point, there is limited technical (computer) support to assist clinicians in the preparation of high quality, personalized communication books and boards (Beukelman et al., 2007). Recently, however, investigators have developed a free resource available for clinicians with a personal computer and Microsoft Publisher®. Templates developed on Microsoft Publisher® are available at <http://aac.unl.edu/> (Weissling & Beukelman, 2006; Weissling et al., 2006) and offer *just-in-time* features that

allow AAC facilitators to create contextually and personally relevant pages quickly for low-technology communication books. For example, the AAC facilitator can insert new text over old text and high-context pictures onto the templates by selecting “change picture” (Dietz, McKelvey, Beukelman, Weissling et al., 2006; Hux et al., in press; Weissling & Beukelman, 2006; Weissling et al., 2006). This development provides promise for continued growth in the development of personally relevant low-technology communication books and boards that integrate high-context scenes.

In addition to utilizing high-technology SGD devices and low-technology communication books/boards, AAC facilitators often employ techniques commonly referred to as the *multiple modality stimulation* approach. The following section will describe several strategies that facilitate improved performance in people with aphasia.

Multiple Modality Stimulation

People with aphasia often depend upon their communication partners—to varying degrees—for successful communication of their intent. It is the partner’s responsibility to scaffold and supplement speech to make interactions contextual and relevant for the person with aphasia (Garrett & Lasker, 2005b; Hux, Manasse, Weiss, & Beukelman, 2001). Garrett and Lasker (2005b) describe a continuum of communicators with severe aphasia—with partner-dependent communicators on one end and independent communicators on the other. To ensure successful co-construction of messages, partner-dependent communicators rely on their communication partners to help manage the

communication environment, create highly familiar contexts, and provide information via multiple modalities (Garrett & Lasker, 2005b; Hux et al., 2001). Independent communicators, on the other hand, can interact competently with a variety of people regarding a diverse range of topics. However, independent communicators often experience breakdowns especially when attempting to convey specific content. Despite their relatively high-level of functioning, independent communicators require intervention to develop compensatory strategies to maximize communicative interactions (Garrett & Lasker, 2005b).

Remnants and props. People with aphasia often carry a low-technology communication book to assist them during communicative interactions. Partners may use this or other available props (e.g., magazines, objects, etc.) as visual input during interactions. The materials in the communication book often contain remnants that the communication partner can use to provide very concrete and personally relevant context during an interaction. Remnants are items, photographs, or objects people save from activities or events they attend. These might include a plane ticket that states the departure and arrival cities, a ticket stub from Walt Disney World, and photos with grandchildren. These materials provide a communication partner a plethora of content to use to tap into the visual modality via linguistic (text) and visuographic (high-context scenes) contextual support during a conversation about an important event in the life of the person with aphasia (Beukelman & Mirenda, 2005; Cunningham & Ward, 2003; Garret & Huth, 2002; Hux et al., 2001; Ho, Weiss, Garrett, & Lloyd, 2005).

The written choice strategy. The written choice strategy is a partner strategy that evolves dynamically with the flow of conversation. To integrate written choice successfully into a conversation with a person with aphasia, the partner must identify a conversation topic of mutual interest and conversational relevance to both parties. Next, the communication partner asks a series of related questions and generates lists of written key words, written in block letters, then verbalizes each word as he/she points to the response options. The person with aphasia then conveys his/her opinion and preferences by pointing to a response option. The communication partner always provides the person with aphasia a response option of *OTHER* or *NOT HERE* in the event that the correct answer is not included in the set of words provided. Once the person with aphasia responds, the interaction continues in this manner until the topic is exhausted (Garrett, 1993; Garrett & Beukelman, 1995; Garrett & Lasker, 2005b; Lasker et al., 1997; Hux et al., 2001). This technique uses both the auditory (via verbal repetition of choices) and visual (via written text) modalities to provide linguistic context to improve the reading and auditory comprehension of people with aphasia during a communicative interaction.

Several years after the introduction of the written choice strategy, researchers conducted a follow-up study to examine the differential contribution of the specific components of the technique (i.e., auditory versus written linguistic context) (Lasker et al., 1997). The authors report an alternating treatment design that compared the standard written choice strategy with two variations: auditory only and visual only. In the auditory-only variation, the researcher did not

orthographically write-out the choices. Instead, she wrote numbers that corresponded with the auditory input. For the second modification, labeled the visual-only condition, the researcher wrote out the three choices; however, she did not verbalize the choices. Data collected during structured conversations between the primary investigator and the person with aphasia, using a Norman Rockwell picture as the stimulus, replicated Garrett's (1993) findings that the written choice strategy is highly effective in generating accurate responses from people with aphasia. Furthermore, the researchers demonstrated that different variations of the written choice strategy might be appropriate for people with aphasia who have various strengths. For example, a person with severe expressive aphasia and mild auditory comprehension deficits may benefit equally well from the auditory-only variation of the written choice strategy. Other variations on the written choice strategy include the integration of rating scales or maps into the answer set (Garrett & Lasker, 2005b; Hux et al., 2001).

Graphic topic setters. Garrett and Huth (2002) introduced another text-based strategy referred to as "graphic topic setters" (p.525). This technique relies on the dual impact of linguistic (e.g., written words) and visuographic (e.g., photographs) context to facilitate comprehension for people with aphasia. Researchers employed two types of stimuli. The first included a photo with a *headline*, plus a caption comprised of four-to-six phrases—printed in block letters. The second only utilized written text—printed in block letters. Results revealed significant differences in the quality and quantity of communicative interactions during both contextual conditions when compared to the no-context

condition. Conversational topics included personal stories (i.e., family life) and current events (i.e., news). The following is example of an exchange between a person with aphasia and his communication partner:

SD: “Yeah, di, di” [pointed to a personal event graphic topic
setter]. Partner: “You wanna tell me about breakfast?” SD:
“Yeah, yeah” [Pointed to written phrase “went out to breakfast”]
(Garrett & Huth, 2002, p. 529)

Analysis revealed increased: (a) conversational initiations, (b) amount of information exchanged, and (c) successful exchanges.

Augmented input. Augmented input techniques provide communication partners with an arsenal of strategies to employ when people with aphasia become confused or cannot follow complex communicative interactions. People with aphasia often convey comprehension difficulties through nonverbal channels such as blank expressions, nodding ambiguously, and looking away. At other times, people with aphasia will answer incorrectly, signaling to their partner that they need assistance to continue the interaction. The partner is responsible for identifying these moments as communicative breakdowns and then choosing the most appropriate technique to represent the complex ideas in a simpler, contextualized manner. Augmented input strategies include: (a) writing key words on paper, (b) the written choice strategy, (c) gesturing symbolically (e.g., hand to mouth and tilt head back for ‘drink’), (d) gesturing deictically (e.g., pointing), and (e) pointing to photographs (Garrett & Beukelman, 1992; Garrett, 1993; Garrett & Huth, 2002; Garrett & Lasker, 2005b).

It is critical to note the success of the abovementioned text-based strategies with people with aphasia despite the fact that these individuals often *fail* standardized reading tests. These include batteries commonly administered to people with aphasia such as the *Reading Comprehension Battery for Aphasia* (RCBA; LaPointe & Horner, 1998) and the reading comprehension subtests of the *Western Aphasia Battery* (WAB; Kertesz, 1982) and the *Boston Diagnostic Aphasia Examination* (BDAE; Goodglass, Kaplan, & Barresi, 2001). Smith (2005) documented overwhelming success using the written choice conversation strategy with two people with global aphasia and one person with severe Broca's aphasia, who both scored less than 30 (out of 100) on the RCBA.

Reading Comprehension Deficits in People with Aphasia

Impact of Aphasia on Reading Ability

Alexia is the term used to describe acquired the oral reading and reading comprehension deficits that frequently accompany aphasia following a CVA. Aphasia often causes an immeasurable reduction in one's social roles; when a person acquires alexia as a concomitant disorder, it often magnifies this problem. The specific impact varies along a spectrum that creates a different reading profile for each person with alexia/aphasia. Some people lose the ability to read sight words such as environmental signs (e.g., exit, restroom, stop, etc.), while others maintain the ability to read written text aloud; however, they may not comprehend what they read. Therefore, the intervention goals for each person will vary (Parr, 1995; 1996; Pierce, 1996; Web, 1987).

In addition to the variability associated with alexia, it is vital to consider the relative importance of reading in a person's life to determine the feasibility of intervention. To gain an understanding of the impact of alexia from a social perspective, Parr (1995) conducted a survey of 20 people with mild-moderate aphasia. The specific goals of the study were to: (a) establish pre-stroke and post-stroke levels of involvement in reading activities, (b) determine the types of reading and writing activities associated with reported social roles, and (c) confirm the extent the stroke affected their reading roles. The analysis of the results produced a spectrum of reading activities participants reported as significant factors in their life; however, no two participants reported the same cluster of reading activities. Some of the reported important reading activities were reading: (a) for leisure, (b) the yellow pages, (c) the newspaper, (d) instructions on food labels, (e) the newspaper, (f) the calendar, (g) bus and train timetables, (h) the Bible, and (i) children's stories (aloud).

Prior research documents the efficacy of employing the multiple modality model to facilitate improved communicative interactions when linguistic restoration is no longer a reality. Limited research exploring this option to improve reading comprehension exists. Rather, the majority of intervention development focuses only on restoration of the reading process via an information-processing model, namely the *reading routes model* (Beeson, 1998; Beeson & Insalaco, 1998; Mayer & Murray, 2002; Web, 1987).

Reading routes model. The reading routes model in aphasia pertains primarily to the reading comprehension of words (Beeson & Hillis, 2001; Caplan,

1992; Webb, 2005). Advocates of the reading routes model describe two *routes* of reading comprehension: lexical-semantic and phonologic. Reading comprehension via the lexical-semantic route occurs when the reader recognizes a word and immediately processes it for semantic representation. At this point, the reader comprehends the meaning of the word. When a reader does not recognize a word (e.g., a novel word or a pseudoword), grapheme-phoneme conversion is required to comprehend the word; this is commonly referred to as the sublexical route. Following this route, the individual must first determine the pronunciation of a word prior to accessing the semantic store for a word.

In summary, the reading routes model explains how people process written text at the word level. This model, however, does not reveal the multifaceted process of comprehending written text beyond the word level (i.e., sentence and paragraph level). To further understand the reading comprehension process and develop functional interventions, researchers must consider the impact of the manipulation of the linguistic and visuographic contextual information that surrounds the written text. The next two sections—resource allocation theory of aphasia and the construction-integration model of reading—provide support for the theory that visuographic context may positively impact the reading comprehension of people with aphasia.

Resource Allocation Theory of Aphasia

Proponents of the resource allocation theory posit that brain damage to nonlinguistic factors may explain much of what we call aphasia (McNeil, 1983; McNeil et al., 1991). They also submit that aphasia is a performance problem

rather than a linguistic competency problem and that there is a *central pool* of cognitive processes available to manage incoming stimuli and to formulate responses. Linguistic activities (i.e., talking, listening, reading, and writing) require a transfer or *allocation* of cognitive resources to complete the task successfully. People deplete their central pool of resources as they engage in more activities and as the complexity of the activity increases. There is debate whether this resource depletion arises due to an overall diminished capacity or a reduced ability to assign cognitive processes *specifically* to linguistic tasks (Brookshire, 1997; McNeil, 1983; McNeil et al., 1991; Mayer & Murray, 2000; Murray, 1999).

The resource allocation theory is not new and the field of speech pathology has alluded to its function for nearly 40 years. In 1969, Hildred Schuell stated, “In aphasia, the problems of most patients appear more related to performance factors than to competence factors...language is not lost or destroyed in aphasia...” (as cited by Duffy & Coelho, 2001, p. 343). Over the past 20 years, researchers have described four attributes that support the notion that aphasia is a non-linguistic performance deficit: (a) transient aphasia, (b) variable performance, (c) qualitative behavioral indices, and (d) stimulability of increased accuracy and efficiency of language (McNeil, 1983; McNeil et al., 1991).

Regarding the hypothesis of transient aphasia, there is evidence that some people suffer from epileptogenic and migraine-induced aphasia—both of which are impossible to differentiate from aphasia caused by cerebrovascular accident (CVA) during the acute phase. In cases of epileptogenic- and migraine-

induced aphasia, the person makes a full recovery within 2-3 weeks. Additionally, one must also consider the *spontaneous recovery* of aphasia following a cerebrovascular accident. This recovery of linguistic functions is not due to relearning the language system. Rather, it establishes that aphasia is transient in some cases and thus the result of, "...an inefficient and fluctuating biological system" (McNeil, 1983, p. 5).

When the behaviors of people with aphasia are considered, they are very typical of McNeil's (1983) second characterization—variability. Oftentimes, people with aphasia demonstrate inconsistent performance from one minute to the next and across modalities, even on homogenous tasks. However, these inconsistencies are not specific to aphasia; they span the cerebral hemispheres and behaviors of neurologically intact individuals, particularly when people are tired or stressed (Brookshire, 1997; McNeil, 1983; McNeil et al., 1991; Mayer & Murray, 2002; Murray, 1999). McNeil (1983) argued that evidence of a linguistic continuum—aphasic-to-normal—further supports a performance-based theory of aphasia. People with aphasia are qualitatively similar to those who are neurologically intact; the difference lies in the *quantity* of the aphasic behaviors. As previously discussed, neurologically intact people often exhibit aphasic-like behaviors when they are tired, stressed, or are required to perform divided-attention tasks.

The final feature of the resource allocation model of aphasia reiterates an intuition clinicians have relied upon for years—people with aphasia are *stimulable* for language (Brookshire, 1997; Duffy & Coelho, 2001; McNeil, 1983; McNeil et

al., 1991). Through manipulation of task stimuli, clinicians can facilitate regulation of the central pool of resources and thus improve linguistic performance. For example, people with aphasia demonstrate improved accuracy and response speed when communication partners employ strategies such as: (a) speaking at a reduced rate, (b) decreasing the complexity of tasks, and/or (c) providing linguistic and visuographic context (Brennan et al., 2005; Brookshire, 1997; Duffy & Coelho, 2001; Germani & Pierce, 1992; Howe, 2004; McNeil, 1983; McNeil et al., 1991; Rose, 2003).

The *construction-integration model* of reading complements the resource allocation theory of aphasia, because it underscores the importance of reducing the demands of working memory (WM)—or allocation of resources—to promote reading comprehension. The following section provides a review the literature about the construction-integration model of reading and its implications when considering the impact of *world knowledge* on readers' comprehension of written text.

Construction-Integration Model of Reading

Advocates of the construction-integration model of reading theorize that writers rely on the readers' familiarity with topics to understand written text. This mirrors speakers' assumptions during conversation. For example, if speakers attempted to state their ideas explicitly, the result would be an impossibly long and rambling monologue (Hirsch, 2003). Since the 1970s, researchers have documented peoples' reliance on *world knowledge* to comprehend speech and written text (Edmondson, 2000; Graesser, Singer, & Trabasso, 1994; Hirsch,

2003; Johnston, 1984; Nicholas & Brookshire, 1987; Nicholas, MacLennan, & Brookshire, 1986; Omanson, 1982; Sanford & Garrod, 1998; Trabasso & van den Broek, 1985; Tuinman, 1974; Wixson & Peters, 1987; Zeece, 2003). Over the years, this evidence facilitated the development of the construction-interaction model of reading.

The theory supporting the construction-interaction model of reading is that reading comprehension originates from the readers' ability to organize or map written text onto their world knowledge (Edmondson, 2000; Wixson & Peters, 1987; Sanford & Garrod, 1998; Zeece, 2003). For this to occur, readers must relate elements they read to their experiences and then construct a mental model, or schema, of the text. If readers do not possess sufficient world knowledge, they will not be able to construct a schema for the written text (Wixson & Peters, 1987; Hirsch, 2003). This holds true even if readers have the appropriate *text knowledge* or understanding of the vocabulary and grammatical structures used in the text. Hirsch offers the following example to illustrate this point:

Here is a sentence by Einstein such as might have been heard
in his Princeton lecture: It will be seen from these reflections
that in pursuing the general theory relativity we shall be led to
a theory of gravitation, since we are able to produce a gravitational
field merely by changing the system of coordinates. (2003, p. 17)

Although people may have adequate text knowledge, in that they are familiar with the vocabulary and syntactical structures presented, most will not comprehend

the above paragraph. That is, unless they have the specific world knowledge to map the written text onto they are likely to struggle with understanding the meaning of the message.

The work of Graesser and colleagues (1994) adds to the construction-interaction model by illuminating the demands on WM during reading tasks. The researchers purport that world knowledge—such as schema, scripts, and life experiences—are overlearned processes and, therefore, are automatically processed.

In conclusion, the construction-integration model of reading comprehension provides evidence to support the notion that people rely on world knowledge to formulate meaning from written text. The more world knowledge readers possess regarding a topic, the faster the information is processed in WM, thus freeing additional resources to allocate toward drawing inferences and making connections between novel (written text) and old information (world knowledge). In essence, the world knowledge people bring to a reading experience provides context from which they can abstract meaning from written text.

Together, the resource allocation theory and construction-integration model provide support for the notion that, when appropriately modified, environmental stimuli (e.g., visuographic context) can positively enhance the reading performance of people with aphasia. Emerging empirical evidence documents the effectiveness of visuographic and linguistic context on the auditory comprehension in people with aphasia (Brennan et al., 2005; Germani &

Pierce, 1992; Howe et al., 2003; Rose et al., 2004). Moreover, relatively new research shows promise in incorporating high-context photographs into AAC systems for people with severe aphasia (Dietz, McKelvey, & Beukelman, 2006; Dietz, McKelvey, Beukelman, Weissling et al., 2006; Hux et al., in press; McKelvey et al., 2007; Weissling & Beukelman, 2006; Weissling et al., 2006). Thus, the question arises: “What is the impact of high-context photographs on the reading comprehension of people with severe aphasia?” The purpose of this dissertation was to evaluate the impact of three levels of visuographic context—high-, low-, and no-context—on the reading comprehension of narratives by people with chronic aphasia.

CHAPTER 3

Methods

Participants

Participants with Chronic Aphasia

Clinical supervisors at three Midwestern universities recruited ten people with chronic aphasia and referred interested candidates (and their caregivers, if appropriate) to the researcher. Each candidate met five inclusion criteria: participants (a) had aphasia due to left cerebrovascular accident (CVA), (b) were at least 3 months post-stroke and medically stable (i.e., no dramatic fluctuations in alertness or behavior), (c) had a negative history of major psychotic episodes or intractable substance abuse, (d) had at least a high school education and no more than 4 years of college, and (e) were native speakers of American English (see Appendix A for demographic questionnaire and refer to Table 3.1 for participant demographics).

Materials

Preparation of Stimuli

Visuographic stimuli. This study included three levels of visuographic context: high-, low-, and no-context. The researcher gathered 12 photographs to develop three narrative passages; this count included two interrelated high-context photos and two low-context photos per passage. The researcher used several resources to access images; these included the researcher's personal photo albums, Internet sites such as Google™ Image Search (Google™, 2006) and Yahoo!® Image Search (Yahoo!®, 2006).

Table 3.1

Participant Demographic Summary

	Age	Gender	Time Post Onset	Education Level	Previous Employment
1	61 years	Female	2 years 6 months	13 years	Computer Tech
2	64 years	Male	3 years	12 years	Business Owner
3	65 years	Male	9 years	14 years	Banking
4	62 years	Male	1 year 6 months	13 years	Industry/Plant Manager
5	28 years	Female	2 years 18 months	14 years	Health Care
6	79 years	Female	2 years	12 years	University Administration/ Student Affairs
7	60 years	Female	3 years	12 years	Business Manager
8	51 years	Male	6 years	14 years	Sales Representative
9	42 years	Male	2 years	14 years	Health Care
10	60 years	Male	6 years 6 months	12 years	Manual Labor/Construction

Contextual-level verification. Five non-brain-injured adult consultants, three females and two males, with an age range of 49-56 years, participated in the contextual-level verification phase. Researchers provided the five non-brain-injured adults with written and verbal definitions of high- and low-contextual scenes and led a 7-minute discussion to provide the participants with guided practice categorizing non-experimental photographs as high- or low-context scenes (Dietz, McKelvey, Beukelman, Weissling, et al., 2006). Next, the non-brain-injured adults viewed the 12 experimental photos in random order during a slideshow presentation using Microsoft PowerPoint® and rated the level of environmental and interactional context as high or low. To receive a high-context rating, all judges had to rate the level both as high. Likewise, to receive a low-context rating, all judges had to rate both the environmental and interactional context as low.

Passage development and analysis. The researcher developed three narrative passages (refer to Table 3.2 for passage characteristics summary) using the *story* that emerged from the two related high-context pictures chosen for each passage. To ensure equivalency, the three passages were balanced for: (a) total number of words, (b) words per sentence, (c) characters per word, (d) Flesch Reading Ease (Flesch, 1948) and (e) Flesch-Kincaid Grade Level (Flesch, 1948).

Based upon the research of Wixson and Peters (1987), the researcher and two research assistants independently completed a *story map* for all three narrative passages to identify the interrelatedness of the story grammar

Table 3.2

Passage Characteristics Summary

	Narrative 1	Narrative 2	Narrative 3
Number of words	107	100	101
Words per sentence	10.7	10.0	10.1
Characters per word	3.9	4.2	3.8
Flesch Reading Ease	95.5	95.1	96.9
Flesch-Kincaid Grade Level	2.5	2.4	2.2

components. This facilitated a holistic representation of each passage and development of comprehension questions that followed a constructive-integration process of determining passage meaning (Wixson & Peters, 1987).

Comprehension question development. The researcher developed nine comprehension questions based upon the story maps and guidelines provided by Wixson and Peters (1987). Each of the two phases of the comprehension question development concentrated on a key component. Phase 1 focused on the category knowledge, or relation among the story elements, required to answer the question. Phase 2 focused on the type of processing, abstract versus concrete, required to answer the question.

Due to the participants' expected reading comprehension challenges, the researcher wrote the comprehension questions and answer choices according to the written choice strategy format (Garrett, 1993; Garrett & Beukelman, 1995). The answer set included four one-word multiple-choice answers that included

one correct answer and three foils. The comprehension questions required the participants to demonstrate comprehension both of concrete (i.e., text-level) and inferential (i.e., beyond text) meaning of each passage (Wixson & Peters, 1987).

Reliability of Stimuli Development

The primary researcher and two research assistants determined the inter-rater reliability for the story maps and the development of comprehension questions. A description of the determination of stimuli development reliability follows.

Story maps. The three judges read the Wixson and Peters (1987) article and then independently completed the story maps for all three stories. During a joint meeting, the judges shared their story maps. If two of the three judges agreed on a story map component (i.e., “*main idea*”), it was considered reliable. The judges jointly discussed any discrepancies and, based upon the mutual agreement of the three researchers, rewrote that section.

Comprehension question development. After determining that each component of the three story maps was reliable, the researchers assessed the reliability of the comprehension question development. The judges independently completed phase 1 and phase 2 of the comprehension question development. During a joint meeting, the judges shared their analyses for each phase. If two of the three judges agreed on a component of a phase (i.e., “*Theme (Main Idea) Text*”), it was considered reliable. The judges jointly discussed any discrepancies and, based upon the mutual agreement of the three researchers, rewrote that question.

Passage dependency index. The Passage Dependency Index (PDI) estimates the degree people rely upon the passage to answer correctly related comprehension questions (Tuinman, 1974). To determine the PDI of the three experimental passages, the researcher distributed three comprehension question sets to 10 non brain-injured adults (see Table 3.3 for demographic data) *prior* to providing them with the passage—referred to as the *without passage condition* (WOP). Next, the researcher allowed the non brain-injured adults to read each passage and then re-administered the corresponding comprehension question set—referred to as the *with passage condition* (WP). Calculation of the PDI used the formula:

$$\text{PDI} = 1 - \frac{\text{mean proportion correct WOP}}{\text{mean proportion correct WP.}}$$

Based on the literature, there are no best practice guidelines for an acceptable level of PDI. However, the seemingly satisfactory range reported in the aphasia and reading comprehension literature is 0.45-0.55 (Hanna, Schell, Schreiner, 1977; Nicholas & Brookshire, 1987; Nicholas et al., 1986; Tian, 2006). During a pilot test, the non-brain-injured adults achieved a PDI of .73 to .78 (see Table 3.4 for PDI Summary), proportions well above the acceptable range.

Instructional Scripts

To ensure high levels of treatment integrity, the researcher utilized instructional scripts (Kazdin, 1982). Additionally, the instructional scripts provided the participants with input regarding the directions during experimental tasks. The four instructional scripts included the: (a) visual screening instructional script (see Appendix B), (b) written choice strategy screening instructional script (see

Table 3.3

Non-Brain-Injured Adults: Demographic Data

	Age	Gender	Education Level
1	36 years	Female	18 years
2	22 years	Female	22 years
3	14 years	Female	14 years
4	22 years	Female	14 years
5	20 years	Female	15 years
6	46 years	Female	18 years
7	32 years	Female	16 years
8	39 years	Male	14 years
9	23 years	Female	16 years
10	33 years	Female	18 years

Table 3.4

Passage Dependency Index Summary

	Passage Dependence Index
Narrative 1 “The Playground”	0.78
Narrative 2 “The Pumpkin Patch	0.78
Narrative 3 “The Family Football Game	0.73

Appendix C), (c) reading passage instructional script (see Appendix D), and (d) comprehension question instructional script (see Appendix E).

Presentation of Stimuli

Visuographic contextual stimuli and reading passages. The researcher arranged all stimuli on 8.5 X 11" white, laminated paper and then organized them in a 2-inch binder. In the high- and low-context conditions, the two pictures were: (a) confined to the left page, (b) arranged vertically and medially on the page, and (c) sized to 4 X 6". The corresponding passage appeared on the right page. In the no-context condition, the passage appeared on the right page, and the left page remained blank.

Comprehension questions. The researcher kept the comprehension questions in a separate binder and employed *aphasia friendly text principles* to avoid confounds during the assessment of the participants' reading comprehension. That is, all written material provided to the participants used: (a) simple words and sentences, (b) large print (18-point Arial font), and (c) large amounts of white space (i.e., use of double spacing and paragraphs presented sentence-by-sentence) (Brennan et al., 2005; Cumley, 2005; Smith & Garrett, 2005; Rose et al., 2003). The researcher also arranged the stimuli according to the principles of the written choice strategy (Garrett & Beukelman, 1992; Garrett, 1993) and presented each question and answer set separately on 8.5 X 11" white paper.

Reading profile. A 5-point Likert scale, for which 1 equaled *strongly disagree* and 5 equals *strongly agree*, was used to gauge the participants' perceptions regarding their pre- and post-stroke reading profile (see Appendix F).

Social Validation

Social validation allows researchers to evaluate, "... whether the intervention effects produce changes of clinical or applied importance" (Kazdin, 1982, p. 252). This type of assessment may take two forms: social comparison or subjective evaluation. For the purposes of this study, the researcher employed a subjective evaluation method using feedback from the participants with chronic aphasia.

To perform the *self-assessment* a 5-point Likert scale, for which 1 equaled *strongly disagree* and 5 equaled *strongly agree* was used to gauge the participants' perceptions regarding their: (a) helpfulness of the pictures, (b) ease of the task, (c) correctness of their test answers, and (d) comprehension of the passage (see Appendix G).

Videography

The researcher used a Sony digital video camera (DCR-HC1000) to record the screening, evaluation, and experimental sessions with each participant. The camera faced the researcher/participant dyad and included only the upper body.

Setting

The researcher conducted all screening, assessment, and experimental sessions in a quiet room at the participants' home. Only the researcher and the participant were present in the room both during the screening and experimental sessions. They were seated beside each other at a table. To avoid fatigue, the researcher provided a 5-minute break between each screening, assessment, and

experimental condition for all participants; additional rest breaks were granted based on individual need. The length of the experimental session varied depending on the ability-level of each participant.

Screenings

Hearing and Vision Screening

To ensure that neither hearing loss nor poor visual acuity adversely affected a participant's performance on experimental tasks, the researcher conducted two screenings. The researcher informally screened the participants' hearing during normal conversation at comfortable loudness levels. Further, the participants' and their caregivers verified functional hearing for conversational interactions. Visual acuity suitable for the experimental tasks (described below) was verified through a visual screening protocol (see Appendix H).

Written Choice Screening

Once the candidates passed the hearing and visual acuity screenings, the researcher engaged them in a *getting-to-know-you conversation*. Prior to conducting the *getting to know you conversation*, the researcher interviewed a friend or family member to obtain answers to specific questions asked during this conversation (see Appendix I). This screening confirmed the participants' ability to engage in conversational exchanges using the written choice strategy (Garrett, 1993; Garrett & Beukelman, 1995). The written choice stimuli were hand-written and constructed dynamically in accord with a candidate's responses. The participants had to answer at least 9 of the 10 written choice questions correctly to pass the screening.

Likert Scale Calibration

To ensure participants understood how to use Likert scale ratings used for the *Reading Profile* and the *Self-Assessment of Performance*, the researcher developed a *Likert scale calibration* (see Appendix J). The researcher asked the participants two questions using augmented input, one concrete yes/no question, using active voice and one complex question, using passive voice. After each question, the researcher asked them to rate the ease of each question, whether they answered the question correctly, and how well they understood the question. The researcher provided accuracy feedback using the same 5-point Likert scale developed for the *Reading Profile* questionnaire and the *Self-Assessment of Performance* rating.

Reading Profile

Upon completion of the aforementioned screenings, the participants completed the *Reading Profile* questionnaire. The researcher provided augmented input as appropriate.

Assessment

Language Assessment

After the candidates passed the above screenings, the researcher verified their aphasia type and severity by calculating their Aphasia Quotient (AQ) using the *Western Aphasia Battery (WAB)* (Kertesz, 1982). Additionally, the candidates completed the reading subtest from the *WAB*. The *WAB* is a standardized test in which people with aphasia provide verbal answer to questions, describe pictures, manipulate and name common objects, follow directions, repeat words, and

perform several reading comprehension tasks (i.e., understanding sentences, commands, and object/picture to word matching) to the best of their ability (see Table 3.5 for summary of results).

Reading Comprehension Assessment

To establish the candidates' reading comprehension abilities, they completed the *Reading Comprehension Battery for Aphasia (RCBA)* (LaPointe & Horner, 1998). This assessment required participants to complete several reading comprehension tasks: a) view word sets and pictures and choose the matching word, b) view pictures and choose the matching sentence, and c) view pictures, read a short paragraph, and answer factual and inferential questions (see Table 3.6 for a summary of results).

Once each candidate met the inclusion criteria, passed the screening protocol, and completed the evaluation protocol, the researcher scheduled the experimental session within seven days, with at least one day of rest in between.

Experimental Procedures

Visuographic Stimuli and Reading Passages

Prior to the presentation of each experimental condition, the researcher provided the participants with a written copy of the reading passage script instructional script (Appendix D) then read it aloud. The researcher verified comprehension using augmented input as necessary.

Comprehension Questions

Immediately following completion of the reading passage, the researcher removed the visuographic and narrative passage stimuli, provided the

Table 3.5

Results of the *Western Aphasia Battery (WAB)* testing

		Participant Scores									
Subtests	Max Score	1	2	3	4	5	6	7	8	9	10
Spontaneous Speech											
Information Content	10	6	1	6	7	1	2	0	4	8	2
Fluency	10	2	5	6	8	0	2	0	4	2	1
Comprehension											
Yes/No Questions	60	60	54	60	58	57	42	59	59	60	59
Auditory Word Recognition	60	46	15	60	53	49	57	37	36	58	46
Sequential Commands	80	18	0	76	37	18	41	30	62	49	43
Repetition	100	50	36	63	97	22	52	20	73	81	0
Naming											
Object Naming	60	12	18	54	38	0	40	11	42	45	0
Word Fluency	20	1	2	3	4	0	7	0	8	3	0
Sentence completion	10	9	2	10	8	0	8	2	6	9	0
Responsive Speech	10	2	0	10	10	0	6	0	4	7	0
Aphasia Quotient (AQ)	100	28	30.5	75.6	76.2	19.8	44.6	19.2	58.3	65.7	20.8
WAB Aphasia Classification	-----	BA ¹	WA ²	CO ³	AN ⁴	BA ¹	BA ¹	BA ¹	BA ¹	BA ¹	BA ¹
WAB Reading Subtest	100	43	47.5	76	36	56	72	31	64	72	36

¹Broca's Aphasia, ²Wernicke's Aphasia, ³Conduction Aphasia, ⁴Anomic Aphasia

Table 3.6

Results of the *Reading Comprehension Battery for Aphasia (RCBA)* testing

Subtests	Max Score	Participant Scores									
		1	2	3	4	5	6	7	8	9	10
Word-Visual	10	10	8	10	5	9	10	8	9	8	7
Word-Auditory	10	10	8	10	10	10	10	9	10	10	9
Word-Semantic	10	10	7	10	9	10	10	7	9	7	8
Functional Reading	10	6	6	9	1	4	1	2	9	8	1
Synonyms	10	4	1	10	7	7	3	4	8	6	3
Sentence-Picture	10	10	6	10	4	6	8	5	10	8	6
Paragraph-Picture	10	3	3	8	1	4	4	3	6	6	4
Paragraph-Factual	10	5	5	10	2	6	3	3	9	7	2
Paragraph-Inferential	10	7	3	6	5	4	3	1	8	9	4
Morpho-syntactical	10	4	4	6	3	4	2	3	6	5	2
RCBA Total Score	100	69	51	89	44	64	54	45	84	75	46

participants with a copy of the written comprehension question instructional script (Appendix E), and then read it aloud. Prior to proceeding to the comprehension questions, the researcher verified comprehension using augmented input as necessary. Next, the researcher presented the corresponding question set, one question at a time, and employed written choice principles to elicit responses. Once the participants provided an answer, the researcher presented the subsequent question. If a participant did not respond within 2 minutes or said, "I don't know," the researcher repeated the written choice question set up to two additional times. A question set was discontinued following three consecutive item errors or if a participant expressed frustration.

The researcher did not randomize the order of the *comprehension questions*; rather, she arranged the stimuli according to the order that achieved the accepted PDI verification level (as described above). However, the researcher did randomize each *answer set* one time and presented them in that randomized order to all participants.

Time to complete experimental conditions. The researcher calculated the length of time required for participants to respond to the comprehension questions. To calculate length of time to answer each item, the researcher used the video counter on the mini-DV playback system. The *response time* started when the researcher completed each question stem and ended as soon as the participant pointed to or spoke the correct answer choice.

Social validation. The participants completed the *Self-Assessment of Performance* questionnaire following completion of each question set. The researcher provided augmented input as appropriate.

Experimental Design

The researcher employed a repeated measures design to examine effects of the level of visuographic context—high-, low-, or no-context—on reading comprehension by people with chronic aphasia. Level of context was counterbalanced across participants using a randomized block procedure.

Independent Variables

This study explored the effects of three levels of visuographic context on the reading comprehension of narratives by people with aphasia: high-, low-, and no-context.

Dependent Variables

The researcher examined the impact of the three levels of visuographic context on the participants': (a) reading comprehension accuracy measured in percent of correct responses, (b) response time measured in seconds, and (d) responses to the *Self-Assessment of Performance* scale.

Data Analysis

The normality of the distributions for each dependent measure was computed using the Kolmogorov-Smirnov (K-S; Chakravart, Laha, & Roy, 1967) test of normality via the Statistical Package for the Social Sciences (SPSS). Although the data were interval in nature, the researcher used non-parametric statistics due to non-normal distribution of the data. The researcher conducted of

a series of one-tailed Friedman's (Friedman, 1937) tests for dependent samples ($p \leq .05$) using SPSS. This allowed determination of group differences on the reading comprehension accuracy and response times across the high-, low-, and no-context conditions. The researcher examined the results of the self-assessment/reading profiles using only descriptive information.

CHAPTER 4

Results

This section includes data on the following variables: pre- and post-stroke reading profiles, reading comprehension response accuracy (i.e., overall accuracy, concrete accuracy, and abstract accuracy), response times, and self-assessment of reading performance. In addition to the group results, the researcher reported the data from individual participants. Due to the heterogeneity among the participants, this reporting method allowed highlighting of individual performance patterns on the experimental tasks otherwise masked by group results. It also formed the foundation for indentifying any subgroups among the participants with aphasia.

Reading Profile

To determine the participants' pre- and post-stroke reading profiles, the researcher tallied and categorized their Likert scale responses to the reading profile questionnaire (see Appendix F). Likert scale ratings of 4 or 5 were interpreted as positive responses, and Likert scale ratings of 1, 2, or 3 were interpreted as neutral or negative responses. As shown in Table 4.1, the data revealed variable reading profiles. Overall, 6 of the 10 participants reported that they read *frequently*, and 5 of the 10 participants reported that they *enjoyed* reading pre-stroke. In contrast, since their strokes, only 1 participant reported that she read frequently. Five of the 10 still reported enjoying reading. Five of the 10 participants also responded positively when asked whether they preferred pictures when reading.

Table 4.1

Reading Profile Results Summary

	Pre-stroke		Post-stroke		
	Read a lot	Enjoyed reading	Reads a lot	Enjoys reading	Likes pictures when reading
	Q1	Q2	Q3	Q4	Q5
Participant 1	5	5	5	5	1
Participant 2	1	1	1	1	4
Participant 3	1	2	1	3	1
Participant 4	5	5	1	3	3
Participant 5	5	5	1	5	5
Participant 6	5	5	1	3	1
Participant 7	3	3	3	3	4
Participant 8	5	5	2	2	5
Participant 9	4	3	2	2	3
Participant 10	3	2	2	2	5
Tally of positive responses					
	6/10	5/10	1/10	2/10	5/10

Reading Comprehension Response Accuracy

After the participants read each passage and answered the subsequent reading comprehension questions, the researcher tallied the total number of correct responses (overall accuracy) as well as the number of correct responses for concrete and abstract questions in isolation. For ease of interpretation, the researcher converted the raw scores to percentages.

Overall Accuracy

Group overall accuracy. The overall accuracy levels ranged from 22% to 100% (*Median* = 55.56, *Mean* = 60.00, *SD* = 25.76) for the high-context condition, 22% to 100% (*Median* = 44.44, *Mean* = 52.22, *SD* = 24.59) for the low-context condition, and 22% to 89% (*Median* = 44.44, *Mean* = 52.22, *SD* = 24.59) for the no context condition (see Figure 4.1). Computation of Friedman's (Friedman, 1937) test revealed no significant difference in overall accuracy among the conditions ($\chi^2_F(2, 10) = 3.00, p = .223$) (see Table 4.2).

Individual overall accuracy. Figures 4.2a through 4.2j show the performance of individual participants across the three experimental conditions. Participant 1, 4, 5, 7, and 8 demonstrated higher accuracy levels in the high-context condition than in the low- and no-context conditions; additionally, they correctly answered the comprehension questions at above chance levels for each experimental condition. Participant 9 performed comparably in the high- and no context conditions and less accurately in the low-context condition; further, he correctly answered the comprehension questions at above chance

Figure 4.1 Overall reading comprehension accuracy, measured in median percent correct, across high-, low-, and no-context conditions.

Table 4.2

Summary of the Overall Accuracy for Each Level of Context

	1 st quartile	Median	3 rd quartile
High-context	33.33	55.56	80.56
Low-context	33.33	44.44	77.78
No context	33.00	44.44	80.56

Figure 4.2a Overall accuracy, measured in percent correct, for Participant 1 across high-, low-, and no-context conditions.

Figure 4.2b Overall accuracy, measured in percent correct, for Participant 2 across high-, low- and no-context conditions.

Figure 4.2c Overall accuracy, measured in percent correct, for Participant 3 across high-, low-, and no-context conditions.

Figure 4.2d Overall accuracy, measured in percent correct, for Participant 4 across high-, low-, and no-context conditions.

Figure 4.2e Overall accuracy, measured in percent correct, for Participant 5 across high-, low-, and no-context conditions.

Figure 4.2f Overall accuracy, measured in percent correct, for Participant 6 across high-, low-, and no-context conditions.

Figure 4.2g Overall accuracy, measured in percent correct, for Participant 7 across high-, low-, and no-context conditions.

Figure 4.2h Overall accuracy, measured in percent correct, for Participant 8 across high-, low-, and no-context conditions.

Figure 4.2i Overall accuracy, measured in percent correct, for participant 9 across high-, low-, and no-context conditions.

Figure 4.2j Overall accuracy, measured in percent correct, for participant 10 across high-, low-, and no-context conditions.

levels in all three conditions. Participant 10 performed comparably in the high- and low-context conditions and less accurately in the no context condition; however, he correctly answered the comprehension questions at above chance levels only in the high- and low-context conditions. Both Participant 2 and Participant 3 performed best in the low-context condition, with Participant 2 performing comparably in the other two conditions and Participant 3 achieving his worst accuracy score in the high-context condition; they both correctly answered the comprehension questions at above chance levels for the three experimental conditions. Participant 6 was the only person to perform better in the no-context condition than in either of the other conditions; his accuracy in the high- and low-context conditions was equivalent. Moreover, he correctly answered the comprehension questions above chance only in the no-context condition. Overall, variability between participants was considerable, but variability within participants was small.

Concrete Accuracy

Group concrete accuracy. Four of the nine comprehension questions in each question set pertained to information contained in the reading passages. These questions constituted the concrete question sets.

The concrete question accuracy ranged from 25% to 100% (*Median* = 75, *Mean* = 68, *SD* 23.71) in the high-context condition, 25% to 100% (*Median* = 62.50, *Mean* = 63, *SD* = 31.67) in the low-context condition, and 25% to 100% (*Median* = 50, *Mean* = 55, *SD* = 28.38) in the no context condition (see Figure 4.3). Computation of Friedman's (Friedman, 1937) test revealed no significant

Figure 4.3 Group concrete accuracy, measured in median percent correct, across high-, low-, and no-context conditions.

difference in concrete question accuracy among the conditions ($\chi^2_F(2, 10) = 2.24$, $p = .326$) (see Table 4.3).

Individual concrete accuracy. Figures 4.4a through 4.4j show the concrete accuracy of individual participants across the three experimental conditions. Participant 7 exhibited superior concrete question accuracy in the high-context condition and exhibited a steady decline in performance in the low- and no-context conditions; additionally she correctly answered the concrete reading comprehension questions above chance levels in all three experimental

Table 4.3

Summary of the Concrete Accuracy for Each Level of Context

	1 st quartile	Median	3 rd quartile
High-context	50.00	75.00	85.25
Low-context	25.00	62.50	100.00
No context	25.00	50.00	81.25

Figure 4.4a Concrete accuracy, measured in percent correct, for Participant 1 across high-, low-, and no-context conditions.

Figure 4.4b Concrete accuracy, measured in percent correct, for Participant 2 across high-, low-, and no-context conditions.

Figure 4.4c Concrete accuracy, measured in percent correct, for Participant 3 across high-, low-, and no-context conditions.

Figure 4.4d Concrete accuracy, measured in percent correct, for Participant 4 across high-, low-, and no-context conditions..

Figure 4.5e Concrete accuracy, measured in percent correct, for Participant 5 across high-, low-, and no-context conditions.

Figure 4.4f Concrete accuracy, measured in percent correct, for Participant 6 across high-, low-, and no-context conditions.

Figure 4.4g Concrete accuracy, measured in percent correct, for Participant 7 across high-, low-, and no-context conditions.

Figure 4.4h Concrete accuracy, measured in percent correct, for Participant 8 across high-, low-, and no-context conditions.

Figure 4.4i Concrete accuracy, measured in percent correct, for Participant 9 across high-, low-, and no-context conditions.

Figure 4.4j Concrete accuracy, measured in percent correct, for Participant 10 across high-, low-, and no-context conditions.

conditions. Participant 6, 8, and 10 achieved the highest accuracy in the high-context condition; they demonstrated equivalent performance in the low- and no conditions. In addition, Participant 6, 8, and 10 correctly answered concrete reading comprehension questions above chance levels in the high-context condition; however, only Participant 6 achieved accuracy at an above chance level in the low- and no-context conditions.

Participant 3 and 9 achieved equivalent accuracy both in the low- and no-context conditions and the lowest accuracy in the high-context condition; further, they both performed above chance accuracy on the concrete reading comprehension questions in all three conditions. Participant 5 was the only person to achieve the highest accuracy in the low-context condition; her accuracy in the high- and no-context conditions was equivalent. She also achieved above chance accuracy levels in all three experimental conditions.

Abstract Accuracy

Group abstract accuracy. Five of the nine comprehension questions in each question set pertained to abstract information not contained in the reading passages. These questions constituted the abstract question set.

The abstract question accuracy ranged from 0% to 100% (*Median* = 54, *Mean* = 54, *SD* = 32.73) for the high-context condition, 0% to 100% (*Median* = 40, *Mean* = 44, *SD* = 35.02) for the low-context condition, and 20% to 100% (*Median* = 40, *Mean* = 50, *SD* = 28.67) for the no context condition (see Figure 4.5). Calculation of Friedman's (Friedman, 1937) test yielded no significant

Figure 4.5 Group abstract accuracy, measured in median percent correct, across high-, low-, and no-context conditions.

difference in the concrete accuracy between the conditions ($\chi^2_F(2, 10) = .60$, $p = .741$) (see Table 4.4).

Individual abstract accuracy. Figures 4.6a through 4.6j show the abstract accuracy of individual participants across the three experimental conditions. Participant 1 was the only person who demonstrated the highest accuracy level in the high-context condition; she demonstrated equivalent performance in the low- and no-context conditions. Additionally, Participant 1 only achieved accuracy

Table 4.4

Summary of the Abstract Accuracy for Each Level of Context

	1 st quartile	Median	3 rd quartile
High-context	35.00	50.00	85.00
Low-context	20.00	30.00	70.00
No context	20.00	40.00	80.00

Figure 4.6a Abstract accuracy, measured in percent correct, for Participant 1 across high-, low-, and no-context conditions.

Figure 4.6b Abstract accuracy, measured in percent correct, for Participant 2 across high-, low-, and no-context conditions.

Figure 4.6c Abstract accuracy, measured in percent correct, for Participant 3 across high-, low-, and no-context conditions.

Figure 4.6d Abstract accuracy, measured in percent correct, for Participant 4 across high-, low-, and no-context conditions.

Figure 4.6e Abstract accuracy, measured in percent correct, for Participant 5 across high-, low-, and no-context conditions.

Figure 4.6f Abstract accuracy, measured in percent correct, for Participant 6 across high-, low-, and no-context conditions.

Figure 4.6g Abstract accuracy, measured in percent correct, for Participant 7 across high-, low-, and no-context conditions.

Figure 4.6h Abstract accuracy, measured in percent correct, for Participant 8 across high-, low-, and no-context conditions.

Figure 4.6i Abstract accuracy, measured in percent correct, for Participant 9 across high-, low-, and no-context conditions.

Figure 4.6j Abstract accuracy, measured in percent correct, for Participant 10 across high-, low-, and no-context conditions.

above chance in the high-context condition. Participant 4, 5, 7, and 9 also achieved the highest accuracy in the high-context conditions. However, Participant 4 and 7 achieved equivalent accuracy scores in the high- and no-context conditions and Participant 5 and 9 accomplished higher accuracy in the no-context condition when compared to the low-context condition. Of this group, Participant 4, 5, and 7 achieved accuracy levels above chance in the high- and no-context conditions, whereas Participant 9 recorded above chance accuracy levels in all three experimental conditions. Both Participant 2 and 10 demonstrate attained their highest accuracy levels in the low-context condition and performed comparably in the high- and no-context conditions; however, Participant 2 attained above chance accuracy levels in all conditions, while Participant 10 only achieved accuracy above chance in the low-context condition. Participant 8 was the only person to achieve equivalent and above chance accuracy levels across all three conditions.

Both Participant 3 and 6 demonstrated lowest accuracy levels in the high-context condition, with Participant 3 achieving comparable accuracy in the low- and no-context conditions, and Participant 6 demonstrating steady improvement as the level of context was decreased. Participant 2 attained above chance accuracy levels in all conditions, while Participant 6 only achieved accuracy beyond chance in the no-context condition.

Response Times

By reviewing the experimental task recordings, the researcher measured the length of time participants took to select their responses to the reading comprehension questions. Response time was measured in seconds.

Group Response Times

Across all participants, response times in the high-context and low-context conditions were longer and more variable (high-context: range = 49.86 to 204.25 seconds, *Median* = 126.42, *Mean* = 132.58, *SD* = 55.35; low context: range = 45.90 to 200.00 seconds, *Median* = 101.88, *Mean* = 114.60, and *SD* = 53.47) than in the no context condition (range = 59.00 to 153.83 seconds, *Median* = 121.38, *Mean* = 89.58, *SD* = 34.46) (see Figure 4.7). Computation of Friedman's test revealed a significant difference in response times across the three conditions ($\chi^2_F(2, 10) = 6.20, p = .045$). Pairwise comparisons between response times both for the high-context and no context conditions and for the low-context and no context conditions approached significance ($\chi^2_F(10, 1) = 3.60, p = .058$ for both comparisons); the Friedman's test computation for pairwise comparison between response times for the high-context and low-context conditions was not significant ($\chi^2_F(10, 1) = 1.60, p = .206$). Table 4.5 summarizes the data for the participants' response times to the reading comprehension questions for each level-of-context condition.

Figure 4.7 Overall median response time, measured in seconds, across high-, low-, and no-context conditions.

Table 4.5

Summary of the Response Times for Each Level of Context

	1 st quartile	Median	3 rd quartile
High-context	67.98	126.42	172.77
Low-context	67.67	101.88	170.66
No context	52.41	59.24	121.39

Individual Response Times

Figures 4.8a-4.8j illustrate the response times of individual participants across the three experimental conditions. Participant 1, 2, and 9 recorded the slowest response times in the high-context condition, demonstrating faster response times as the level of context was decreased. Both Participant 5 and 8 recorded the longest response time in the low-context condition and shorter, yet comparable, response times for the high- and no context conditions. In contrast, Participant 7 and 10 achieved comparable response times in the high- and low-context conditions with both recording the fastest response time in the no-context condition. Participant 4's shortest response time occurred in the low-context condition; he demonstrated similar longer, yet comparable, response times in the high- and no context conditions.

Self-Assessment of Reading Comprehension

To determine the participants' perceptions of their performance in each experimental condition, the researcher tallied and categorized their Likert scale responses to the self-assessment questionnaire (see Appendix G). Likert scale ratings of 4 or 5 were interpreted as positive appraisals; Likert scale ratings of 1, 2, or 3 were interpreted as neutral or negative appraisals. Tables 4.6 through 4.8 summarize these data.

Analysis of the data revealed that 9 of the 10 participants perceived the pictures as helpful in the high-context condition. Likewise, 6 of the 10 participants reported the pictures as helpful in the low-context condition. Additionally, 6 of the 10 participants reported that pictures would have helped in the no-context

Figure 4.8a Response time for Participant 1, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8b Response time for Participant 2, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8c Response time for Participant 3, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8d Response time for Participant 4, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8e Response time for participant 5, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8f Response time for Participant 6, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8g Response time for Participant 7, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8h Response time for Participant 8, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8i Response time for Participant 9, measured in seconds across high-, low-, and no-context conditions.

Figure 4.8j Response time for Participant 10, measured in seconds across high-, low- and no-context conditions.

Table 4.6

Summary of Self-Assessment of Performance—High-Context

	Pictures helped me understand the story	This was easy.	I answered the the questions right.	I understood the entire story.
Participant 1	5	5	3	3
Participant 2	5	5	5	4
Participant 3	1	4	5	3
Participant 4	5	3	3	1
Participant 5	5	4	5	5
Participant 6	5	5	5	5
Participant 7	4	3	3	4
Participant 8	4	4	4	3
Participant 9	4	4	4	5
Participant 10	5	5	3	3

Tally of Positive Responses

9/10	8/10	6/10	5/10
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Table 4.7

Summary of Self-Assessment of Performance—Low-Context

	Pictures helped me understand the story	This was easy.	I answered the the questions right.	I understood the entire story.
Participant 1	4	4	4	4
Participant 2	2	3	2	2
Participant 3	2	4	4	4
Participant 4	5	4	3	1
Participant 5	4	3	5	4
Participant 6	5	5	5	5
Participant 7	3	5	3	1
Participant 8	3	2	2	4
Participant 9	4	4	3	3
Participant 10	5	5	5	5

Tally of Positive Responses

6/10	7/10	5/10	6/10
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Table 4.8

Summary of Self-Assessment of Performance—No-Context

	Pictures helped helped me understand the story	This was easy.	I answered the the questions right.	I understood the entire story.
Participant 1	5	2	1	3
Participant 2	3	3	4	3
Participant 3	2	4	5	5
Participant 4	5	3	3	1
Participant 5	5	5	4	5
Participant 6	5	5	5	5
Participant 7	3	5	3	1
Participant 8	2	5	4	4
Participant 9	4	3	4	4
Participant 10	5	3	3	3

Tally of Positive Responses

6/10	5/10	6/10	5/10
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condition. The participants rated the *ease* of the task similarly both for the high- and low-context conditions; 8 and 7 participants, respectively, rated the task as easy in these conditions. However, in the no context condition, only 5 participants rated the task as easy. There was minimal differentiation on participants' Likert scale ratings across the experimental conditions regarding their perception of whether they answered questions *correctly* and whether they *understood* the story; 5 to 6 participants responded positively to these questions.

Summary of the Results

The following section is an overview of the results in relation to the research questions presented in Chapter 1.

Research Question 1

What differences exist in the reading comprehension response accuracy of people with chronic aphasia when they read narrative passages presented with high-context scenes, low context scenes, and no-context? Contrary to the research hypothesis, analysis of the data revealed no overall difference in the reading comprehension response accuracy between the experimental conditions. Furthermore, the analysis yielded no significant difference between experimental conditions for concrete accuracy and abstract accuracy. However, inspection of individual reading comprehension response accuracy revealed variability between participants, thus, highlighting that a subset of participants did benefit from the use of visuographic context during the narrative reading tasks.

Research Question 2

What differences exist in the response time (measured in seconds) of people with chronic aphasia when they answer questions related to read passages presented with high context scenes, low-context scenes, no-context?

The researcher hypothesized that response times would be significantly faster for narrative passages presented with high-context scenes and low-context as compared to narrative passages presented with no-context. In general, the data did not support this hypothesis. Rather, participants tended to demonstrate faster response times in the no-context condition when compared to the low- and high-context conditions. Additionally, analysis of the data revealed a trend for faster response times in the low-context condition compared to the high-context condition. The difference in response times across the three experimental conditions reached significance ($p = .045$); however, pairwise comparisons between the high- and no-context conditions, as well as the low-context and no-context conditions only approached significance (i.e., $p = .058$ for both comparisons). Response time differences between the high- and low-context conditions were not statistically significant ($p = .206$).

Research Question 3

How do people with chronic aphasia perceive the helpfulness of high- and low-context scenes when presented with narrative reading passages? As hypothesized, participants generally perceived visuographic context as helpful when paired with narrative reading passages. People with chronic aphasia rated high-context scenes as very helpful and low-context scenes as moderately

helpful when reading narrative passages. Furthermore, people with chronic aphasia also reported that pictures would have helped them understand the narrative reading passages presented with no-context.

Research Question 4

How do people with chronic aphasia perceive the ease of reading narrative passages presented with high-context scenes, low context scenes, and no-context? Consistent with the research hypothesis, people with chronic aphasia perceived the narrative passages presented with high-context and low-context scenes as easier than passages presented with no-context. Contrary to the hypothesis, there was minimal difference in the perception of ease of narrative reading passages presented with high- and low-context.

Research Question 5

How do people with chronic aphasia perceive their reading response accuracy of reading narrative passages presented with narrative passages presented with high-context scenes, low context scenes, and no-context? Contrary to the research hypothesis, people with chronic aphasia reported moderate confidence in their response accuracy regardless of experimental condition.

Research Question 6

How do people with chronic aphasia perceive their comprehension of narratives presented with high-context scenes, low-context scenes, and no-context? The participants reported moderate confidence in their comprehension of narrative reading passages presented in all three experimental conditions.

CHAPTER 5

Discussion

This chapter includes four sections. First, the major outcomes of this research are discussed. Next is a discussion of the implications of the investigation. Following this is a description of the study limitations and directions for future research. The chapter concludes with an impression statement.

Major Outcomes

Three findings in this dissertation merit further discussion. These include the participants': (a) self-assessment of their success relative to the helpfulness of pictures and ease of the narrative reading tasks across the three experimental conditions, (b) reading comprehension response accuracy, and (c) response times.

Self-Assessment

Participants overwhelmingly perceived pictures as helpful during the high-context condition and moderately helpful during the low-context condition. Further, the majority of the participants reported that pictures would have assisted them during the no-context condition. Likewise, people with chronic aphasia also reported that the narrative reading tasks were easier in the high- and low-context conditions than in the no-context condition.

These data seem to correlate with the documented positive impact of a *picture walk*, a common prereading instruction method utilized with emergent readers (Edmondson, 2000; Zeece, 2003). Essentially, children peruse pictures of a target book and develop a story based on their ideas about the pictures, or

an adult engages them in a discussion about the story using leading questions. These questions might include the following: (a) “What do you think this story is about?” (b) “What is happening next?” or (c) “How do you know?” The basic principle of a story walk is to activate the reader’s world knowledge by means of pictures, thus providing the child with a strategy to decipher the text meaning. Theoretically, children learn to employ this strategy in the later stages of reading development when they are trying to decode new vocabulary (Edmondson, 2000; Fountain, 2003; Zeece, 2003). Perhaps the participants who demonstrated significant reading comprehension deficits relied upon the pictures in the high- and low-context conditions to activate their world knowledge when attempting to decode the narrative passages.

In turn, activation of world knowledge in the high- and the low-context conditions may have facilitated a participant’s perception of greater task ease when compared to the no-context condition. This assumption is in line with the work of Rose et al. (2003) who reported significantly higher confidence ratings reported by people with chronic aphasia after reading health brochures that employed *aphasia friendly principles* (i.e., simple words and sentences, large print, large amounts of white space, and relevant pictures) than after reading traditionally-formatted health brochures. Together, these findings suggest that modification of the visuographic components of reading materials facilitates an increase in the confidence, or the ease, with which people with chronic aphasia perform reading tasks.

Reading Comprehension Response Accuracy

A statistically significant difference did not occur across experimental conditions either for overall accuracy or for concrete question accuracy. An explanation for this relates to the heterogeneity that existed within the participant pool regarding reading ability. Specifically, some participants demonstrated a ceiling effect in that they performed with high levels of accuracy on the comprehension questions regardless of experimental condition. Other participants demonstrated the opposite effect—that is, they performed near or below chance levels when responding to comprehension questions across all three conditions. Given these stark ability differences, identifying subgroups within the participant group may be appropriate for interpretation of the current findings.

For the purposes of this discussion, the researcher categorized the participants into three groups. Group 1 (Participant 3, 8, and 9) consisted of participants who scored above a 70 on the *Reading Comprehension Battery for Aphasia (RCBA)* (LaPointe & Horner, 1998) and achieved high accuracy levels on the comprehension questions (overall) and on the subset of concrete questions. Groups 2 and 3 included those who scored below 70 on the *RCBA*, with the distinguishing feature being that Group 2 (Participant 2, 6, and 10) achieved low overall accuracy levels on the overall and concrete comprehension questions and Group 3 (Participant 1, 4, 5, and 7) achieved relatively high concrete accuracy levels. Because performance accuracy on the abstract comprehension

questions did not follow this pattern of group differentiation, this discussion pertains only to overall and concrete accuracy data.

Group 1. All participants in Group 1 demonstrated comparable and high overall accuracy levels (i.e., 79% to 100% accuracy) when responding to comprehension questions associated with the high-, low-, and no-context conditions. These data suggest participants in Group 1 had relatively intact reading comprehension for narrative passages presented at a second grade-level. Additionally, these findings lend credence to conclusions of Germani and Pierce (1992) when they investigated the influence of linguistic context on the reading comprehension of narratives by people with aphasia. Germani and Pierce had participants silently read (a) predictive narratives, (b) non-predictive narratives, and (c) predictive narratives without target sentences. After reading each narrative, the participants answered a (written) comprehension question and pointed to the correct noun choice. Analyses of the data revealed that 75% of the participants benefited from the predictive narratives and 83% of the participants benefited from the non-predictive narratives. Germani and Pierce's findings added to a growing body of evidence indicating that some people with aphasia benefit from linguistic context during reading comprehension tasks.

Analysis of Group 1's concrete accuracy data provides a greater appreciation of the relation between visuographic context and reading comprehension. Specifically, Participant 8 demonstrated a distinctive pattern of success when responding to concrete questions across the three experimental conditions. He achieved 100% accuracy in the high-context condition but only

50% accuracy both in the low- and no-context conditions. Although the other two Group 1 participants did not demonstrate such a dramatic distinction in their performance across the conditions, high-context images appear to have a positive influence on the reading comprehension of at least some people who achieve relatively high reading comprehension scores on the *RCBA*.

Two primary differences exist in the performance of Group 1 and Group 2 participants regarding the high-context condition. The first is the magnitude of change that appeared between the low- and no-context conditions and the high-context condition (i.e., 50% for Group 1 and 30% for Group 2), and the second is general performance level (i.e., 100% for Group 1 and 50% for Group 2).

Group 2. Group 2 participants also achieved comparable levels of overall accuracy across the experimental conditions; however, their accuracy performance contrasts from Group 1 participants, because they had consistently low accuracy rather than consistently high. As documented in Chapter 3, the Passage Dependency Index (PDI) for the three experimental narratives ranged from .73 to .78; in essence, non-brain damaged participants answered roughly 25% of the questions correctly without having read the narrative passage. After reading the narrative passages, Group 2 participants achieved overall accuracy levels comparable to, or slightly above, the PDI regardless of the level of visuographic support. Still, however, Participant 6 and 10 demonstrated 50% concrete accuracy in the high-context condition and only 20% accuracy in the low- and no-context conditions. These data suggest that some people who demonstrate low reading comprehension abilities may benefit from high-context

scenes when dealing with concrete information similarly to some people with relatively good reading comprehension abilities. Thus, there appears to be a consistent trend for high-context scenes to influence the reading comprehension of people with chronic aphasia in a positive manner when dealing with concrete information.

Group 3. Individuals in Group 3 differed from the Group 2 participants in that they performed above chance for overall accuracy across all three conditions. In addition, they achieved higher overall accuracy scores in the high-context condition than in the low- and no-context conditions.

Three of the four participants in Group 3 (i.e., Participant 4, 5 and 7) exhibited improved concrete accuracy when they read narrative passages presented either with low- and/or high-context scenes as compared to the no-context condition. Two of these four (i.e., Participant 4 and 5) were also distinguishable from the Group 1 and 2 participants in that they demonstrated equivalent or higher concrete accuracy levels with low-context scenes than with high-context scenes. Participant 5 benefited most from low-context scenes, while Participant 4 demonstrated comparable concrete accuracy scores across high- and low-context conditions. In contrast, Participant 7's performance revealed a steady increase in concrete accuracy as the researcher increased the level of visuographic context.

While all participants in Group 3 scored below 70 on the *RCBA*, Participant 5 scored a 64 and the remaining three participants scored between 43 and 45 on the *RCBA*. On the surface, this higher-level of residual reading

comprehension ability might explain why Participant 5 achieved such high general performance (i.e., 100% concrete accuracy) with low-context scenes. However, it does not explain his lower, yet comparable, performance in the high- and no-context conditions. His inconsistent performance supports previous reports describing the variability of performance of people with aphasia (McNeil, 1983; McNeil et al., 1991).

Although the patterns of improved general performance for Group 3 are slightly different from Groups 1 and 2, a trend of improvement in concrete accuracy persisted when people with chronic aphasia read narratives combined with some level of visuographic context. These findings mirror those of other researchers who concluded that people with aphasia with reduced comprehension skills on standardized aphasia battery subtests improved in their auditory comprehension given supports in the form of linguistic and/or visuographic context (Garrett, 1993; Garrett & Huth, 2002; Lasker et al., 1997; Pierce & Beekman, 1985). These results challenge the findings of other investigators suggesting pictures adversely affect the comprehension of people with aphasia (Brennan et al., 2005; Waller & Darley, 1978).

An important factor to consider when evaluating the participants' response accuracy includes cognitive factors associated with processing visuographic information. According to Wilkinson and Jagaroo (2004), non-brain-injured people process high-context scenes in a holistic manner because of natural integration of the portrayed objects, people, and actions. As a result, non-brain-injured people tend to process these photos automatically, thus facilitating the

efficiency of the associated cognitive processes (Fabre-Thorpe, Delorme, Marlot, & Thorpe, 2001; Wilkinson & Jagaroo, 2004). This insight provides a theoretical framework to support the trend of improvement in concrete accuracy when people with chronic aphasia read narratives combined with high-context scenes. However, this theory does not elucidate why some participants exhibited comparable or superior benefit from low-context scenes when compared to high-context scenes.

Response Times

Based on the construction-integration model of reading comprehension, high-context scenes activate the world knowledge that people bring to reading experiences, and, in turn, they assist them in abstracting meaning from written text (Edmondson, 2000; Graesser et al., 1994; Hirsch, 2003; Johnston, 1984; Nicholas & Brookshire, 1987; Nicholas, 1986; Omanson, 1982; Sanford & Garrod, 1998; Trabasso & van den Broek, 1985; Tuinman, 1974; Wixson & Peters, 1987; Zeece, 2003). Further, due to the relative amount of information depicted in a high-context scene compared to a low-context scene, one might surmise that a high-context scene would activate more world knowledge than a low-context scene. This leads to the supposition that high-context images might result in accelerated processing within working memory (WM) compared to low-context images, thus freeing additional resources for allocation toward the drawing of inferences and the forming of connections between novel (written text) and old information (world knowledge) (Edmondson, 2000; Fountain, 2003; Graesser et al., 1994; Zeece, 2003). Regarding the current study, this line of

reasoning prompted the hypothesis that people with chronic aphasia would demonstrate faster response times in the high-context condition than the low- and no-context conditions.

However, the outcomes of this study suggest that, overall, people with chronic aphasia respond more slowly to questions following narrative reading passages presented with any level of visuographic context than to narrative passages presented with no visuographic support. At the same time, a subgroup of people with chronic aphasia demonstrated equivalent response times across the experimental conditions, as well as overall faster response times than the other participants. Once again, examining the results with regard to subgroups within the participant pool may help with understanding these findings; therefore, the researcher categorized the participants into two groups based upon their response time patterns.

Group 1. Group 1 (Participant 3, 6, 8, and 9) demonstrated relatively fast response times with little variability across the high-, low-, and no-context conditions. This outcome suggests that the visuographic context offered virtually no advantage for people with chronic aphasia who had either relatively high or low residual reading ability at the second grade level (based on *RCBA* scores). In essence, the passages were either too simple or too challenging for the participants in this subgroup, and, consequently, they did not appear to attend to the visuographic context.

Group 2. In contrast, Group 2 (Participant 1, 2, 4, 5, 7, and 10) exhibited longer or comparable response times following narrative passages presented

either with high- or low-context scenes than following narrative passages presented with no context. Although these results counter the original research hypothesis, they provide additional support both for the resource allocation theory of aphasia and for the construction-integration model of reading.

Proponents of the resource allocation theory advocate that people with aphasia have a reduced *central pool* of cognitive resources available or have difficulty allocating attention for language purposes. Therefore, when they participate in a linguistic activity, such as reading, they may deplete their cognitive resources (McNeil, 1983; McNeil et al., 1991; Mayer & Murray, 2002; Murray, 1999). Complementing this notion, the construction-integration model of reading emphasizes the importance of reducing the demands on cognitive resources—specifically working memory—through the activation of world knowledge (Graesser et al., 1994; Hirsch, 2003; Johnston, 1984; Nicholas & Brookshire, 1987; Nicholas et al., 1986; Omanson, 1982; Sanford & Garrod, 1998; Trabasso & van den Broek, 1985; Tuinman, 1974; Wixson & Peters, 1987). It appears that presenting narrative passages with some level of visuographic context may have provided increased access to the participants' world knowledge and facilitated engagement of deeper-level information processing, thus resulting in longer response times during the comprehension question session. It is also noteworthy that this behavior occurred even though the participants did not have access either to visuographic context or to narrative passages during the comprehension question sessions. These findings add to the existing literature, because researchers have not yet documented the impact

of visuographic context on the response times of people with reading comprehension challenges secondary to chronic aphasia.

Implications of the Investigation

For decades, researchers have examined the impact of the use of *pictures* on auditory comprehension and, more recently, have begun to investigate this same variable on the reading comprehension of people with aphasia. Researchers investigating comprehension report conflicting results on the relative helpfulness of pictures during these tasks (Brookshire, 1987; Brennan et al., 2005; Pierce, 1983; 1988; 1991; Pierce & Beekman, 1985; Stachowiak et al., 1977; Waller & Darley, 1978). These conflicting findings may stem from the variability across studies regarding the types of visuographic support provided. The results of the current investigation, considered within the framework of the resource allocation theory of aphasia and construction-integration model of reading, suggest that contextually-rich visuographic information is supportive to at least some individuals with chronic aphasia when they perform reading comprehension tasks.

Another clinical implication from the current study concerns the sensitivity of available reading comprehension evaluation tools such as the *RCBA* (LaPointe & Horner, 1998), and the reading subtests of the *WAB* (Kertesz, 1982) and the *BDAE* (Goodglass, Kaplan, & Barresi, 2001). As noted by other aphasiologists, the reading subtests included in standard aphasia batteries, as well as the subtests included in reading specialty tests for use with people with aphasia, tap into linguistic processes without regard to underlying cognitive mechanisms

(Helm-Estabrooks, 2001; Garrett & Lasker, 2005a; 2005b). To address this issue, Garrett and Lasker (2005a; 2005b; 2005c) suggest the incorporation of intelligence measures to gain insight into the ability of people with chronic aphasia to use augmentative and alternative communication (AAC) systems. However, if clinicians do this, they should be aware of the linguistic demands inherent in most intelligence measures and may wish to rely on measures specifically targeting non-verbal aspects of intelligence. For this reason, *Raven's Coloured Progressive Matrices (RCPM)* (Raven, 1938)—a non-verbal assessment of general intelligence—is often selected for administration, as is the case when clinicians compute the *cognitive quotient* of the *WAB*. Helm-Estabrooks (2001) offers the *Cognitive-Linguistic Quick Test (CLQT)* as another option to probe the executive function skills of people with aphasia. This tool consists of 10 tasks, five of which require minimal language demands; these include Personal Facts, Symbol Cancellation, Confrontation Naming, Clock Drawing, Story Retelling, Symbol Traits, Generative Naming, Design Memory, Mazes, and Design Generation. Research is currently underway to explore the relation between cognitive skills and AAC ability among people with chronic aphasia (Garrett & Lasker, 2005a; 2005c). This forthcoming data may provide additional insight about prerequisite cognitive skills necessary for people with aphasia to benefit from the use of visuographic context during a variety of reading comprehension tasks (i.e., procedural, narrative, expository, etc.) at a variety of complexity levels (i.e., word-level, sentence-level, paragraph-level, etc.).

Limitations of the Study and Future Directions

This dissertation helped to lay the foundation to understand some of the cognitive-linguistic principles that support the use of high-context scenes during reading comprehension tasks with people who have chronic aphasia. As with most preliminary studies, several limitations warrant further discussion. These include participant recruitment and heterogeneity, picture array and stimuli development, and manipulation of stimuli. Examination of these limitations may reveal directions for future research on this topic.

Participant Recruitment and Heterogeneity

The primary aim of this preliminary investigation was to explore the impact of three levels of visuographic context—high-, low-, and no-context—on the reading comprehension of narratives by people with chronic aphasia. Because the research was among the first to address this issue, the researcher recruited participants that represented the spectrum of aphasia severity. This approach potentially allowed for identification of subgroups that might benefit most from this intervention technique. However, the recruitment strategy limited the likelihood of finding significant accuracy outcomes due to the heterogeneity of reading ability within the participant pool.

Future researchers should recruit a participant pool that reflects people whose reading ability lies within the moderately impaired range, as the outcomes of this study indicate that this population may benefit the most from high-context visuographic supports during reading. Additionally, researchers need to investigate the benefit of visuographic context on the reading comprehension of

people who demonstrate higher-levels of residual reading ability—*RCBA* (LaPointe & Horner, 1998) scores between 70 and 89—when presented with reading materials beyond the second grade complexity level. It would also be beneficial to replicate this study using a variety of lower-level reading materials (i.e., shorter paragraphs, sentences, words, etc.) to examine the impact of visuographic context on the reading comprehension of people with lower-level reading ability (i.e., *RCBA* scores below 40).

Picture Array and Stimuli Development

Another potentially problematic issue during this study was the arrangement of the visuographic stimuli. In this study, the researcher presented the pictures to the participants simultaneously with the narrative passage. However, the participants viewed the pictures on a separate sheet of paper. Additionally, the researcher formatted the high- and low-context pictures using two different *views*: portrait and landscape. This was dependent on the perspective of the target photos. For example, two horizontally framed photos fit onto one 8.5 X 11” piece of paper only in the landscape view. In contrast, a stimulus set containing one horizontally- and one vertically-framed photo fit onto one 8.5 X 11” piece of paper only in the portrait view. Despite the uniform size of the photographs (i.e., 4 X 6”), this discrepancy might have influenced how the participants processed the visuographic information across the conditions.

Furthermore, the number and types of pictures included in each stimulus set potentially affected the results of this study. Specifically, the stimulus sets, both for the high- and low-context conditions, contained two photos. The

researcher developed each narrative passage around the theme of two interrelated high-context photos. However, only one high-context stimulus set included the same people in the same environment in both pictures (i.e., The Playground). The remaining two high-context stimulus sets contained photos that portrayed similar-looking, but different, people; additionally the photos depicted two different environments. In addition, each stimulus set developed for the low-context condition only included two photos. These pictures were chosen based on the researcher's perceived importance to the central theme of the narrative; however, components critical to the overall theme of each narrative may have been neglected, especially with regard to abstract associations to the narratives. Inclusion of additional photographs—either in the high-context or in the low-context conditions—or inclusion of photographs with different content structures may impact the performance of people with aphasia. In particular, the decisions regarding the picture arrays used in the current study may have affected participants' performance accuracy, especially with regard to the abstract reading comprehension questions.

To eliminate confounds associated with picture arrays, future investigators should standardize both the size and the view in which they present the visuographic stimuli to the participants. A content unit analysis of the narratives would provide a standardized approach to determining the number of people, objects, and actions to include in the high-context stimuli, as well as number of photos that should be included in the low-context condition.

In addition, researchers should consider issues relating to the development of narratives. Specifically, in addition to ensuring that each narrative includes a *problem* and a *resolution*, the narratives should include a balance for number of words, sentence, characters, settings, Flesch Reading Ease (Flesch, 1948), and Flesch-Kincaid Grade Level (Flesch, 1948). Secondly, researchers should not develop narratives based on available photographs, but instead develop visuographic stimuli based on narratives.

Manipulation of Stimuli

Another factor to consider when interpreting these data is that the researcher did not point to, or otherwise reference, the high- or the low-context scenes during the experimental tasks. The researcher strategically planned this when designing this study to avoid bias and to observe how the participants naturally utilized the photos. However, this behavior is atypical in the clinical setting. Traditionally, when speech-language pathologists employ compensatory strategies to facilitate improved communication or employ augmented comprehension approaches, they refer to the prop(s) in some manner. Violating this strategy may have impacted participants' performances.

It is also possible that removal of the narrative passages and the visuographic context during the comprehension question sessions influenced the outcomes of this investigation. When a person has chronic aphasia and further restoration of the linguistic system is unlikely, interventionists typically do *not* remove supportive materials during interactions. Given the consistent, positive outcomes researchers report regarding various compensatory strategies

employed with people who have chronic aphasia (i.e., the written choice strategy, tagged yes/no questions, augmented comprehension, remnants, graphic topic setters, etc.) (Garrett, 1993; Garrett & Beukelman, 1995; Garrett & Lasker, 2005b, Garret & Huth, 2002; Ho et al., 2005; Hux et al., 2001; Lasker et al., 1997; Weissling & Beukelman, 2006; Weissling et al., 2006), it seems logical to infer that these supports assist people with aphasia to allocate their cognitive resources more efficiently than when such supports are not available and thus improve their linguistic performance. Future investigators should design studies to evaluate the independent and joint impact of the researcher referencing the visuographic context during the reading comprehension tasks and making the visuographic context and narrative passage available during the comprehension question sessions.

Impressions

Although the outcomes of this introductory study suggested reading comprehension improvements only for concrete material, continued systematic replication, employing the aforementioned suggestions, could potentially provide better understanding of how to best present VSDs in conjunction with various reading materials. In essence, this dissertation provided preliminary data to support the notion that VSDs have the potential to assist people with chronic aphasia to regain increased independence using supported reading comprehension strategies.

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Appendix A

Inclusion Criteria and Demographic Questionnaire¹

Potential Participant's Name:**Date of Birth (month/day/year):****Address:****Spouse/Caregiver/Contact Person:** _____

- ❖ Does the candidate have a legal guardian: Yes No
- ❖ If so, please list that person as the contact person.

Phone Number:

The potential candidate must:

1. Have aphasia due to LEFT cerebrovascular accident.	YES	NO
Date of CVA (month/year):		
2. Be at least 3 months post-onset.	YES	NO
3. Have at least an 8 th grade education & NO MORE than a 4-year college degree (B.A./B.S.)	YES	NO
❖ Level of Education:		
___ 8 th grade		
___ some high school		
___ completed high school		
___ 1 year of college		
___ 2 years of college (or A.A./A.S.)		
___ 3 years of college		
___ 4 years of college (B.S/B.A.)		
___ Master's Degree		
___ M.D. or Ph.D.		

4. Be a native speaker of American English	YES	NO
5. Be alert and attentive for four or more hours per day.	YES	NO
6. Have no dramatic fluctuations in alertness or behavior due to uncontrolled diabetes, blood pressure problems, or other medications.	YES	NO
7. Have a negative history of major psychotic episodes or and intractable substance abuse.	YES	NO
8. Be able to communicate using the traditional format of the Written Choice Strategy?	YES	NO

For Example:

WHERE ARE YOU FROM?

- NEBRASKA
- CALIFORNIA
- MAINE
- NOT HERE

¹Inclusion Criteria and Demographic Questionnaire adapted from:

Garrett, K. L. (1993). Changes in the conversational participation of individuals with severe aphasia given three types of partner support. (Doctoral dissertation, University of Nebraska-Lincoln, 1993). *Dissertation Abstracts International*, 54, 5113.

Appendix B

Visual Screening

Instructional Script

❖ YOU WILL READ SOME NAMES

❖ CIRCLE YOUR NAME

❖ THIS IS WHAT IT LOOKS LIKE

-Next, the researcher shows the participant the practice items.

Appendix C

Written Choice Strategy Screening

Instructional Script

- ❖ **Listen carefully.**
- ❖ **We are going to talk.**
- ❖ **I want to get to know you better.**
- ❖ **I will ask you some questions.**
- ❖ **You can ask me questions too.**

Appendix D

Reading Passage

Instructional Script

- ❖ **Listen carefully.**
- ❖ **You will read a story.**
- ❖ **Read to yourself.**
- ❖ **Take your time.**
- ❖ **Look at me after you are done.**

Appendix E

Comprehension Question

Instructional Script

- ❖ **Listen carefully.**
- ❖ **You will read some questions.**
- ❖ **I will also read them to you.**
- ❖ **You have four answer choices.**
- ❖ **Point to the correct answer.**
- ❖ **Do not turn the pages.**
- ❖ **I will turn the pages.**

Appendix F

Reading Profile

1. I read a lot BEFORE my stroke.

1	2	3	4	5
strongly				strongly
disagree				agree

2. I liked to read BEFORE my stroke.

1	2	3	4	5
strongly				strongly
disagree				agree

3. I read a lot NOW.

1	2	3	4	5
strongly				strongly
disagree				agree

4. I like PICTURES when I read.

1	2	3	4	5
strongly				strongly
disagree				agree

Appendix G

Self-Assessment of Performance

High- and Low-context conditions**1. The pictures HELPED me understand the story.**

1	2	3	4	5
strongly				strongly
DISagree				agree

2. This was EASY.

1	2	3	4	5
strongly				strongly
DISagree				agree

3. I answered the questions RIGHT.

1	2	3	4	5
strongly				strongly
DISagree				agree

4. I understood the ENTIRE story.

1	2	3	4	5
strongly DISagree				strongly agree
☹				☺

No-context condition

1.The pictures WOULD HAVE *helped* me understand the story.

1	2	3	4	5
strongly DISagree				strongly agree
☹				☺

2. This was EASY.

1	2	3	4	5
strongly DISagree				strongly agree
☹				☺

3. I answered the questions RIGHT.

1	2	3	4	5
strongly				strongly
DISagree				agree

4. I understood the ENTIRE story.

1	2	3	4	5
strongly				strongly
DISagree				agree

Appendix H

Vision Screening

Participants will be given the following directions while the researcher covers the lines above and below the target line using a piece of paper with a slot large enough to reveal necessary information (to decrease confusion of task instructions). The participant's name will be used and interspersed with familiar family names (i.e. spouse, children, etc.). The participant must pass with 100% accuracy.

1. Here is your name: John

2. Circle your name each time you see it.

3. Practice Items: the researcher will perform the task using (a). to demonstrate. Next, she will ask the participant to practice using (b).

a. Scott John Silvia John Mary

b. Mary Silvia John Scott John

Test Items

1. John Mary Scott John

Silvia

2. Mary John Silvia Scott John

3. Scott John Silvia John Mary

4. John Silvia John Mary Scott

5. Silvia John Mary Scott John

Appendix I
Written Choice Screening
Caregiver Questionnaire

1. Where is _____ from?
2. How long has _____ lived in Lincoln (Omaha, Kearney, etc)?
3. How many kids does _____ have?
4. When is _____'s birthday?
5. How old is _____?
6. Where did _____ work?
7. What kind of work did _____ do at (insert from 6 above)?
8. What sports does _____ enjoy watching?
9. What other hobbies does _____ enjoy?
10. What type of T.V. shows does _____ enjoy watching?
11. What is your relationship to _____?

Appendix J

Likert Scale Calibration

-Is your name _____?

❖ YES

❖ NO

1. This was EASY.

1	2	3	4	5
strongly				
strongly				
disagree				agree

2. I answered the question CORRECTLY.

1	2	3	4	5
strongly				
strongly				
disagree				agree

3. I understood the sentence.

1	2	3	4	5
strongly				
strongly				
disagree				agree

-The gorilla was chased by the raccoon.

-Did the gorilla chase the raccoon?

❖ YES

❖ NO

1. This was EASY.

1	2	3	4	5
strongly				
strongly				
disagree				agree

2. I answered the question CORRECTLY.

1	2	3	4	5
strongly				
strongly				
disagree				agree

3. I understood the sentence.

1	2	3	4	5
strongly				
strongly				
disagree				agree