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Determining the Relationship Between Language and Attention in Elders with Nonfluent Aphasia

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DETERMINING THE RELATIONSHIP BETWEEN LANGUAGE AND ATTENTION IN ELDERS WITH NONFLUENT APHASIA

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DEDICATION

To those who were told they couldn’t, and did.

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DETERMINING THE RELATIONASHIP BETWEEN LANGUAGE AND ATTENTION IN ELDERS WITH NONFLUENT APHASIA

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ABSTRACT

Researchers have questioned whether the occurrence of aphasia creates executive function deficiencies that result in cognitive-linguistic deficits. Aphasia is a breakdown in language comprehension and production caused by a focal lesion in the left hemisphere of the brain (Papathanasiou, Coppens, & Potagas, 2013). Executive function refers to a set of "higher order component functions required to control and coordinate performance on complex problem solving tasks" (Dick & Overton, 2010). Researchers have speculated that attention, an important part of executive function, may be compromised in addition to language deficits in persons with aphasia. The purpose of this exploratory multiple case comparison is to investigate the relationship between language and attention in persons with aphasia by comparing measures of attention that rely on language comprehension and use against measures of attentions that are independent of language comprehension and use.

The study investigated eight participants between the ages 57 and 79 who have experienced a lesion in the left hemisphere of the brain resulting in nonfluent aphasia. Each participant completed subtests from the following assessments in order to measure language and attention: *Western Aphasia Battery Bedside Screener-Revised*, *Cognitive Linguistic Quick Test, The Test of Everyday Attention*, and the *Leiter International Performance Scale-Revised*.

Attention was affected to varying degrees in some participants with nonfluent aphasia. The degree to which attention was affected was not consistently related to the severity of aphasia.

This study concludes by describing each participant's performance in detail and providing clinical implications for diagnosis and treatment.

KEY WORDS: APHASIA, LANGUAGE, ATTENTION, MULTIPLE CASE STUDY

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CHAPTER I

INTRODUCTION

Cerebral vascular accident, known as stroke, is the third leading cause of long-term disability in elders (persons over 65 years) (LaPointe, 2011). The ability to comprehend, use, and manipulate language is often affected when an individual has a stroke on the left side of the cerebral cortex of the brain. A lesion here may result in a loss of language comprehension and production—a condition known as aphasia. Researchers and clinicians have commonly held the precept that a lesion in the part of the brain that houses language skills results in language impairment alone (Papathanasiou, Coppens, & Potagas, 2013). As such, rehabilitation has focused on recovery of language skills. Recently, however, researchers have been assessing other cognitive processes to determine whether other cognitive factors apart from residual language ability affect how persons with aphasia progress in the rehabilitative processes designed to help them recover their language skills. Importantly, the first consideration is whether the brain lesion affects language alone, or whether other cognitive skills are also affected. Relatedly, there is a second consideration of whether persons with aphasia call upon other cognitive capacities to help them regain their language skills.

Ellis and Young (1988) define aphasia as a selective breakdown of language processing itself, of underlying cognitive skills, or of the necessary cognitive resources, resulting from a focal lesion. Murray, Holland, and Beeson (1997) conjecture that an impairment of cognitive processes, such as working memory, attention, allocation of attention, and sequencing, exists in persons with aphasia (as cited in Fridriksson, Nettles, Davis, Morrow, & Montgomery, 2006 p. 401). While the relationship between language and these various cognitive processes warrants careful study, the current study examines specifically the relationship between language and attention in older persons with aphasia.

Attention is vital to daily activity. Filley (2002) defines attention as one's ability to maintain a coherent line of thought. Attention acts as a gatekeeper by regulating and prioritizing information processed by the central nervous system. Without intact attention, one would have difficulty learning, remembering, and behaving appropriately (Sterr, 2004). Current research continues to validate and delineate the relationship between language and attention (Murray, 1999).

The Significance of Attentional Abilities in the Treatment of Aphasia

Schuell, in seminal work on aphasia, (Schuell, Jenkins, & Jimenez-Pabon, 1964, as cited by McNeil & Copland, [2011]) states that "the language impairment that defines aphasia is often accompanied by other sensory, motor, and cognitive disorders that are not in and of themselves aphasia." Clinicians need to be aware of the concomitant impairments that consistently occur with aphasia in order to provide appropriate treatment.

Basso (2004, as cited in McNeil & Copland [2011]) offers a theory that can guide aphasia therapy. A clinician needs to have (1) a means for deriving a diagnosis of the functional impairment affecting the person with aphasia, (2) a model of the cognitive-linguistic processes to be treated, (3) knowledge of what forms of language impairments can be treated, and (4) a hypothesis regarding the neural basis for recovery. Basso also believes it is important to look beyond a person's language impairment and consider any other factors besides a brain lesion that may affect recovery, such as a person's ability to learn. Attention is a component of learning and is therefore relevant to recovery of functional language skills. A clinician needs to be aware of how to treat all of the cognitive-linguistic factors that can help persons achieve their full potential for recovery.

Several authors implicate non-language cognitive factors in recovery from aphasia. For example, some persons with severe nonfluent aphasia do not respond to any form of communication therapy, as was noted by Nicholas, Sinotte, and Helm-Estabrooks (2005), who postulate that the nonfluent aphasia in conjunction with non-linguistic cognitive functions may be responsible for unsuccessful communication. Vallila-Rohter and Kiran (2013) believe that non-linguistic cognitive impairments may interfere with the "online construction" and "transaction success" of language processes, thus reducing a person's success in regaining communicative competence (p. 80). The goal of communication therapy is to rehabilitate an individual with aphasia to the point where he/she can return to his/her premorbid activities, roles, and responsibilities (Meuller & Dollaghan, 2013). In order to improve an individual's quality of life, a clinician must be aware of and work with any concomitant deficits that may occur in persons with aphasia, such as impairment of attentional skills.

Language and Attention

The noted psychologist William James stated, "Attention improves performance in relation to attended stimuli. It allows a person to perceive, discriminate, remember, and react better than if attention is not engaged" (as cited by O'Donnell, 2002 p. 100). Attention is basic and critical to all activities; *failure to attend equals failure to process information, despite what may be spared in the ability to understand spoken and written stimuli* (Helm-Estabrooks, 2002, p.172). Even slight deficits in an individual's ability to attend to target stimuli can compromise his/her ability to learn, which will affect progress in communication therapy. Vallila-Rohter and Kiran (2013) believe that a person's ability to learn is a better predictor of success in aphasia therapy than his/her level of functioning in language skills.

The relationship between language and attention is still not well understood. Murray (2012) believes that the cognitive domains of attention and language are probably linked in persons with aphasia, but researchers are not yet able to describe deficit patterns or uncover a clear relationship between the two cognitive processes. Moreover, there is no prior research addressing how attention is affected in persons with aphasia based on the severity and/or type of aphasia, notably fluent (posterior) aphasia versus nonfluent (anterior) aphasia.

Purpose of the Study

Researchers still debate whether or not attention, as a cognitive process, is affected by the language loss that occurs in aphasia. Many studies that have been conducted concerning the relationship between attention and language have relied on tasks that depend upon a participant's language comprehension and use, which confounds obtaining data on attentional skills alone. Fischler (2000, p. 381) states that “in the study of attention, language has often become a more convenient vehicle for stimulation delivery and response than it has been the target for analysis” (as cited by Kurland, 2011 p. 51). The purpose of this exploratory multiple case comparison is to further investigate the relationship between language and attention in persons with aphasia by comparing measures of attention that rely on language use and comprehension against measures of attention that are independent of language use and comprehension. Understanding the impact aphasia has on attention, as well as the relationship between language and attention impairments in aphasia, is important for speech-language pathologists. Knowledge in this area will assist in appropriate planning, goal setting, and treatment of persons with aphasia (see Murray, 2002).

The research questions are:

1. Can it be identified whether attention is affected in persons with nonfluent aphasia?
2. Is there a trend for how attention is affected in persons with nonfluent aphasia based on the severity of aphasia?
3. Can attentional skills be measured as discrete skills in persons with nonfluent aphasia?
    a. In measures dependent of language, can attentional skills alone be identified in persons with nonfluent aphasia?
    b. In measures independent of language, can attentional skills alone be identified in persons with nonfluent aphasia?

The hypotheses under study are:

1. It can be identified whether attention is affected in persons with nonfluent aphasia.
2. There is a trend for how attention is affected in persons with nonfluent aphasia based on the severity of aphasia.
3. Attentional skills can be measured as discrete skills in persons with nonfluent aphasia.
    a. In measures dependent on language, attentional skills alone can be identified in persons with nonfluent aphasia.
    b. In measures independent of language, attentional skill alone can be identified in persons with nonfluent aphasia.

The null hypotheses of the study are as follows:

1. It cannot be identified whether attention is affected in persons with nonfluent aphasia.
2. No trend can be identified for how attention is affected in persons with nonfluent aphasia based on the severity of aphasia.
3. Attention skills cannot be measured as discrete skills in persons with nonfluent aphasia.
    a. In measures dependent on language, attentional skills alone cannot be identified in persons with nonfluent aphasia.
    b. In measures independent of language, attentional skills alone cannot be identified in persons with nonfluent aphasia.

In summary, it is hypothesized that this study will determine that attention is affected in persons with aphasia. Hypothesizing that attention is affected in persons with nonfluent aphasia is based on the proximity of the anterior brain lesions that cause nonfluent aphasia to the attentional processes located primarily in the frontal lobe.

Kurland (2011) speculates that attention skills can be identified in persons with aphasia through measures that are language dependent as well as measures that are language independent. In this study, both sorts of measures are used, in order to attempt to compare measures of attention that rely on language with measures of attention that are independent of language. The purpose is to measure attention skill alone, as a discrete skill that is not dependent upon or confounded by language comprehension and use.

Significance of the Study

This exploratory multiple case comparison study has theoretical significance in that is has not yet been established whether the brain lesion that causes aphasia affects language alone, or whether other cognitive skills are also affected, notably the skill of attention. Nor is there significant research on whether persons with aphasia call upon other cognitive capacities, notably attention, to help them regain their language skills. In addition, attention as a component of learning has not been carefully studied for its relationship to recovery of functional language skills. It is also not well established whether performance of attention skills that rely on language can be specifically observed in persons with aphasia, and whether measures of attention that are independent of language can be similarly observed.

This study had practical significance in that a clinician needs to be aware of how to diagnose the presence, severity, and impact of cognitive-linguistic factors that can influence the clinical presentation of aphasia. Specifically, ascertaining the clinical presentation of concomitant deficits in attention is important in any diagnostic work-up.

Clinicians need to be able to treat deficits in attention as factors that may inhibit recovery of communication skills in persons with aphasia. Clinicians may guide persons with aphasia who retain strengths in attention skills to use these strengths to support their recovery of communication skills.

CHAPTER II

LITERATURE REVIEW

PART I: DEFINITIONS, THEORIES, AND RELATIONSHIPS

Definitions of Aphasia

The definition of aphasia has been presented in many different ways throughout the history of its research. The many definitions will be reviewed in order to clearly state the parameters of this study.

Owens, Metz, and Farinella (2011) state that "aphasia literally means without language." Benso (1979) defined aphasia as "a loss or impairment of language caused by brain damage" that is acquired, not learned, and not functional, psychogenic, or affective in nature (as cited by McNeil & Pratt, 2001 p. 905). The above definitions are succinct and open to interpretation. The definitions serve as a good starting point for the study of aphasia, but are not sufficient when defining the disorder for research or treatment. It is necessary to provide an explanation that goes beyond the etiology of the disorder to further define the underlying processes and systems involved and relate how aphasia presents itself within individuals.

Murray and Chapey (2001) define aphasia as "an acquired impairment in language production and comprehension and in other cognitive processes that underlie language" (as cited by Vinson, 2012, p. 550). Hula and McNeil (2008) support Murray and Chapey's definition of the disorder by stating that aphasia is a "disorder of language or a disorder of the cognitive apparatus used to comprehend and produce language" (p. 169). These researchers highlight the idea that aphasia may be a disorder of the cognitive systems that underlie language rather than an isolated disorder of language itself.

It is important to note that aphasia is not the result of motor speech impairment, dementia, or deterioration of intelligence (Owens, Metz, & Farinella, 2011). Aphasia has a rapid onset and is caused by a lesion, generally due to a stroke or traumatic brain injury, in one of more of the areas of the left hemisphere of the brain that control language processes. The areas most often affected are the temporal and frontal lobes of the left hemisphere. A person diagnosed with aphasia presents with impairments of receptive and/or expressive language, which can lead to difficulty with auditory comprehension, retention of information, verbal expression, reading, and writing (Vinson, 2010).

Aphasia is a linguistic performance disorder, not a linguistic competence disorder. Researchers are able to demonstrate this by citing aphasia's transience, by the stimulability of persons with aphasia, and by the variance in performance observed between and within interactional sessions with persons with aphasia (McNeil & Pratt, 2001). Aphasia is a disorder where a person is impaired in manipulating language for communication.

Darley (1982) and McNeil (1988) offer comprehensive definitions of aphasia, which include the etiology and manifestation of the disorder. Darley defines aphasia as an:

> impairment, as a result of brain damage, of the capacity for interpretation and formulation of language symbols; multimodality loss or reduction in efficiency of the ability to decode and encode conventional meaningful linguistic elements (morphemes and larger syntactic units); disproportionate to impairment of other intellective functions; not attributable to dementia, confusion, sensory loss, or motor dysfunction; and manifested in reduced availability of vocabulary, reduced efficiency in application of syntactic rules, reduced auditory retention span and impaired efficiency in input and output channel selection (as cited by McNeil & Pratt, 2001 p.905).

McNeil states:

> Aphasia is a multimodality physiological inefficiency with [greater than loss of,] verbal symbolic manipulations (e.g. association, storage, retrieval, and rule implementation). In isolated form it is caused by focal damage to cortical and/or subcortical structures of the hemisphere(s) dominant for such symbolic manipulations. It is affected by and affects other physiological information processes to the degree that they support, interact with, or are supported by the symbolic deficits (McNeil & Pratt, 2001 p. 907).

The current study adopts a definition of aphasia based on ideas proposed by Darley and McNeil. For the purposes of the study, aphasia is a multimodality disorder where the manipulation, comprehension, and formulation of linguistic symbols and elements present as the prominent deficit in individuals affected. Brain damage that disrupts the operational performance of the structures and processes that underlie language causes aphasia. The inability to monitor and manipulate language processes affects and is affected by other physiological/cognitive processes that support, are supported by, and interact with underlying language processes.

For the purposes of this study, two types of aphasic syndromes are defined. Fluent aphasia is due to a lesion in the posterior portions of the left hemisphere of the brain. A person with fluent aphasia may present with word substitutions, verbose verbal output often lacking meaning, and decreased auditory comprehension (Owens et al., 2011). Nonfluent aphasia is generally due to a lesion in or near the frontal lobe of the left hemisphere of the brain. A person with nonfluent aphasia will have slow labored speech, as well as impaired word finding and syntax (Owens et al., 2011). It is extremely difficult to identify the exact location where language resides due to the complexity of the process of comprehending, manipulating, and using language.

Severity of aphasia varies based on the cause of the disorder, the location and extent of brain injury, and the age and health of the individual. A person with aphasia may experience spontaneous recovery, where the severity of the aphasic syndrome will decrease after the onset of the disorder, often due to reduced brain swelling. Affects of spontaneous recovery may be seen for a few months after the onset of aphasia (Owens et al., 2011).

Theories of Aphasia

Many theories of aphasia have been proposed since the study of the impairment began. Schuell's (1964) classic theory holds that aphasia as a unitary phenomenon that occurs with additional complications and symptoms (as cited by Papathanasiou et al., 2013, p. 16). Researchers who believe that aphasia is a unitary syndrome state that the core impairment in aphasia crosses all language modalities and components of language, and can be accounted for by an underlying impairment. In this model, every aspect of language is affected in aphasia because they are all interfaced.

The Cognitive Neurophysiological Model assumes that components of cognition are organized into modules that are domain specific (Papathanasiou et al., 2013). The cognitive neurophysiological aphasiologists believe that language processes are represented and organized in modules that are composed of several components, and that each of the components is meant to process one specific type of input. When brain damage occurs, it can disrupt one component of the module and leave the others functionally intact (McNeil & Copland, 2011).

The Cognitive Perspective of Aphasia is a theory that relates to therapy for individuals affected. The theory states that individuals with aphasia have a preserved language mechanism that is adequate for successful language functioning in the presence of a disorder (Hula & McNeil, 2008). Researchers and clinicians accept this theory based on aphasic syndromes' transience and affected individuals' stimulability for language production. Persons with aphasia have been observed demonstrating metalinguistic knowledge about aspects of language they fail to perform. For example, persons with aphasia can describe the metalinguistic concept of "naming" but may struggle to perform the linguistic task of naming objects.

The Classical Connectionist Theory is currently the theory most widely used by aphasiologists and clinicians. This theory speculates that brain centers, composed of association cortices, hold representations required for particular language functions. Information flows between the centers through dedicated pathways. The model explains that other parts of the brain are involved in language; certain language functions occur outside of the defined centers. Because of its emphasis on brain centers, this theory splits aphasia into fluent and nonfluent syndromes, thus organizing the impairment based on lesion sites (Hula & McNeil, 2008). Fluent aphasia is known as a posterior syndrome, whereas nonfluent aphasia is known as an anterior syndrome.

The Classical Associative Connectionist model of aphasia brings together many aspects of the previous models and is the theory of aphasia that underlies the current study. This model supports the idea that the main deficit in individuals with aphasia centers around the appropriate comprehension and use of language that arises from defined language centers in the left hemisphere of the brain. The model accepts that the language centers are not independent of other brain processes, so lesions of or around the main language centers will have an affect on other cognitive processes that interface with language (Hula & McNeil, 2008). The present study is predicated upon the stance that cognitive processes and language are interconnected. As such, the areas of the brain responsible for language and attention are interconnected. Also, it is important to organize aphasia into fluent or nonfluent syndromes based on site of lesion. The nature of the connections between cognitive and linguistic processes may differ based on the language regions affected. The anterior and posterior syndromes may have different relationships with cognitive processes (notably, with attentional processes).

Definitions and Theories of Attention

Higher-level cognitive processes contribute to one's ability to maintain social and intimate relationships, maintain employment, manage household finances, and generally to participate as a productive member of society (Meuller, 2013). Attention is the basic component that underlies all of the higher cognitive processes, making it essential in the completion of activities of daily living (Helm-Estabrooks, 2002). No other cognitive tasks are possible if attention is lacking.

William James, a psychologist of the late 19th and early 20th centuries, stated, "Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneous possible objects or trains of thought. Focalization, concentration of consciousness are its essentials. It implies withdrawal from some things in order to deal effectively with others" (as cited by Filley, 2002, p. 89). Attention implies the ability to maintain focus on particular stimuli without being distracted by one's internal and external environments.

Attention comprises of a variety of cognitive mechanisms that allow an individual to select specific stimuli from the enormous range of sensations conveyed to the brain (O'Donnell, 2002). It is believed to be the most basic building block of cognitive processing (Bhatnagar, 2008). James stated that, "attention improves performance in relation to attended stimuli - [it] allows a person to perceive, discriminate, remember, and react better than if attention [is] not engaged" (as cited by O'Donnell, 2002, p.101). The ability to attend is critical to new learning (Bhatnagar, 2008).

Types of Attention

Attention is a system that is both voluntary and involuntary. The voluntary system of attention is goal-oriented and intentional; the system is motivated by external demands. The voluntary, active system of attention relates to one's ability to intentionally complete a task. The involuntary system of attention takes a more passive role. It is driven by unexpected stimuli entering the surrounding environment and distracting one's attention to it; the involuntary system is reflexive and sensory-driven (Connor & Fucetola, 2011; Gazzaniga, Ivry, & Manguan, 2009; O'Donnell, 2002).

Murray (1999) reports that the allocation of attention is regulated by several characteristics: the novelty of the input, the intent to attend to a specific stimulus, and a person's arousal level. An individual will not effectively complete a task if its demands exceed his/her attentional capacity or if his/her attentional resources are not appropriately used. In daily life, humans are inundated with external and internal input; attention acts as the gatekeeper to keep humans from becoming overwhelmed by surrounding stimuli (Filley, 2002).

The current study considers three specific types of attention. *Selective attention* refers to the ability to attend to a specific signal while inhibiting attention to competing signals. For example, when one is in a crowded restaurant, one would use selective attention to attend to the conversation at one's table rather than conversations occurring in the surrounding environment. *Sustained attention* is the ability to maintain a particular response set for an extended period of time. One requires sustained attention while completing lengthy tasks, such as studying for a test without becoming distracted by the environment. *Divided attention* is the ability to simultaneously attend to multiple tasks, such as watching a movie while writing a paper. When attention is divided between two tasks, performance on each task suffers (McCallum, 2003).

Structures and Systems of Attention

A unitary locus of control of attention has never been identified. Attention is represented in the brain as a diffuse system that is responsible for maintaining the basic level of attention that needed to monitor internal and external events. This system is known as the attentional matrix (Filley, 2002 p. 92). The anatomy of this system is not well understood.

It is believed that many structures within the brain underlie various components of attention. The thalamus is thought to be an important structure in the attentional system due to its numerous connections via thalamic nuclei to the cerebral hemispheres (Bhatnagar, 2008; Kurland, 2011). Research has shown that damage to the thalamus or the brainstem affects persons' ability to switch focus (Kurland, 2011). Evidence has shown that damage to white matter within the brain has also disrupted the attentional system (Filley, 2002).

Researchers postulate two types of attentional systems within the brain. Evidence indicates that a right hemisphere attentional system selects spatial elements from the external environment and organizes information into appropriate responses. The system allows one to narrow focus on spatial stimuli relevant to oneself. The "posterior system" of right hemisphere attention is located in the parietal lobe; it regulates sensory surveillance and stimulus selection. The "anterior system" of right hemisphere attention is located in the dorsolateral prefrontal cortex and the cingulate gyrus. The "anterior system" is concerned with motivation and action of the appropriate response set (Filley, 2002).

Diffuse attention permits the awareness of selected elements from a wide array of external and internal events. It is believed to be centered within the frontal lobes of the brain, but the system is not hemisphere specific. The diffuse attentional system is not well understood (Filley, 2002).

Theories of Attention

The limited capacity theory of attention is widely accepted and often used in explanation of the attentional system. The concept originates from the observation that human performance is compromised when overloaded with multiple stimuli (Gazzaniga et al., 2009). Researchers speculate that, within the attentional system, one or more pools of attention processing resources exist. Interestingly, although one's attentional capacity is limited, one can flexibly allocate resources to preferred activities (Murray, 1999).

The Central Bottleneck (CB) Theory of attention states that some forms of information within the system can be processed in a parallel fashion, but particular components of competing tasks are processed serially (Hula & McNeil, 2008). The CB Model has three stages. First, the processing that precedes and includes the perceptual encoding of a stimulus occurs within the precentral stage. Second, the central stage of the CB model includes the response selection and related processing. The third or postcentral stage refers to the initiation and execution of the desired response. The precentral and postcentral stage are able to run parallel with any stage of a competing task, but the central stage is only able to process one piece of information at a time (Hula & McNeil, 2008). Bottlenecks can occur within a stage or at the interface of two stages. If concurrent operations bottleneck, then the completion of one operation must wait (Murray, 1999).

The CB model states that the bottleneck is able to weed out irrelevant stimuli and process vital information. The problem of the limited capacity of the system is overcome by the bottleneck's ability to efficiently pass through high-priority information before attending to less pressing stimuli (Gazzaniga et al., 2009).

Language and Attention

A broad agreement that cognitive processes require intact attention exists among researchers (Kurland, 2011). One of the first milestones in a child's language development is joint attention; attention is integral in a child's ability to learn, remember, and manipulate language during linguistic interactions (Kurland, 2011). It is assumed that attention continues to be essential for language construction throughout adulthood.

Head (1926) proposed that intelligence is not directly affected in persons with aphasia; instead, intellect suffers due to inadequate interaction between memory, general intelligence, and impaired linguistic formulation and expression (as cited by Fridriksson et al., 2006 p. 401). Attention, a basic component of cognitive processing, will affect higher-level cognitive abilities, due to its limited capacity and propensity to bottleneck. Researchers hypothesize that if the central bottleneck is affected in persons with aphasia, the intermittent serial processing delays disrupt the language construction stream, which leads to a breakdown in one's linguistic representation (i.e., using words to represent thoughts and ideas) (Hula & McNeil, 2008, p. 173-174). The relationship between language and attention is still not well understood and requires further research (Kurland, 2011).

Attention and its Relationship to Language in Aphasia

Linguistic models of aphasia are unable to account for certain aspects of the impairment. For example, certain individuals have good stimulability for language cueing, while others do not. Perhaps attention is a component of stimulability. As another example, for many persons, there is unexplained within-subject variability, such that their language performance is highly inconsistent. Attention may impact how well they perform. Alexander (2006) states that executive function and/or attention deficits that impair goal directed behaviors could explain some difficulties that some persons with aphasia have with producing extended discourse (as cited by Kurland, 2008).

Murray (1999) notes that the Attentional Model of Aphasia hypothesizes that under linguistic conditions where resource demands are reduced, individuals with aphasia should demonstrate increased linguistic performance. Murray showed the hypothesis to be true, especially when tasks demands are minimized due to the automaticity of target responses. These results can account for individuals with aphasia having variable performances on linguistic tasks within the same environment. Therefore, researchers are considering the possibility that cognitive processes that underlie and support language may be impaired in persons with aphasia (Murray, 1999, 2012).

Hula and McNeil (2008) argue that language is attentional in nature. Kurland (2011) states language is dependent upon functioning and appropriate response selection, sustained attention, and response inhibition. Connor and Fucetola (2011) further the argument that attention and language are related by stating that attention plays a role in comprehension at every level — from phoneme identification to discourse processing. Kurland (2011) found that the attentional network is linked to self-monitoring, error detection, and self-correction during verb generation tasks.

Individuals also need to be able to allocate attention to incoming stimuli while inhibiting responses to distractions within the environment. One's ability to select appropriate stimuli (selective attention) and maintain concentration on the target stimuli (sustained attention) is integral to further processing of stimuli, whether it be auditory or visual. Attention is the foundation for reading, writing, auditory comprehension, and discourse comprehension (Connor & Fucetola, 2011).

Some researchers conjecture that older persons with aphasia may have fewer attentional and/or working memory resources prior to the onset of aphasia. Fewer cognitive resources are brought to communication contexts. Therefore, as task demands increase, individuals' performances decrease, but the performance deficits may not be related to language alone (Murray, 1999).

Structural Evidence for the Relationship of Attention and Language

The left middle cerebral artery (MCA) runs through the language areas of the brain, but also has many connections with the prefrontal cortex and frontal lobe region. Due to the nature of the areas that the MCA provides nutrition for, damage to the artery can cause language impairments and damage executive functioning — with a primary component of the central executive being attentional skill (Fridriksson et al., 2006). If the area nourished by the left MCA is injured, an individual may be vulnerable to diffuse attentional dysfunction. One may become overwhelmed by incoming stimuli and experience difficulty maintaining attention to even a single stimulus (O'Donnell, 2002).

Implications for Persons with Aphasia: Diagnosis and Treatment

The ultimate goal of therapy for individuals with aphasia is communication within everyday settings that entail unpredictable demands and fluctuating circumstances. Although the exact nature and impact of attention deficits on persons with aphasia is not well known, evidence strongly suggests that attention should be considered when evaluating and treating affected individuals (Murray, 1999). However, current therapy regimens for individuals with aphasia are often directly related to building language performance (Helm-Estabrooks, 2002). This would suggest that impairments in executive functioning, specifically in attention, are not identified and addressed. If executive function impairments actually are present in persons with aphasia, then functional communication within daily settings may be more impaired than indicated by the severity of the language impairment alone (Fridriksson et al., 2006). An attentional deficit in an individual with aphasia could have more impact on his/her ability to return to work than a language impairment (Murray, 2002). Understanding the attentional components involved in aphasia will enhance proper planning for treatment of persons with aphasia (O'Donnell, 2002).

PART II: RELEVANT STUDIES: METHODS AND RESULTS

Many studies have been completed in order to further clinical knowledge of the nature of aphasia. Many researchers believe that deficits in aphasia go beyond language; the following studies sought to collect data on how the cognitive processes that may underlie language processing are affected by the disorder. Results of the studies were often uncertain, but provide enough evidence to prompt further research on the subject.

Learning and Aphasia

Vallila-Rohter and Kiran (2013) conducted a study where non-verbal tasks were used in order to assess whether persons with aphasia learned tasks in a fashion that was similar to healthy age-matched individuals. The researchers hypothesized that healthy controls would learn categories equally well when following two methods of instruction. The researchers postulated that persons with aphasia would demonstrate non-linguistic category learning parallel to controls unless those persons with aphasia have co-occurring cognitive deficits.

The study consisted of 20 participants, 10 male and 10 female, with a single event left hemisphere stroke. Aphasic syndromes across the participants varied, including Wernicke's, Broca's, Conduction, Transcortical Motor, and Anomic.

Two training tasks were used in the study: Feedback Based training (FB) and Paired Association training (PA). FB training was conducted by randomly presenting category A and category B animals on a computer screen one at a time. The participant was given a target amount of time to guess which category the animal belonged in; after a response was given, the participant received the correct answer. In PA training, category A and B animals were presented on a computer screen one at a time with a label denoting its associated category. Participants were instructed to study the animals and its label with the task of later identifying the animal within a specific category. A short testing period was conducted after the training period. The assessment given was identical to the training methods for both FB and PA.

Eleven of nineteen accounted participants produced category learning results that were similar to controls following at least one method of instruction. Of the eleven participants that exhibited successful learning, eight showed successful learning following one method of training, but not the other. One method of learning did not appear to provide an advantage over another in persons with aphasia.

Results from Vallila-Rohter's and Kiran's study identified that learning new categories of information is impaired in persons with stroke related aphasia. The researchers speculate that the observable deficits in the study may be a result of impairments at the level of response encoding and execution. The results revealed that persons with aphasia who appear to have a higher level of language competency do not necessarily have intact cognitive systems. Vallila-Rohter and Kiran (2013) concluded that many individuals with aphasia are likely to have deficits that extend beyond language, which warrants additional support and strategies in learning environments.

Executive Function Impairments

Purdy (2002) conducted a study in order to explore executive function ability in persons with aphasia and control groups by assessing the accuracy, efficiency, and time required to complete a series of assessments. Purdy chose the *Porteus Maze* (PM, Porteus 1959), *Wisconsin Card Sorting Test* (WCST, Grant & Berg, 1993), the *Tower of London* (TOL, *Tower of London,* n.d.), which is a test of planning, and the *Tower of Hanoi* (TOH, *Tower of Hanio,* n.d.), which is a test of problem solving, to measure executive functioning in participants. The study measured efficiency by counting the number of trials required to complete each task in the PM, the number of cards used in the WCST, and the total number of moves required on all items for the TOL. Participants were unable to simultaneously complete both parts of the TOH.

Purdy found that persons with aphasia were less efficient across all three tests, and were unable to complete the test that required more complex cognitive processing. The results indicate that persons with aphasia do demonstrate some characteristics of impaired executive function.

Fridriksson, Nettles, Davis, Marrow, and Montgomery (2006) investigated executive function impairments and functional communication in persons with aphasia. Fridriksson et al. (2006) used the *American Speech Language Hearing Association Functional Assessment of Communication Skills for Adults* (ASHA-FACS, Frattali, Thompson, Holland, Wohl, & Ferketic, 1995), the *Color Trails Test* (CTT, D'Elia, Satz, Uchiyama, & White, 1996), the *Wisconsin Card Sorting Test-64* (WCST-64, Kongs, Thompson, Iverson, & Heaton, 2000), and the *Bedside Evaluation Screening Test 2nd Edition* (BEST-2, West, Sands, & Ross-Swain, 1998) in order to assess executive function and functional communication in individuals affected with aphasia. The study used 25 participants with single-event stroke-induced aphasia.

The researchers found that half of the sample was unable to complete a single category of the WCST-64, which contributed to a lack of statistically significant correlation between the WCST-64 and ASHA-FACS. The lack of completion itself is an indicator of decreased executive functioning. There was a negative correlation between the ASHA-FACS and the CTT. Fridriksson et al. (2006) found that greater proficiency on the CTT indicated more intact functional communication ability in persons with aphasia. Therefore, executive function and functional communication ability were closely related in that sample of persons with aphasia.

Helm-Estabrooks (2002) organized a study to measure cognitive ability in individuals whose aphasia ranged from mild to severe. The researcher sampled 13 right-handed participants affected by a left hemisphere stroke resulting in aphasia. In order to measure cognitive functioning in persons with aphasia, Helm-Estabrooks utilized the eight subtests of the *Cognitive Linguistic Quick Test* (CLQT, Helm-Estabrooks, 2001). The researcher used the assessment in order to compare performance between linguistic and non-linguistic cognitive tasks, as well as compare the relationship between non-linguistic cognitive performance and age, education, and time post onset of aphasia.

Results yielded data showing that all persons with aphasia scored below the cut-off score for each linguistic task. Two of the persons with aphasia scored above the cut off score for non-linguistic cognitive tasks. Persons with severe aphasia showed great variability on nonlinguistic cognitive scores. Helm-Estabrooks concluded that there are in fact cognitive deficits in persons with aphasia, but one cannot predict the severity of cognitive deficits based on language scores.

Mueller and Dollaghan (2013) conducted a systematic review of assessments used to identify executive function impairments in adults with acquired brain injury. While this is not specifically a study of aphasia, its results speak to the need for further inquiry into diagnosing executive functioning in adults with neurological impairments. The researchers reviewed eight studies that measured executive function in individuals with acquired brain injury in order to determine broad patterns across the studies. The researchers used diagnostic accuracy metrics, standardized mean comparisons, and correlation coefficients as tools to discern the patterns.

Meuller and Dollaghan (2013) found that there was no diagnostic testing common to each study. The studies reviewed did not utilize a consistent definition of executive function impairment; in fact, the studies assumed that an individual with an acquired brain injury had executive function impairments and that persons in the control groups did not. Meuller and Dollaghan (2013) concluded that a lack of strong evidence for the clinical utility of executive function testing in those with acquired brain injury exists due to lack of consistency across studies and definitions of the impairment.

Cognition as Related to Aphasia

Geva, Bennett, Warburton, and Patterson (2011) carried out a study to discover the relationship between inner and overt speech in individuals with stroke-induced aphasia. Reports by individuals with aphasia of the disparity between their thoughts and their expression prompted the study. Researchers sampled 29 participants with chronic aphasia and 27 typical participants as a control group. The researchers chose a series of measurements of individuals' inner and overt speech, including the *Raven's Progressive Matrices* (Raven, 1938), the *Comprehensive Aphasia Test* (Swinburn, Porter, & Howard, 2004), the *Apraxia Battery for Adults* (Dabul, 1979), the *Brixton Test of Executive Functions* (Burgess & Shallice, 1997), the *Rey-Osterreith Complex Figure Test* (Meyers & Meyers, 1995), the *Psycholinguistic Assessments of Language Processing in Aphasia* (Kay, Colheart, & Lesser, 1992), and parts of the *Addenbrooke's Cognitive Examination-Revised* (Mathuranath, Nestor, Berrios, Rakowicz, & Hodges, 2000).

The results revealed that inner and overt speech abilities in persons with aphasia vary. Inner and overt speech can be predictors of each other in some cases, but in other cases, these skills are not predictors of one another. A person with aphasia has significantly impaired inner speech abilities when compared to typical adults. In some cases, inner speech abilities remained somewhat intact, and overt speech was compromised due to motor difficulties. In other participants, speech output was significantly better than the participant's inner speech skills. In most cases, overt and inner speech functioned similarly, demonstrating cognition may underlie and be related to language deficits of an individual.

Attention Impairments in Anterior Brain Damage

Godefroy and Rosseaux (1996) assessed skills in divided and focused attention in individuals with prefrontal lobe damage. The researchers collected a sample of 11 participants and performed a magnetic resonance imagery (MRI) test on each person in order to assess the prefrontal lobe damage. After the MRI, participants were given a neuropsychological and behavioral battery consisting of the *Weschler Adult Intelligence Scale* (Weschler, 1981), the *Mini Mental Status Evaluation* (Folstein, Folstein, & Mc-Hugh, 1982), the *Battery 144 Memory Assessment* (Signoret, 1991), and the *Modified Card Sorting Test* (Nelson, 1976), and digit span testing. An attention assessment was also given; participants were involved in reaction time tests to evaluate each individual's ability to focus attention and regulate attention between perceptual channels. The attention assessment taxed response to both auditory and visual stimuli. It was not reported whether the participants had aphasia

Researchers found that participants with lesions in the prefrontal cortex evidenced deficits in divided and focused attention, as well as observable higher distractibility. Participants with a lesion in the prefrontal cortex demonstrated decreased performance when the presentation of the target stimuli was random and inconsistent. Godefroy and Rosseaux discovered that sustained attention appeared to be controlled by the right hemisphere of the brain, but selective attention had no clear hemispheric distribution.

Attention in participants with a left hemispheric lesion was impaired when the superior areas of the prefrontal cortex and the head of the caudate nucleus were damaged. Performance readily decreased when the number of perceptual channels increased. Godefroy and Rosseaux noticed that the left dorsolateral area of the prefrontal cortex may be involved in attention regulation across perceptual channels. The study demonstrated the possibility that persons with anterior aphasia, namely those with a lesion in the frontal lobe, may suffer from attention deficits in addition to language impairments.

Aphasia and Attention

Murray (2012) studied the relationship between cognition and aphasia, with a focus on attention. Studies conducted prior to Murray's research revealed that cognitive processes that underlie and overlay language are affected in persons with aphasia, but the link between the processes is not concrete. The goal of Murray's study was to clarify the relationship between higher-level processes to pinpoint the true nature of aphasia. Murray states a belief that attention and language are probably related, but researchers and clinicians require definite patterns in order to provide viable treatment for the existing deficits.

Murray tested 78 participants, 39 persons with aphasia due to left hemisphere damage and 39 persons without aphasia. The study consisted of two sessions lasting approximately one to two hours each. Each participant was assessed using subtests from the *Test of Everyday Attention* (TEA, Robertson, Ward, Ridgeway, & Nimmo-Smith, 1994), subtests of the *Behavioral Inattention Test* (Wilson, Cockburn, & Halligan, 1987), the *Rating Scale of Attentional Behavior* (RSAB, Ponsford & Kinsella, 1991), subtests of the *Weschler's Memory Scale* (Weschler, 1987), the *Tompkin's et al. Working Memory Protocol* (Tompkins, Bloise, Timko, & Baumgaertner, 1994), and the *Ruff Figural Fluency Test* (RFFT, Ruff, 1996).

The data revealed a variation in performance by participants with aphasia on attention assessments. Complex attention skills, such as divided attention tasks, showed a decrease in performance when compared to basic attention skills, such as sustained attention. The RSAB was the test most sensitive to attention deficits in participants with aphasia. Differences in performance between the control group and experimental group were observed in every assessment used. Murray concluded that attention measures were the only significant predictor of cognitive differences between control participants and participants with aphasia. Murray's study requires follow-up research to discover the patterns by which attention is affected in individuals with aphasia.

Call for Further Research

Researchers have not yet discovered which aspects of attention are affected in persons with aphasia. Further research is needed to elucidate the relationship between language and attention in persons with aphasia in order to increase the theoretical and clinical knowledge needed to accurately diagnose and treat aphasia.

Murray's recent research serves as a catalyst for the present study, the purpose of which is to continue the investigation of the relationship between attention and aphasia. The intent here is to discover whether attention is affected in persons with aphasia and whether there is a trend for how attention is affected based on the severity of aphasia. If indeed attentional skills can be measured as discrete skills in persons with aphasia, that is can show unique results, the findings of the present study could support the call for evidence-based practice in aphasia diagnosis and treatment (see the American Speech-Language-Hearing Association [ASHA] paper by Frattali et al., 2005).

CHAPTER III

METHODS

Purpose of the Study

This exploratory multiple case comparison study examines a sample population that is representative of persons with nonfluent aphasia in order to clarify the relationship between language and attention. Behavioral assessments are used to explore the relationships between measure of attention and measures of language. This study means to define the relationship between language and attention by determining whether attention is compromised in persons with nonfluent aphasia; and whether attention can be measured as a discrete skill in persons with nonfluent aphasia using measures dependent and independent of language; and whether there is a trend pertaining to level of severity of nonfluent aphasia and performance deficits on attention measures. In order to conduct this exploratory research, a descriptive, multiple case comparison design was proposed.

Participant Safeguards

Approval of the study by the Institutional Review Board of Cleveland State University (CSU-IRB) was obtained in October 2013, which covered the recruiting of participants, the consent form, and the study procedures. IRB approval did not authorize the researcher to examine participant's medical charts; the researcher could not confirm exact site of lesion or the specific type of aphasia a participant had. The researcher could only confirm whether a participant presented with fluent or nonfluent aphasia through testing. The consent form informed participants of the study procedures and their right to abstain from completing the study. Each participant was required to sign a consent form that declares that the participant understands and agrees to participate in the study.

Considerations for Selection of Methods and Materials

The relationship between language and attention in aphasia is still not well understood (Murray, 2012). Studies conducted concerning the relationship between language and attention in persons with aphasia have used tests and measures that have relied on language expression or comprehension (Kurland, 2011). Fischler (2000) stated, "in the study of language and attention, language has often become more of a convenient vehicle for stimulation delivery and response than it has been the target for analysis" (as cited by Kurland, 2011, p. 51).

In order to meet the requirements of this study, the assessments given to the participants must reveal a number of factors. It is necessary to use measures of the type and severity of aphasia, along with measurements of divided and sustained attention that are completely language independent, and measurements of divided and sustained attention that are language dependent. Tests often used in the study of language and attention, such as the *Wisconsin Card Sorting Task* (Grant & Berg, 1993) or the *Color Trails Test* (D'Elia et al., 1996), were excluded based on the receptive language demands the tasks place on participants. Other measures of attention were excluded based on the fine motor skills needed, such as detailed writing, and/or the expressive language demands each task places on participants.

Materials: Test Selection and Administration Requirements

Assessments used include the *Western Aphasia Battery Revised Bedside Record Form* (WAB-R Bedside; Kertesz, 2006), subtests from the *Test of Everyday Attention* (TEA; Robertson et al., 1994), subtests from the *Cognitive Linguistic Quick Test* (CLQT; Helm-Estabrooks, 2001), and select portions of the *Leiter International Performance Scale Revised* (Leiter-R; Roid & Miller, 1997). Table 1 provides a summary of the characteristics of each test and allows for quick comparison of the tests, and all test protocols are found in Appendices C through I. Each participant's testing session begins with the WAB-R, and then the other subtests are given in random order to avoid testing effects. The assessment portion of the study lasts approximately 90 minutes per individual.

WAB-R Bedside Screener for Aphasia

The WAB-R provides general information about the severity and symptoms of an individual's aphasia. The researcher observes for any signs of visual-spatial neglect, especially right side neglect, during administration of all subtests. The WAB-R Bedside measures demonstration of spontaneous speech (content and fluency), auditory verbal comprehension, sequential commands, repetition, object naming, reading, writing, and motor apraxia. The screening results define the aphasic symptoms (which then suggest fluent or nonfluent aphasia) and the severity of each participant's aphasia. The WAB-R defines severity of aphasia through a calculated Aphasia Quotient (AQ), which is proportional to the severity of aphasia regardless of the type (fluent or nonfluent) or etiology. The ratings of severity are as follows: 0-25 as very severe; 25-50 as severe; 51-75 as moderate; 76-100 as mild. The screener takes approximately 15 minutes to complete; the assessment is to be the first assessment given to each participant.

TEA: A Language Dependent Measure of Divided and Sustained Attention

The TEA is a normed test of attention that includes measures of sustained attention, selective attention, attentional switching, and divided attention. The TEA is normed on ages 18 to 80. The test is used in the present study for language dependent measures of divided and sustained attention.

The TEA has been used in various studies through out the field of speech-language pathology. Murray (2012) used the assessment in a study meant to clarify the relationship between aphasia and cognition with a focus on attention. Subtests of the TEA were utilized in order to measure auditory attention in participants in a study carried out by Conroy, Snell, Sage, and Lambon (2012). Sterr (2004) used the TEA to test attentional abilities in a study that explored the extent and range of individual variations in attention performance in persons with intellectual disability. Murray (2002) stated the TEA is useful in assessing variety of attention functions while utilizing everyday life materials (p. 110).

The subtests of the TEA utilized for this study are the Map Search and the Telephone Search while Counting. The Map Search is an assessment of sustained attention. Directions are given verbally. The participant is asked to search a map for a total of two minutes while circling target symbols. When one minute elapses, the participant is instructed to switch markers. The assessment captures the participant's ability to inhibit irrelevant stimuli while attending to a set task.

The Telephone Search while Counting assesses an individual's divided attention skills. The subtest is split into two parts. First, the participant searches through a telephone directory and identifies target symbols. The participant then completes a similar search task while simultaneously counting strings of tones presented on an audio recording. Each part of the test is timed to completion. The participant's accuracy and efficiency on each task are compared in order to assess divided attention skills.

The subtests of the TEA are deemed appropriate for this study. The directions are simple, and the tasks mirror activities that one may complete in daily life. The subtests also require limited fine motor skills; each task can be complete with the non-dominant hand by participants with impairment of their dominant hand. The tasks do not require expressive language during assessment.

CLQT: A Language Dependent Measure of Sustained Attention

The CLQT is a test designed to assess cognitive abilities, such as memory, attention, executive functions, language, and visuospatial skills, in adults with compromised neurological function. The assessment is normed on ages 18 to 89. In the current study, the CLQT provides a language dependent assessment used to measure sustained attention skills in participants.

The CLQT has been used in past studies meant to measure participants' cognitive skills. Nicholas, Sinotte, and Helm-Estabrooks (2005) utilized the CLQT in a study meant to determine whether individuals with severely restricted verbal output could increase functional communication skills via alternative and augmentative communication means. The assessment was also used in a study to determine the relationship between linguistic and nonlinguistic task performance, as well as in the study of impaired and intact cognitive functions in persons with aphasia (Helm-Estabrooks, 2002).

The Symbols Trails and Mazes subtests of the CLQT are to be used in the current study. The Symbol Trails tests sustained attention in participants. The directions are given verbally, taxing the receptive language of individuals. Participants are required to draw lines between shapes from smallest to largest, draw lines connecting alternating shapes, and then draw lines connecting alternating shapes from smallest to largest. The subtest reveals a participant's ability to attend to and complete a task.

The Mazes subtest is believed to assess sustained attention. Participants are required to complete two mazes in this task, each differing in level of difficulty. The examinee is expected to go through the maze without crossing over walls, stopping before the finish point, or deviating from the correct path. The subtest demonstrates the participant's ability to finish a task until completion, inhibit incorrect responses, self-monitor, and self-correct.

The subtests of the CLQT are deemed appropriate for persons with aphasia. The directions are simple and short. The Symbols Trails subtest allots training periods to ensure the participant understands the task. The assessments also require limited motor skills; each task can be completed with a participant's non-dominant hand if the dominant hand is impaired.

Leiter-R: A Language Independent Measure of Divided and Sustained Attention

The Leiter-R is an assessment designed as a completely nonverbal test of cognition. The Leiter-R was chosen based on its reliability and validity. The Leiter-R provides attention specific subtests administered in a completely nonverbal mode of presentation. The test manual recommends the assessment be used in clinical settings and research with special populations, including persons with communication disorders. The Leiter-R assessment has not yet been used in studies regarding the relationship between language and attention in adult populations.

These subtests of the Leiter-R provide language independent assessments of sustained and divided attention. The Leiter-R has been normed and standardized on ages 2-20; as such, it is an appropriate test for adults. The scores obtained in the current study will be reported as a raw score criterion measure (total correct items out of total possible items) rather than as a standardized measure obtained by comparison to age norms.

Scattone, Raggio, and May (2012) compared the Leiter-R for concurrent validity with another nonverbal test of intelligence. The Leiter-R scores obtained were within a few points of the scores on the other intelligence assessment, thus ensuring its concurrent validity as a measure of cognition. Crepeau-Hobson and Vujeva (2012) stated that the Leiter-R is useful in testing persons with motor impairments, due to no scoring penalty for lack of motor skill. There is also no penalty for lack of expressive communication, in that the test is free of the need for a verbal response. These freedoms support the usefulness of its subtests for the current study.

The Leiter-R Attention Sustained Subtest features directions given in the form of gestures and nonverbal cues. The researcher indicates to the participant that he/she should cross out as many of the target pictures as possible in a given amount of time. The test has minimal need for fine motor skill. A teaching trial with cueing is given to ensure the participant's comprehension of the task.

The Attention Divided Subtest of the Leiter-R is also given in a nonverbal capacity through use of gestures and cues. The participant is required to point to target pictures on an easel while sorting cards in numerical order in an allocated amount of time. A teaching trial for this task is given to ensure the participant's comprehension of the task. The subtests of the Leiter-R are believed to be appropriate for persons with aphasia due to their independence from language expression and comprehension. The test has minimal need for fine motor skill.

The use of various subtests from different sources compare measures that are vital to the constructs under study. As Table 1 illustrates, comparison of language dependent and language independent measures is obtained via the CLQT vs. the Leiter-R and via the TEA vs. the Leiter-R. The comparison between the subtests of the CLQT and the TEA provide evidence of attention measures on language dependent assessments. The severity of the disorder a participant presents with can be compared to attention measures.

Table 1.

Subtest Characteristics as Related to the Purposes of the Current Study

	Measure of Language	Measure of Sustained Attention	Measure of Divided Attention	Language Dependent	Language Independent
WAB-R Bedside Screener	+			+	
CLQT Mazes		+		+	
CLQT Symbol Trails		+		+	
TEA Telephone Search while Counting			+	+	
TEA Map Search		+		+	
Leiter-R Sustained		+			+
Leiter-R Divided			+		+

Participants: Target Sampling

A target sample size of 30 participants, who would be between 40 and 85 years of age, each affected by a left hemisphere lesion resulting in aphasia, was desired. Each participant is required to have at least an eighth grade education. Persons excluded from the study would have a history of any of these factors: alcohol and/or drug abuse, an unrelated and/or prior traumatic brain injury (TBI), degenerative disease, a right hemisphere stroke, a congenital disorder that affects language, or if they did not speak English as a first language. Recruitment of participants was conducted through the Cleveland State University Speech and Hearing Clinic as well as additional sites (hospitals, nursing homes, and other clinics) within the Cleveland, Ohio area.

Procedures

The study proposal was initially submitted to the CSU-IRB in July 2013. IRB approval was contingent upon the researchers obtaining site approval to recruit participants at local sites. In order to recruit sites, the researchers phoned nursing homes, clinics, and hospitals. Sites that responded to the phone calls with positive interest were sent an informational email instructing them how to assent to participation in writing using the site approval form found in Appendix A. Once sites had agreed and given written agreement to participate, then full IRB approval was obtained in October 2013, at which time the researchers could recruit individual participants within sites. Recruitment was achieved by email exchanges and phone calls with site liaisons.

The researcher and each site liaison scheduled times to carry out testing with prospective participants, who were each given a synopsis of the study by site staff before the researcher arrived for testing. Background information for each participant (i.e., age, time post onset of stroke, education, pertinent medical background, speaker of English as a first language) was obtained by the researcher by speaking with participant's family members or with participant's staff liaison at the site. Participants gave written consent before testing commenced on the day of the scheduled testing. The consent form is found in Appendix B. The researcher verbally reviewed the consent form with the participant before his/her signature was obtained. There were two copies of each consent form; one was signed and returned to the researcher, the other was kept by the participant.

After consent was obtained, the researcher proceeded with testing. The WAB-R Bedside Screener was administered first, in order to measure participant's expressive and receptive language. The participant was asked to answer a series of questions, carry out tasks, and name objects, in order to measure multiple language skills. An example of the WAB-R Bedside Screener can be found in Appendix C. The screener lasted approximately 15 minutes.

The attention subtests were given in random order to avoid testing effects. In the TEA Map Search, the participant was instructed to imagine he/she was on a trip to Philadelphia and needed to find restaurants in the surrounding area. The participant was required to search the map for a target symbol denoting restaurants in the area and to circle as many of those symbols as possible in a two-minute time frame. An example of the map used in the TEA Map Search is provided in Appendix D. The participant was asked to switch colored writing implement at the one-minute marker of the test. The subtest lasted approximately five minutes.

The TEA Telephone Search while Counting was split into two subtests. The participant was instructed to imagine that he/she was on vacation at a friend's house and needed to find a plumber in the yellow pages to fix the kitchen sink. The plumbers with double symbols by their names were rated the best (double squares, double stars, double x's, etc). Participants were asked to work as quickly and efficiently as possible to circle the target symbols and put an x in a box to show the researcher he/she was finished with the activity. The test was timed. The participant was then asked to carry out the same task while completing a second, equally important task of counting tones presented on an audio recording; this test was also timed. An example of the phone page used in the TEA Telephone Search while Counting can be found in Appendix E. The entire subtest took approximately 10 minutes to complete.

The Leiter-R Sustained Attention test entailed four teaching trials and sub-tasks. Teaching trials and sub-tasks of the Leiter-R Sustained Attention can be found in Appendix F. Per the test directions, the researcher gave task directions nonverbally to the participant. The participant was given a template with shapes—at the top of each template, a target symbol was provided. The participant was given a predetermined amount of time (30 or 60 seconds) to cross out as many of the same symbol on a page full of various symbols as possible. The subtest took approximately seven minutes to complete.

The Leiter-R Divided Attention subtest had one teaching trial and three sub-tasks. The participant was given directions nonverbally for each task. The participant was required to carry out two tasks simultaneously; the first task asked the participant to point to target symbols on a template; the second task asked the participant to sort cards in numerical order (cards numbered 1-10, 1-15, and 1-20). Examples of the picture templates of the Leiter-R Divided Attention subtest can be found in Appendix G. Each trial of the task became increasingly more difficult. The subtest took approximately 10 minutes to complete.

The CLQT Symbol Trails test required the participant to connect shapes in a pattern. The subtest had two teaching trials and one scored task. The teaching trials and scored task of the CLQT Symbol Trails are exhibited in Appendix H. In the teaching trials, the participant was asked to connect differently size circles from smallest to largest, and then alternate connections between circles and triangles. The final scored task required the participant to alternate connections between circles and triangles from smallest to largest. The task took approximately five minutes to complete.

The CLQT Mazes test required the participant to trace through two mazes of increasing difficulty. The CLQT mazes can be found in Appendix I. Directions required the participant to start at the arrow and end at the picture of money. The task took approximately three minutes to complete.

The participant was provided with breaks between subtests and as needed throughout the testing period. From the initial consent to go forth with the assessments to the end of the session, the testing took approximately 90 minutes per individual.

CHAPTER IV

RESULTS

Chapter 4 provides descriptive summary statistics and proposes comparisons that are revealed by these data. The intent is to describe the relationship of nonfluent aphasia and attention as revealed by test scores.

Participants

The participants recruited for this study exhibited the characteristics described in Table 2. The target sample included participants between ages 40 and 85; the actual sample of this study included participants between ages 57-79. The World Health Organization proposes that an elder is an individual 60 years of age or older, but stipulates that the definition is somewhat arbitrary (*Definition of an older or elderly person*, n.d.). For the purposes of this study, an elder is operationally defined as an individual of 55 years or older.

Table 2.

Characteristics of Participants

Participant	Age	Gender	Education	Time Post Onset
A	57	Male	Associates Degree	21 mos.
B	79	Female	High School Diploma	27 mos.
C	67	Male	High School Diploma	7 mos.
D	74	Male	Some College	220 mos.
E	71	Female	High School Diploma	26 mos.
F	64	Male	Bachelors Degree	54 mos.
G	57	Male	Graduation Equivalency Diploma	90 mos.
H	Refusal			
I	67	Female	High School Diploma	24 mos.

A total of nine participants was recruited, but participant H cannot be reported upon due to his refusal to engage in testing. Background information for each participant was collected during the signing of the consent form; information was obtained from the participant, family members present, and/or the participant's site liaisons, who in all cases were speech-language pathologists. The eight participants in the study have no history of dementia, alcohol abuse, right brain trauma, unrelated TBI, degenerative diseases, English not as a first language, or congenital disorders that affect language. The eight remaining participants were five males and three females between the ages of 57 and 79. Each participant has the equivalence of a high school education; some pursued higher education. The timing of participants' left-hemisphere strokes varied between seven months and 220 months prior to this encounter. All had been diagnosed by a speech-language pathologist as having nonfluent aphasia. Participants were tested in quiet, private rooms in clinics and nursing homes. Some family members were present, but were located out of the participant's view to avoid distraction. Not all participants were able to complete each subtest within the test battery. Results will account for missing data and individual descriptions of each participant's performance will be discussed in Chapter 5.

Language Measures

WAB-R

Individualized administration of the WAB-R Bedside Screener yielded an Aphasia Quotient score for each participant based on correct performance on test items. A total score of 100 is possible. The Aphasia Quotient score provides a severity score for persons with aphasia by using the following formula: Sum of the Content, Fluency, Auditory Verbal Comprehension, Sequential Commands, Repetition, and Object Naming scores divided by six, and then multiplied by 10. The rating scale is as follows: 0-25 is very severe aphasia, 26-50 is severe, 51-75 is moderate, and 76-100 is mild. The participants' scores ranged from 13.33 to 82.5. Most of the participants fell within the severe range based on Aphasia Quotient scores. The Aphasia Quotient scores follow no trend in regards to age or time post onset. Table 3 and Figure A depict these scores. Participants' data are arranged by severity, from least to most severe aphasia.

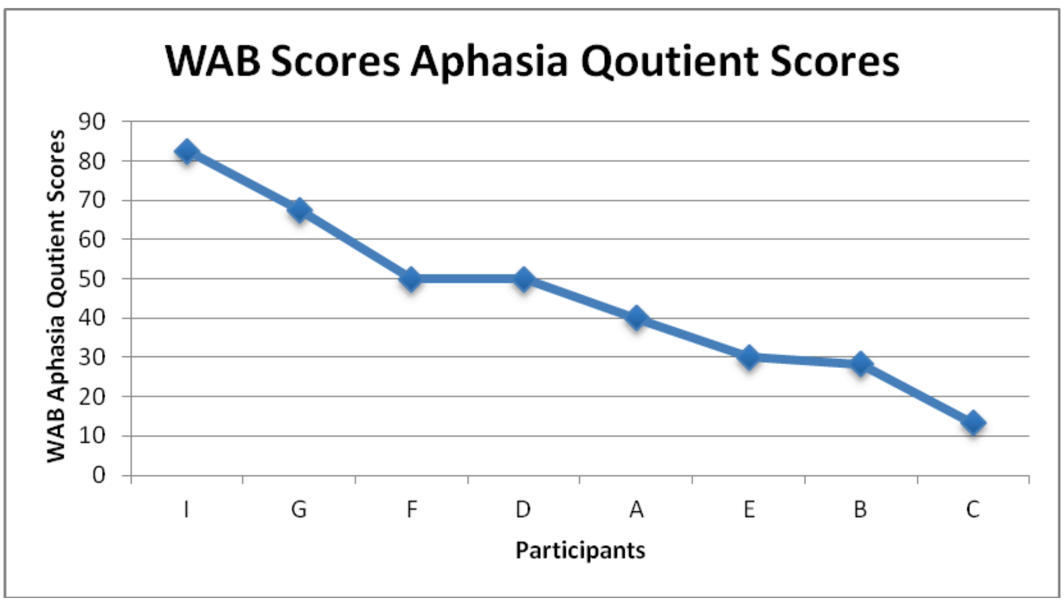
Table 3.

WAB-R Aphasia Quotient Scores

Participant	Aphasia Type	Aphasia Severity	Age	Time Post Onset	WAB Aphasia Quotient (out of 100)
I	Nonfluent	Mild	67 yrs.	24 mos.	82.5
G	Nonfluent	Moderate	57 yrs.	90 mos.	67.5
F	Nonfluent	Severe	64 yrs.	54 mos.	50
D	Nonfluent	Severe	74 yrs.	220 mos.	50
A	Nonfluent	Severe	57 yrs.	21 mos.	40
E	Nonfluent	Severe	71 yrs.	26 mos.	30
B	Nonfluent	Severe	79 yrs.	27 mos.	28.3
C	Nonfluent	Very Severe	67 yrs.	7 mos.	13.33

Figure A.

WAB-R Aphasia Quotient Scores



Note. According to the WAB-R Bedside Screener, participant I presents with mild aphasia, participant G presents with moderate aphasia, participants F through B present with severe aphasia, and participant C presents with very severe aphasia.

Table 4 and Figure B show a breakdown of the WAB-R subtest scores. Each subtest has a total possible score of 10. Participants tended to perform best on the Verbal Comprehension portion of the screener, which required participants to answer yes/no questions of increasing complexity. The participants' scores on the Fluency portion of the screener generally hovered around 4 and 5, which denote effortful, agrammatic speech with some paraphasias and anomia. This type of speech is consistent with an anterior, left hemisphere stroke resulting in nonfluent aphasia. The scores on the Content and Repetition subtests were lower in persons whose overall severity of aphasic deficits was greater. Participant scores on the Naming and Sequential Commands subtests showed variability and did not share a trend with aphasia severity. Participants who performed better on the Naming portion of the screener independently used auxiliary methods to help them recall words (for example. gestures, explaining the object's traits, etc.).

Table 4.

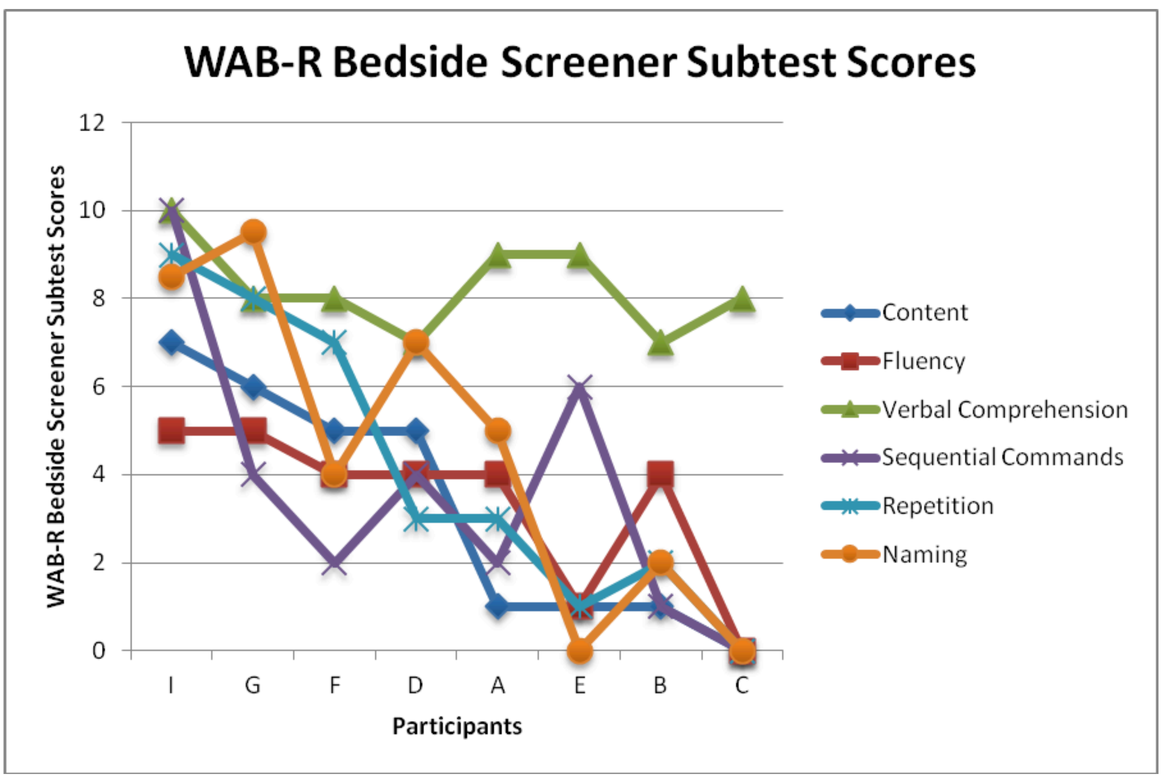
WAB-R Subtest Scores

Participant	Aphasia Type	Aphasia Severity	Age	Time Post Onset	Content	Fluency	Verbal Comprehension	Sequential Commands	Repetition	Naming
I	Nonfluent	Mild	67	24 mos.	7	5	10	10	9	8.5
G	Nonfluent	Moderate	57	90 mos.	6	5	8	4	8	9.5
F	Nonfluent	Severe	64	54 mos.	5	4	8	2	7	4
D	Nonfluent	Severe	74	220 mos.	5	4	7	4	3	7
A	Nonfluent	Severe	57	21 mos.	1	4	9	2	3	5
E	Nonfluent	Severe	71	26 mos.	1	1	9	6	1	0
B	Nonfluent	Severe	79	27 mos.	1	4	7	1	2	2
C	Nonfluent	Very Severe	67	7 mos.	0	0	8	0	0	0

Note. All subtest scores are out of 10 possible points.

Figure B.

WAB-R Bedside Screener Subtest Scores



Utility of the WAB-R. The WAB-R was used as a measure of language in the current study. The screener illustrates language skills in multiple areas, while providing the aphasia type and the severity of the impairment. The assessment revealed many characteristics of each participant within a short period of time. The WAB-R showed participants' ability to produce and comprehend language at varying levels of difficulty, revealed processing time needs, and showed the ability to independently use compensatory strategies in order to produce desired responses (for example, using gestures to help with Object Naming, or independently asking for repetition of directions in Sequential Commands and Repetition)

Sustained Attention Measures

Test of Everyday Attention (TEA): Map Search

The TEA Map Search is a subtest with verbally dictated directions meant to measure sustained attention. The subtest scoring information indicates that the low average score for number of symbols identified by persons age 50 to 60 years is 52; the researchers used this number as the criterion for the total number of symbols participants were expected to circle. The participants in this study were unable to achieve that number. The results were variable across participants. Participant I was unable to complete the test due to the inability to see the symbols on the given map. Participants D and E were unable to accurately complete the task. These findings are shown in Table 5 and Figure C. The percentage scores in Table 5 are graphed in Figure C.

Table 5.

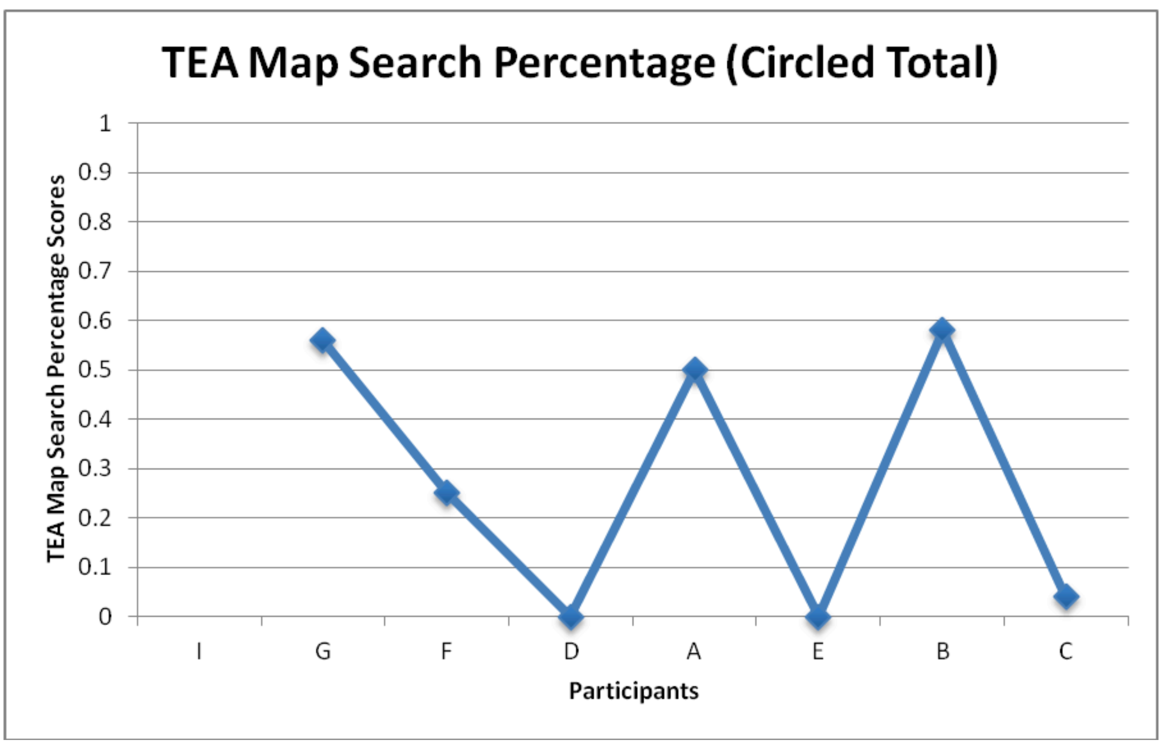
TEA Map Search: Total Symbols Circled

Participant	Aphasia Severity	Total Number of Symbols Circled (Raw Score)	Number of Symbols Available	TEA Map Search Percentage (Total Symbols Circled)
I				
G	Moderate	29	52	0.56
F	Severe	13	52	0.25
D	Severe	0	52	0
A	Severe	26	52	0.5
E	Severe	0	52	0
B	Severe	30	52	0.58
C	Very Severe	2	52	0.04

Note. Criterion score is 52. Participant I was unable to complete the subtest due to inability to see the symbols.

Figure C.

TEA Map Search: Total Symbols Circled



Note. Participant I was unable to complete the subtest due to inability to see the symbols.

Comparing participants' performance on the first minute and the second minute of the Map Search exercise allowed for measure of the participants' ability to sustain attention and remain focused on the task. The TEA Map Search takes a total of two minutes to complete. Participants were asked to switch colored markers at the one-minute completion point in order to measure their sustained performance through out the exercise. As Table 6 describes, participant F and participant B were able to maintain a similar performance in the first and second minutes of the task. Participant G was able to increase the quantity of symbols he found in the second minute in comparison to the first minute of the task. In contrast, participant A's performance decreased in the second minute in comparison to the first minute. Although participant C was able to increase performance in the second minute, the researcher's subjective impression of participant C's test performance calls into question participant C's comprehension of the task. Participant D and participant E were unable to accurately complete the task, thus their performance score remained at 0 through out the entire subtest. (Figure D graphs performance on the TEA Map Search).

Table 6.

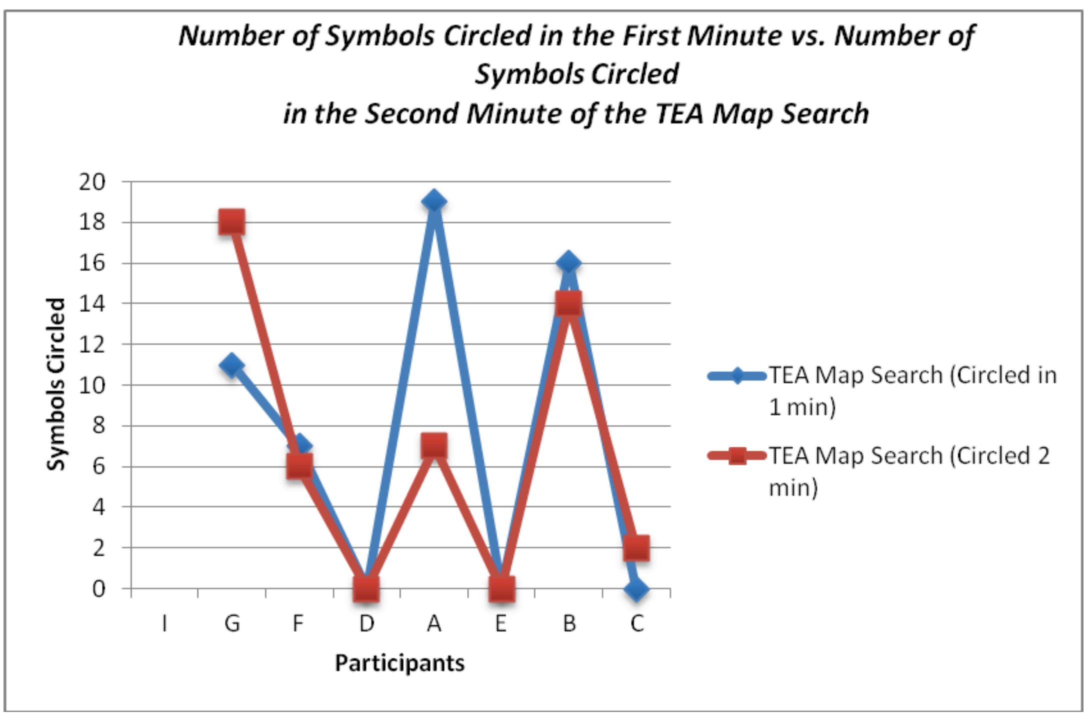
Number of Symbols Circled in the First Minute vs. Number of Symbols Circled in the Second Minute of the TEA Map Search

Participant	Circled in One Minute	Circled in Two Minutes
I		
G	11	18
F	7	6
D	0	0
A	19	7
E	0	0
B	16	14
C	0	2

Note. Criterion score is 52 for both tests combined. Participant I was unable to complete the subtest due to inability to see the symbols.

Figure D.

Number of Symbols Circled in the First Minute vs. Number of Symbols Circled in the Second Minute of the TEA Map Search



Utility of the TEA Map Search. The TEA Map Search effectively demonstrates the ability to sustain attention on a given task in a two minute time period. At the task's mid-point, participants were instructed to switch colored pens in order to determine if participants maintained the same efficiency through out the task. The assessment revealed a participant's ability to sustain attention, as well as their self-organization of a task and the ability to continue a task after a minor interruption.

Cognitive Linguistic Quick Test (CLQT): Mazes

The CLQT Mazes is a verbally dictated test meant to measure sustained attention. Participants were required to complete two mazes of increasing complexity without mistakes. A score of eight is possible. Results varied across participants; no pattern was found in relation to the participant's severity of aphasia, age, or time post onset of stroke. Participant G, participant F, and participant A received perfect scores on the subtest. Participant D made mistakes completing the maze, but finished the exercise. Participant I and participant B received the same score of 50%, meaning both participants were unable to accurately complete the second maze. Participant E and participant C were unable to adequately complete the exercise. Results are depicted in Table 7 and Figure E. The percentage scores found in Table 7 are graphed in Figure E.

Table 7.

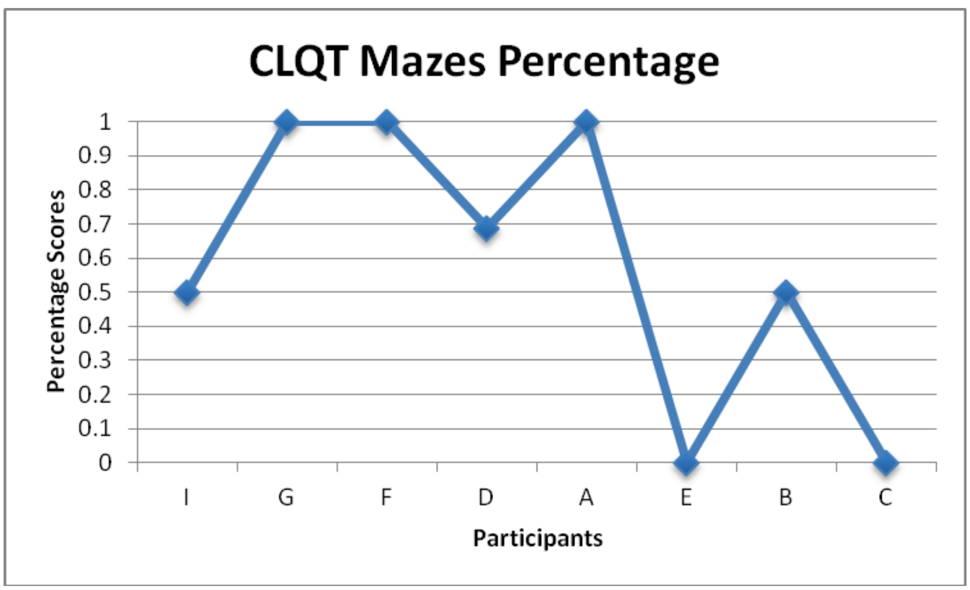
CLQT Mazes

Participant	Raw Score	CLQT Mazes Percentages
I	4	0.5
G	8	1
F	8	1
D	5.5	0.69
A	8	1
E	0	0
B	4	0.5
C	0	0

Note. The score for CLQT Mazes is out of 8 possible points.

Figure E.

CLQT Mazes



Utility of CLQT Mazes. The CLQT Mazes effectively demonstrated participants' ability to sustain attention to two tasks of different complexity. The subtest reveals participants' ability to self-correct, inhibit incorrect responses, and recognize the end of a task.

Cognitive Linguistic Quick Test (CLQT): Symbol Trails

The CLQT Symbol Trails is a verbally dictated test meant to reveal participants' sustained attention skills. The highest possible score is 10. Results varied across participants; no pattern was seen between participants' performance and their aphasia severity rating, time post onset of stroke, or age. Participant A was able to accurately complete the exercise. Participant I, participant G, participant F, participant D, and participant B were able to partially complete the exercise with varying success. Participant E and participant C were unable to accurately complete the exercise. Table 8 and Figure F present these data. Figure F graphs the percentage scores given in Table 8.

Table 8.

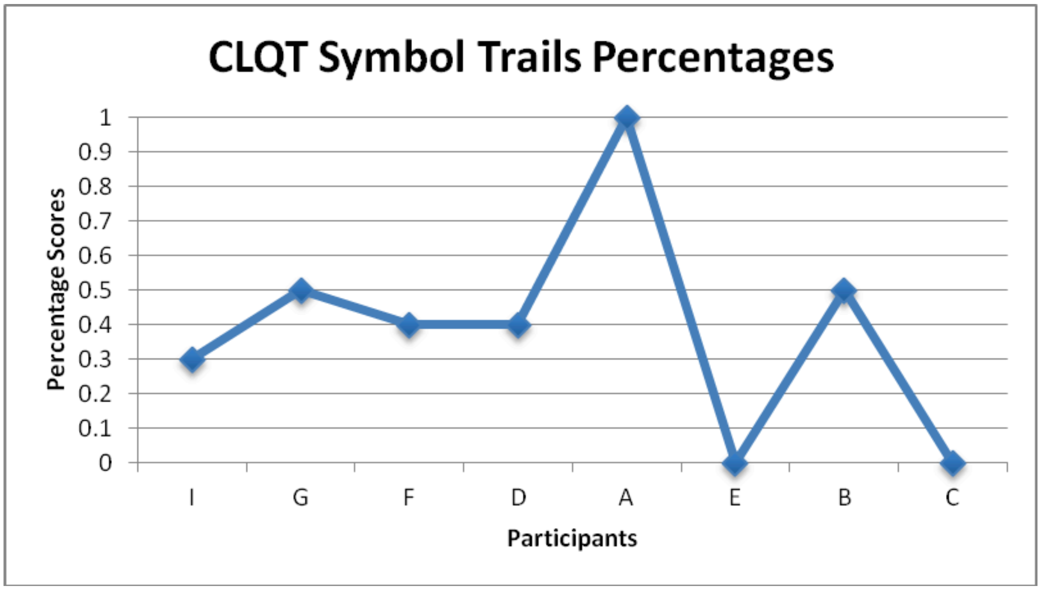
CLQT Symbol Trails

Participant	Raw Score	CLQT Symbol Trails Percentages
I	3	0.3
G	5	0.5
F	4	0.4
D	4	0.4
A	10	1
E	0	0
B	5	0.5
C	0	0

Note: Scores for CLQT Symbol Trails is out of 10 possible points.

Figure F.

CLQT Symbol Trails



Utility of the CLQT Symbol Trails. The CLQT Symbol Trails measured a participant's ability to sustain attention to a verbally presented task while revealing other characteristics of the participant, such as visual processing and selective attention. The test provided detailed teaching trials for the participants to ensure comprehension of the task. While proctoring the CLQT Symbol Trails, the researcher could determine the participants' self-regulation, impulsiveness, and ability to regain attention to task after a mistake. These behavioral observations are detailed in Chapter 5.

Leiter-R (Sustained Attention)

The Leiter-R features a nonverbal test of sustained attention. Per test administration instructions, the researcher used gestures to direct participants to cross out target symbols. The highest possible score is 145. Participants' scores fell at 40% accuracy or less. Participant A performed the best on the test, at just over 40%. These data are given in Table 9 and Figure G. Figure G presents the percentage scores given in

Table 9.

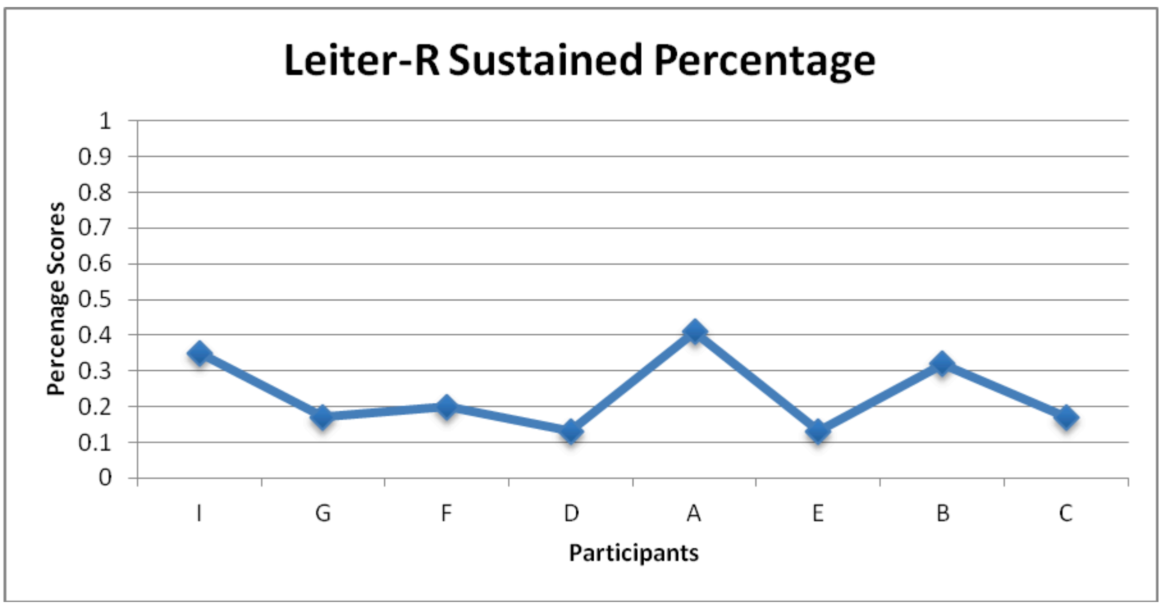
Leiter-R Sustained

Participant	Leiter-R Sustained- Raw Score (out of 145)	Leiter-R Sustained Percentage Correct
I	52	0.36
G	25	0.17
F	29	0.2
D	32	0.22
A	59	0.41
E	19	0.13
B	47	0.32
C	24	0.17

Note. Scores for Leiter-R Sustained are out of 145 possible points.

Figure G.

Leiter-R Sustained



The researcher scored the number of incorrect selections that the participant made in order to determine the participant's ability to inhibit incorrect responses. Participant A and participant F made no mistakes and participant B made one mistake, revealing their ability to sustain attention to target responses. Participant G, participant D, and participant I had a larger number of mistakes, but the number of mistakes made was lower than the score of correct target selections (i.e., there were fewer wrong selections than correct selections). Participant E and participant C had a larger number of incorrect selections when compared to correct target selections; the researcher believes participants E and C were guessing rather than making calculated decisions. Table 10 and Figure H portray Sustained Attention data.

Table 10.

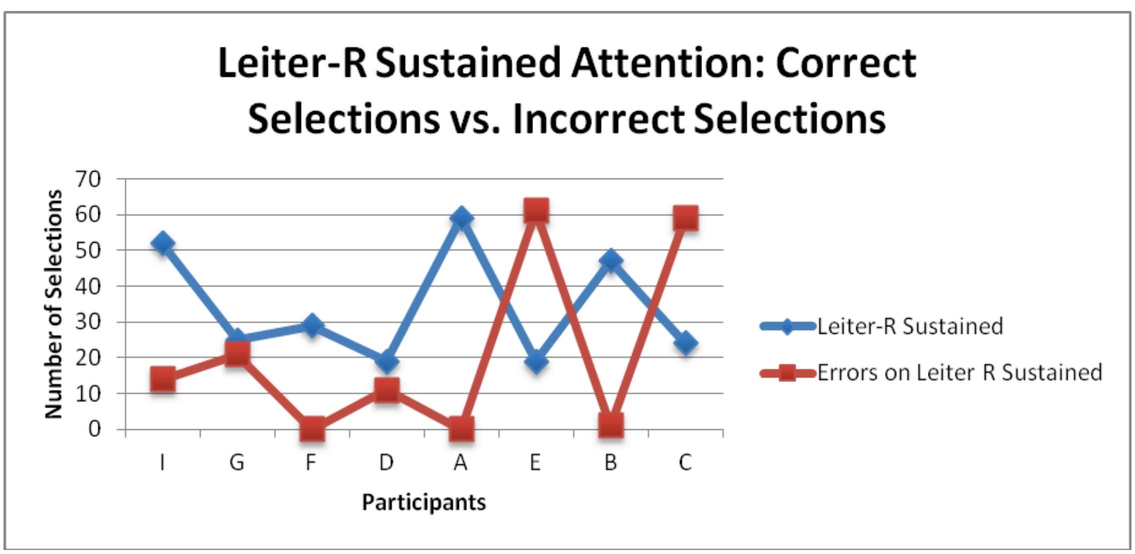
Leiter-R Sustained Attention: Correct Selections vs. Incorrect Selections

Participant	Leiter-R Sustained- Raw Score	Leiter-R Sustained- Errors Made
I	52	14
G	25	21
F	29	0
D	32	11
A	59	0
E	19	61
B	47	1
C	24	59

Note. The highest possible raw score is 145.

Figure H.

Leiter-R Sustained Attention: Correct Selections vs. Incorrect Selections



Utility of the Leiter-R Attention Sustained Subtest. The Leiter-R sustained attention components effectively showed participants' ability to sustain attention to a task when given nonverbal directions. The researcher was able to observe the participants' ability to sustain attention as the complexity of the tasks increased, could see them inhibit incorrect responses, and could note how they organize the execution of a task. Use of the Leiter-R Sustained Attention Subtest gave the researcher the ability to compare a nonverbal test of attention to measures of attention that employ verbal tasks.

Divided Attention Measures

Leiter-R Divided Attention

The Leiter-R Divided Attention Subtest measures divided attention when directions are given using gestures in the place of language. Participant E, participant B, and participant C were unable to complete the task due to its complexity. The participants who completed the task required verbal directions in order to complete the subtest accurately. This change in administration protocol obviated the measure as a language independent task, and resulted in a language dependent task. The results reveal that the participants with more severe nonfluent aphasia had better divided attention skills, but the data set is not complete. The data show that participant I, with the strongest language skills, had the weakest divided attention skills. Table 11 and Figure I portray these data. Figure I graphs the percentage scores given in Table 11.

Table 11.

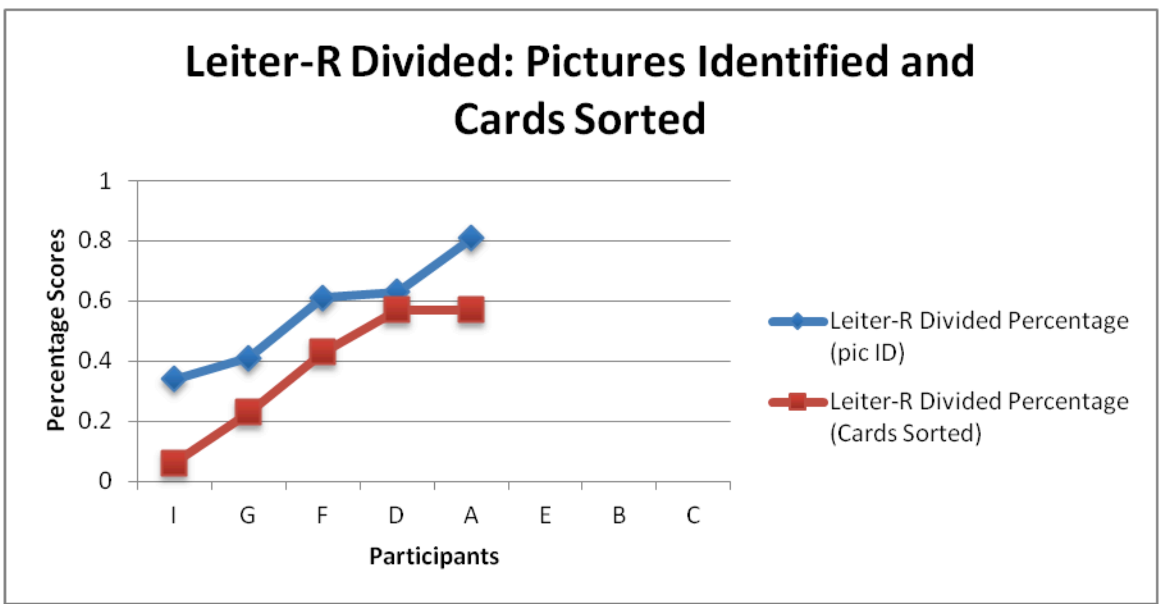
Leiter-R Divided: Pictures Identified and Cards Sorted

Participant	Pictures Identified Raw Score	Pictures Identified Percent	Cards Sorted Raw Score	Cards Sorted Percent
I	20	0.34	2	0.06
G	24	0.41	8	0.23
F	36	0.61	15	0.43
D	37	0.63	20	0.57
A	48	0.81	20	0.57
E				
B				
C				

Note. Pictures Identified Raw Score is out of a possible score of 59. Cards Sorted Raw Score is out of a possible score of 35. Participant E, Participant B, and Participant C were unable to complete the subtest.

Figure I.

Leiter-R Divided: Pictures Identified and Cards Sorted



Utility of the Leiter-R Divided Attention Subtest. It may be that the Leiter-R Attention Divided Subtest is too complex for persons with nonfluent aphasia. The participants with the most severe nonfluent aphasia were unable to complete the subtest due to its complexity. The participants who could complete the subtest demonstrated behaviors that indicated that they operated on the separate tasks as if the tasks were related in some way. The researcher needed to supplement the nonverbal directions with verbal language to ensure accurate completion and to allow the participants to feel successful. However, this additional input invalidates the results of this subtest. Despite these difficulties, the assessment did reveal participants' ability to simultaneously process two tasks, to quickly and effectively switch between tasks, and to demonstrate the processing time required to achieve the desired response.

Test of Everyday Attention: Telephone Search while Counting

The TEA Telephone Search is a two-part test meant to measure verbal divided attention. The first section of the subtest recorded the amount of time a participant took to circle target symbols. The score measured accuracy and efficiency under a sustained attention condition. The second section of the subtest required a participant to repeat the identical task while counting strings of tones presented on a compact disk recording. The score measured accuracy and efficiency under a divided attention condition.

Table 12 and Figure J depict the differences in performance under conditions of sustained attention versus divided attention. Participants' performance varied on this subtest. Participant F and participant E were unable to complete the subtest. Participant I's performance remained stable throughout both tasks, at approximately 50%. Participant I took less time to circle target symbols in the divided attention portion of the task when compared to the sustained attention portion. Participant G's, participant D's, and participant C's performance circling target symbols suffered in the divided attention task, although these participants did not attempt to count the string of tones. These three participants thus demonstrated that they needed to use sustained attention to complete the task. Participant G took more time to circle target symbols in the divided attention task, where as participant D took approximately the same amount of time, and Participant C took less time. Participant A circled one less symbol in the divided attention portion of the subtest as compared to the sustained attention portion of the subtest.

Table 12.

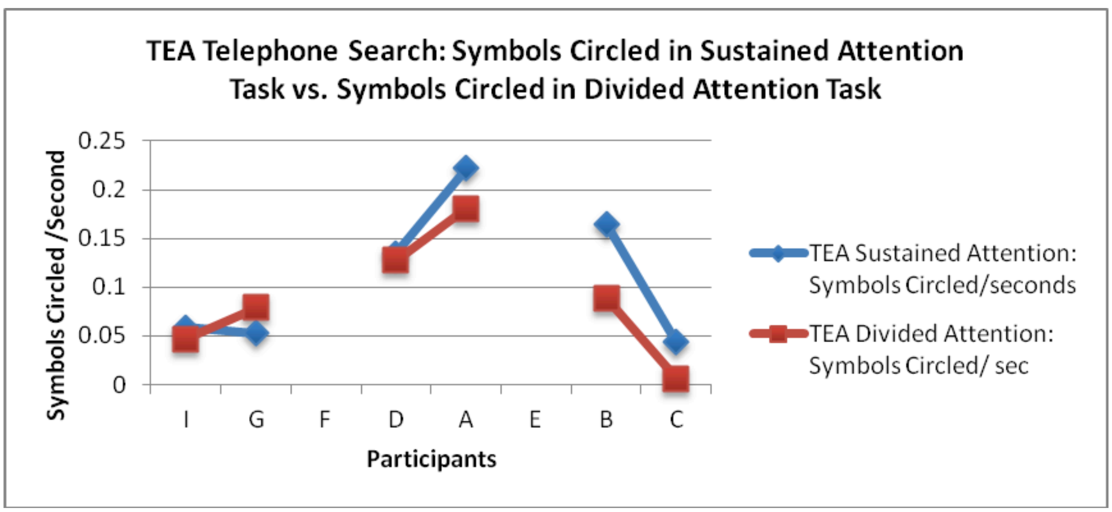
TEA Telephone Search: Symbols Circled in Sustained Attention Task vs. Symbols Circled in Divided Attention Task

Participant	Symbols Circled	Time Taken (sec.)	TEA Sustained Attention: Symbols Circled/seconds	Symbols Circled Divided	Time Taken (sec.)	TEA Divided Attention: Symbols Circled/ sec
I	9	154	0.06	9	193	0.05
G	15	285	0.05	10	127	0.08
F						
D	17	126	0.13	14	110	0.13
A	20	90	0.22	19	105	0.18
E						
B	17	103	0.17	12	135	0.09
C	4	92	0.04	1	165	0.006

Note. Participant F and Participant E were unable to complete the subtest.

Figure J.

TEA Telephone Search: Symbols Circled in Sustained Attention Task vs. Symbols Circled in Divided Attention Task



Note. Participant F and participant E were unable to complete subtest.

Table 13 and Figure K show differences in sustained attention versus divided attention performance. Although participant A attempted to count strings of tones while circling target symbols on the given template, he was unable to accurately do so. Participant A took less time to circle target symbols in the divided attention task. Participant B's performance of circling target symbols suffered in the divided attention task, but the amount of time it took the participant to circle the symbols decreased. Participant B was unable to accurately count strings of tones. Overall, it took less time for participants to circle target symbols in the divided attention task, although their accuracy suffered (with the exception of participant I). Participants were also unable to accurately count the strings of tones in the divided attention task. The percentage scores given in Table 13 are graphed in Figure K.

Table 13.

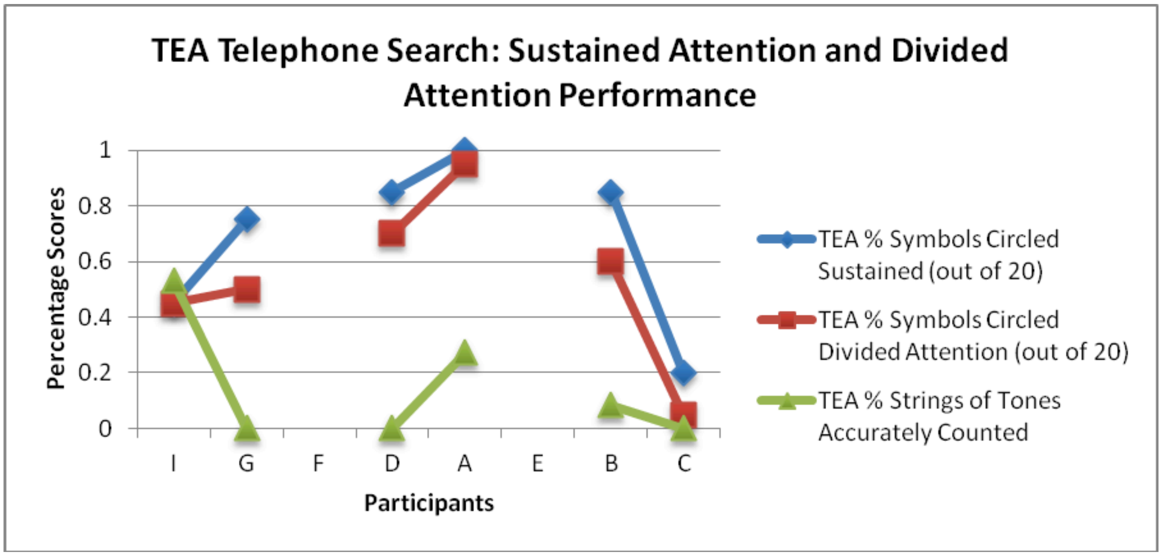
TEA Telephone Search: Sustained Attention and Divided Attention Performance

Participant	TEA Symbols Circled Sustained	TEA % Symbols Circled Sustained	TEA Symbols Circled Divided Attention	% Symbols Circled Divided Attention	String of Tones Accurately Counted	Strings of Tones Attempted	% Strings of Tones Accurately Counted
I	9	0.45	9	0.45	9	17	0.53
G	15	0.75	10	0.5	0	2	0
F							
D	17	0.85	14	0.7	0	0	0
A	20	1	19	0.95	3	11	0.27
E							
B	17	0.85	12	0.6	1	12	0.08
C	4	0.2	1	0.05	0	0	0

Note. The raw score of number of symbols circled in the sustained and divided subtests is out of 20 possible points.

Figure K.

TEA Telephone Search: Sustained Attention and Divided Attention Performance



Utility of the TEA Telephone Search while Counting. The TEA Telephone Search while Counting accurately revealed participants' ability to carry out a divided attention task and provided a comparison of participants' performance on the divided attention task with their performance on a similar sustained attention task. The task revealed detailed data on a participant's accuracy and efficiency of task completion. The TEA Telephone Search while Counting showed participants' ability to simultaneously complete two tasks, as well as the accuracy with which the participants completed the tasks, and the amount of processing time participants' required to complete the task.

Correlations between Attention Subtest Scores and the WAB-R Aphasia Quotient Scores

A Spearman Rank Order Correlation was calculated for each of the attention subtests in relation to the WAB-R Bedside Screener Aphasia Quotient scores. The Spearman correlation was chosen based on the small sample size collected for the current research study. The only attention measure that correlated with the WAB-R Aphasia Quotient score were the Leiter-R Divided Attention subtests. The researcher deemed the correlations inaccurate due to the number of participants who were unable to complete the subtest. The correlations between the remaining attention subtests and the WAB-R Aphasia Quotient scores were insignificant. The severity of a participant's nonfluent aphasia does not correlate with his/her attention skills. Table 14 provides these data.

Table 14.

Correlations between Attention Subtest Scores and the WAB-R Aphasia Quotient Scores

WAB vs. CLQT	WAB vs. Mazes	WAB vs. Leiter Sustained	WAB vs. TEA Map Search	WAB vs. TEA Telephone Search while Counting	WAB vs. Leiter-R Divided Pictures Identified	WAB vs. Leiter R Divided Cards Sorted
0.25	0.54	0.21	0.36	0.24	-0.97	-0.97

Comparisons between Language and Attention as Revealed by Descriptive Data

Test results allow for description of whether a participant had stronger language scores or stronger attentional scores. Relationships between scores can also be seen. In order to derive comparisons, a score of 65% or greater on testing is being used as a criterion for higher performance, and a score of less than 65% is being considered as lower performance.

Table 15 offers a composite of all test scores for all participants. Scores that meet the 65% criterion are in bold type. Figure L allows for a visual comparison of each participant's score on each subtest.

Table 15.

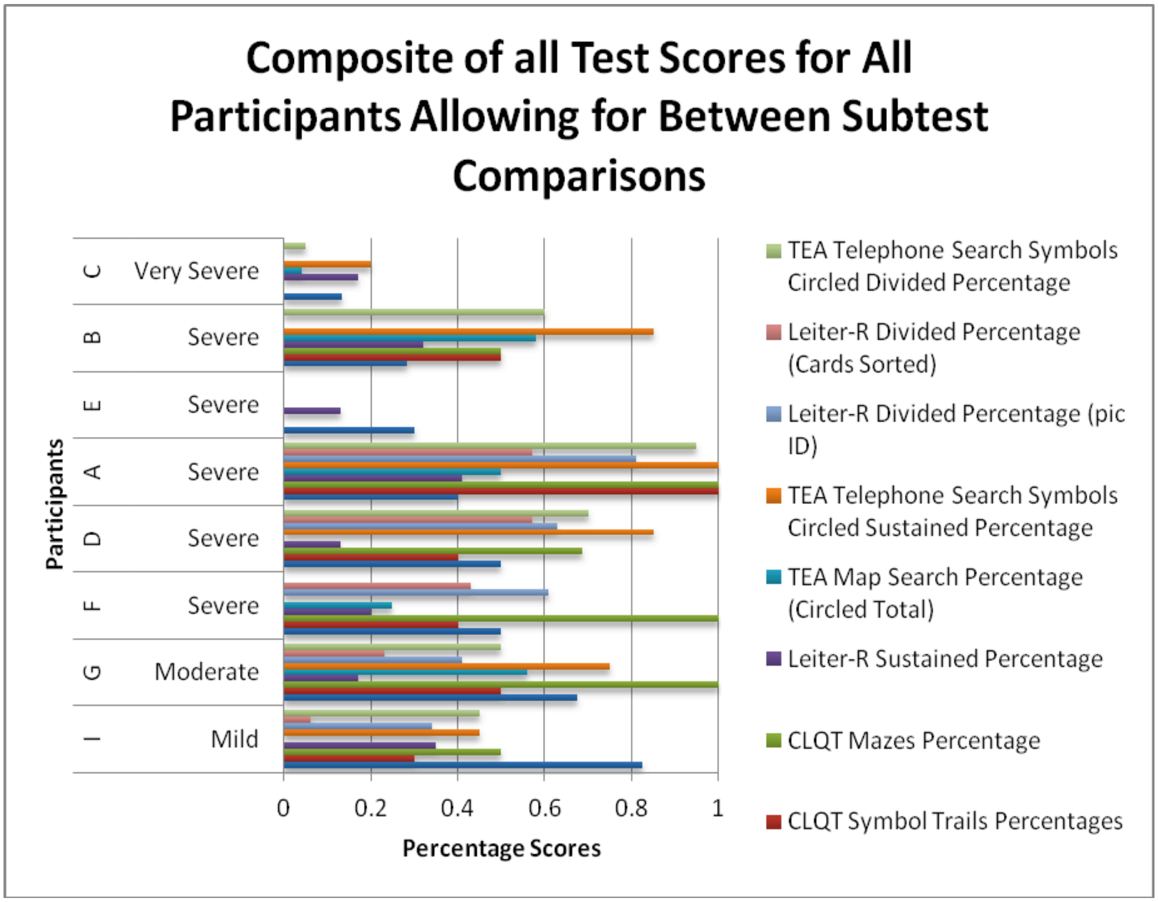
Composite of All Test Scores for All Participants Allowing for Between Subtest Comparisons

Participant	Aphasia Type	WAB	CLQT Symbol Trails	CLQT Mazes	Leiter-R Divided (Pic ID)	Leiter-R Divided (Cards Sorted)	TEA Map Search (Circled Total)	TEA Telephone Search-Symbols Circled Sustained	TEA Telephone Search-Symbols Circled Divided
I	Mild	**82.50%**	30%	50%	34%	6%	Ø	45%	45%
G	Moderate	**67.50%**	50%	**100%**	41%	23%	56%	**75%**	50%
F	Severe	50%	40%	**100%**	61%	43%	25%	Ø	Ø
D	Severe	50%	40%	**68.75%**	63%	57%	0%	**85%**	**70%**
A	Severe	40%	**100%**	**100%**	**81%**	57%	50%	**100%**	**95%**
E	Severe	30%	0%	0%	Ø	Ø	0%	Ø	Ø
B	Severe	28.30%	50%	50%	Ø	Ø	58%	**85%**	60%
C	Very Severe	13.33%	0%	0%	Ø	Ø	4%	20%	5%

Note. Results are shown as percentage scores with 65% considered a higher score that denotes a satisfactory level of competent performance on the subtest. Scores of 65% or greater are in bold type.

Figure L.

Composite of all Test Scores for All Participants Allowing for Between Subtest Comparisons



Participant I

On the whole, participant I, who has mild nonfluent aphasia, performed better on sustained and divided attention subtests when directions were given verbally, with the exception of the CLQT Symbol Trails subtest. Participant I achieved higher than a 65% score on the WAB-R; the language subtest score was higher than any of the attention subtest scores. These findings suggest that participant I's language skills tested better than her attentional skills.

Participant G

Participant G scored better on the language subtest than on any of the divided attention subtests. He had variable performance on the sustained attention subtests in comparison to the language tasks. Participant G obtained better scores on the CLQT Mazes and the TEA telephone search sustained portion than on the WAB-R. Participant G demonstrated better performance on the divided and sustained attention subtests when directions were presented verbally. The TEA Telephone Search while Counting revealed that participant G performed better on sustained attention tasks than on divided attention tasks. Participant G achieved higher than 65% on the WAB-R, the CLQT Mazes, and the TEA Telephone Search Sustained. The findings suggest that participant G's language skills tested better than his divided attention skills.

Participant F

Participant F achieved WAB-R AQ scores that are somewhat in between the sustained and divided attention subtest scores. The CLQT Mazes and Leiter-R Divided Pictures Identified subtest were above the WAB-R AQ scores; the CLQT Symbol Trails, Leiter-R Sustained, Leiter-R Divided Cards Sorted, and TEA Map Search subtest scores were all below the WAB-R AQ scores. Participant F performed better on sustained attention subtests when directions were given verbally. Divided attention scores could not be compared since participant F was unable to complete the TEA Telephone Search while Counting. Participant F achieved above 65% solely on the CLQT Mazes. Participant F's overall attention skills are not strong.

Participant D

Participant D achieved language subtest scores above scores obtained on the CLQT Symbol Trails, the Leiter-R Sustained, and the TEA Map Search. The WAB-R

AQ score also was below some verbal and nonverbal measures of attention (CLQT Mazes, Leiter-R Divided Subtest, and TEA Telephone Search while Counting). In general, participant D performed better in sustained and divided subtests when directions were presented verbally. The TEA Telephone Search subtests revealed participant D's performance decreases when carrying out a divided attention task. Participant D achieved above a 65% on the CLQT Mazes and the Telephone Search sustained and divided subtests. Participant D's overall attentional skills are not strong.

Participant A

Participant A's language scores were below the scores on all attentional measures. Participant A performed better on attention subtests when directions were presented verbally. Participant A achieved above 65% on the CLQT Symbol Trails, the CLQT Mazes, the Leiter-R Divided, and the TEA Telephone Search Sustained and Divided Attention subtests. Participant A's overall attention skills are not strong.

Participant E

Participant E's language scores were above all attention subtest scores. Participant E was only able to complete the CLQT Symbol Trails, the CLQT Mazes, the Leiter-R Sustained, and the TEA Map Search. Most subtests were not completed accurately. Participant E's attentional skills were not strong.

Participant B

Participant B's WAB-R AQ scores were below all attention subtest scores. Participant B performed better on sustained attention subtests when directions presented verbally; performance on the divided attention subtests could not be measured due to incomplete data collection (participant B was not able to complete the Leiter-R Divided

Attention Subtest). The TEA Telephone Search subtests revealed that participant B's performance suffered when required to complete a divided attention task. Participant B achieved above a 65% solely on the TEA Telephone Search Sustained attention task. Participant B's attentional skills were not strong.

Participant C

Participant C's WAB-R AQ score was between the measures obtained for verbal sustained attention—the language scores were below the TEA Telephone Search sustained portion and above the CLQT Mazes, CLQT Symbol Trails, and TEA Map Search. His language scores were below the nonverbal sustained attention subtest. Participant C's language scores were above the verbal score for divided attention. Participant C's nonverbal sustained attention performance was between verbal sustained attention performance; divided attention could not be compared due to incomplete data collection (participant C was unable to complete the Leiter-R Divided Attention Subtest). Participant C did not achieve above 65% on any subtest and his overall attentional skills were not strong.

Comparative Trends

This study revealed no trend for how language and attention are affected in nonfluent aphasia. Each participant in the study demonstrated different strengths and weaknesses. Participant I exhibited strong language skills, but severely affected attentional skills. Participant G demonstrated satisfactory language skills as well as sustained attention skills; participant G's divided attention performance was below expectations. Participant F demonstrated difficulty with both language and attention tasks—his performance on the language and attention tasks was somewhat comparable.

Participants A, B, and D exhibited stronger attentional skills when compared to language skills. Participants E and C did not demonstrate strengths in language or attention skills.

Tables 16 and 17 provide summaries of these trends. In Table 15, the percentage score for each attention subtest is compared to the WAB-R AQ score. Table 15 compares participants' performance on attention subtest to language performance. A + sign indicates a better comparative performance, and a – sign indicates a lesser performance by comparison.

Table 16.

Language Performance Compared to Attentional Performance

Participant	AQ Score	CLQT Symbol Trails	CLQT Mazes	Leiter-R Sustained	Leiter-R Divided	TEA Map Search	TEA Telephone Search Sustained	TEA Telephone Search Divided
I	82.5	-	-	-	-	**Ø**	-	-
G	67.5	-	+	-	-	-	+	-
F	50	-	+	-	=	-	**Ø**	**Ø**
D	50	-	+	-	+	-	+	+
A	40	+	+	=	+	+	+	+
E	30	-	-	-	**Ø**	-	**Ø**	**Ø**
B	28.3	+	+	=	**Ø**	+	+	+
C	13.33	-	-	=	**Ø**	-	+	-

Note. **Ø** denotes the participant was unable to complete the subtest.

Table 16 is a final summary of participants' strengths. Participants' strengths were based on percentage scores on each subtest. Scores above 65% were deemed to be a strength for participants. Attention subtest scores were averaged and subjected to the 65% criterion. In sum, for three participants, language appears better than attention. In three other participants, attention appears better than language. It is clear for all participants that language is reduced from normal elders' capacities by their nonfluent aphasia, and their attention skills are reduced from normal elders' capacities as well.

Table 17.

Participant Strengths

Participant	Language Skills	Attention Skills
I	+	-
G	+	-
F	-	-
D	-	+
A	-	+
E	-	-
B	-	+
C	-	-

Response to Research Questions

The first research question is, "Can it be identified whether attention is affected in persons with nonfluent aphasia?" This investigation found that attention is presumably affected in persons with nonfluent aphasia, because many participants evidenced poor attention scores, but results varied across participants. Participant I, with an AQ of 82.5, scored higher on the language subtest than on any attention subtest, revealing that the participant with the mildest nonfluent aphasia had severe attentional issues. Participant G, with an AQ of 67.5, had a language score that was in the middle of the range of his sustained attention subtest scores, revealing that the participant struggled with both language and attention. Participant A, with an AQ of 40, had better scores on every attentional measure, revealing the participant's attention skills were more intact than his language skills.

The second research questions asked, "Is there a trend for how attention is affected in persons with nonfluent aphasia based on the severity of aphasia?" This investigation showed that there is not a trend for how attention is affected in persons with nonfluent aphasia based on severity of aphasia. Participant I had the best AQ scores, but performed worse on attention tests than participants who trailed her language scores (participants G, F, D, and A). Where AQ scores were low for participants nearing or at the very severe range of aphasia (participants E, B, and C), attention scores were also low. Participant B, who had a similar AQ score to participant E, performed markedly better on attention subtests than participant E. Participant B's aphasia severity was not related to performance on attention tasks.

The third research question, "Can attentional skills be measured as a discrete skill in persons with nonfluent aphasia?" was answered in the affirmative. In measures dependent on language, this research found that attention can be measured as a discrete skill in persons with nonfluent aphasia. Tests that use simple verbal directions, allow for repetition of directions, and give practice trials allow examiner to measure attention as a discrete skill. Measures of attention that did not require language output and required limited motor skills allowed participants to perform activities to their fullest potential. In measures independent of language, participants did not perform as well when compared to measures dependent on language. In the nonverbal test of divided attention, the examiner needed to supplement gestural directions with language to ensure participants' task comprehension. From this small sample, it appeared that persons with nonfluent aphasia tended to respond better when directions were verbally presented.

The first hypothesis, that attention skills can be identified in persons with nonfluent aphasia, is accepted based on the results of this study. The second hypothesis, that a trend will be seen between language severity and attentional skills, is rejected based on the results of this study. Performance was too variable to establish a true trend. The third hypothesis, that attention skills can be identified in persons with nonfluent aphasia through measures that are language dependent as well as language independent is partially rejected. Based on the results of this study, attention can be identified as a discrete skill in measures that are language dependent, but cannot be identified as a discrete skill in measures that are language independent.

The first null hypothesis, that attention is not affected in persons with nonfluent aphasia, is rejected based on the results of this study. Attentional difficulties were observed in this sample. The second null hypothesis, that no trend can be observed between language and attention skills, is supported. The third null hypothesis, that attention cannot be measured as a discrete skill in persons with nonfluent aphasia is partially rejected. In measures dependent on language, attentional skills were identified in persons with nonfluent aphasia. In measures independent of language, attentional skills alone were not identified in persons with nonfluent aphasia.

CHAPTER V:

CONCLUSIONS AND DISCUSSION

Conclusions Revealed Through Participant Case Studies

Each participant will be discussed individually in order to fully explore what his or her pattern of performance reveals about identifying whether attention is affected in persons with nonfluent aphasia.

Participant I

Participant I was a 67-year-old female with mild nonfluent aphasia who was 24 months post onset of her stroke. The WAB-R Bedside Screener revealed that she had some word finding difficulties and paraphasias; overall, participant I spoke in mostly content words with missing grammatical markers. Participant I was able to answer yes/no questions, follow directions, and repeat phrases. She had difficulty accurately completing many of the attention subtests.

On sustained attention subtests, participant I demonstrated good self-awareness. In the CLQT Mazes and CLQT Symbol Trails, she was aware when she made a mistake, but was unable to bring her attention back to the task at hand. She gave up on completing the CLQT Symbol Trails and the second maze of CLQT Mazes. Participant I accurately completed the first two trials of the Leiter-R Attention Sustained subtest in an organized fashion. Once symbols became more complex, she was unable to attend to the target symbol/pattern as a whole. Participant I was unable to complete the TEA Map Search due to difficulty with her eyesight—she had trouble seeing the target symbols on a given map.

Participant I demonstrated difficulty completing the attention divided subtests. On the Leiter-R divided, she required continual prompts to switch her attention between tasks. She perseverated on prior target symbols, and did not discriminate based on the details of the symbols (e.g., color). In the sustained portion of the TEA Telephone Search, participant I was able to attend to detail and systematically carry out the search, although she did so inaccurately. On the divided portion, participant I attempted to count the presented tones but had to stop searching for symbols as she counted. Participant I was unable to accurately count tones. Participant I's performance on the language subtest was significantly greater than her performance on any of the attention subtests.

Participant G

Participant G was a 57-year-old male with moderate nonfluent aphasia who was 90 months post onset of his stroke. The WAB Bedside Screener revealed that his language contained mostly nouns with a small amount of verbs. Participant G could provide the main idea of a message, but was unable to provide full explanations with details. He also required ample time to respond to conversations as well as questions. Participant G was able to answer yes/no questions, and could partially complete the Sequential Commands portion of the WAB-R Bedside Screener with repetition of directions. He completed the repetition portion of the screener, but presented with word omissions and paraphasias as complexity of the phrases increased.

Participant G was able to accurately complete the CLQT Mazes portion of the exam, although the second, more complex maze took him the given two minutes to complete. In the CLQT Symbol Trails, participant G completed the practice trials with 100% accuracy, but became overwhelmed during the testing trial. He was unable to regain attention to the task. Participant G demonstrated decent sustained attention throughout the Leiter-R Sustained, but required prompts to continue work when he came to the end of each line. When target symbols became more complex (shape patterns), he treated each shape as a different entity instead of looking at the pattern as a whole. Participant G completed the TEA Map Search accurately and efficiently, increasing his rate of symbol identification through the second minute of the task.

In the Leiter-R divided attention task, participant G took ample time to get situated to the task, and demonstrated difficulty switching between the two tasks. When prompted to switch between tasks, he needed to reacquaint himself with the desired response. In the TEA Telephone Search Sustained, participant G took his time and looked for one target symbol at a time. For example, he went through every column looking for double squares, and then repeated the process for stars, etc. He did miss some symbols. During the TEA Telephone Search Divided, participant G’s concentration seemed to be affected—he did not search for the symbols separately. Also, participant attempted to count tones while searching, but gave up after the second string. Participant G presented with affected attention skills, both sustained and divided.

Participant F

Participant F was a 64-year-old male with severe nonfluent aphasia, who was 54 months post onset of his stroke. The WAB Bedside Screener revealed that participant F was able to provide some content words and give partial answers to the examiner's questions. He had difficulty naming objects, but independently used gestures to help him recall words. Participant F was able to answer yes/no questions, although he demonstrated increased difficulty when questions became complex. Participant F had difficulty accurately completing Sequential Commands, and could only repeat single words and simple sentences.

Participant F exhibited adequate sustained attention skills, although demonstrated a long processing time, which affected his ability to efficiently complete tasks. He was able to accurately complete both CLQT Mazes. Participant F demonstrated understanding of the CLQT Symbol Trails, but did not show awareness of the mistakes made during task completion. Participant F completed the Leiter-R in an organized fashion and did not make any mistakes. He demonstrated awareness that the tasks of increasing complexity would be more challenging, and worked slowly to ensure accuracy. Participant F demonstrated the same systematic search during completion of the TEA Map Search.

Participant F required cues to move back and forth between tasks in order to complete the Leiter-R Divided Attention subtest. He was independently able to revisit target symbol, and did not make mistakes during completion of the subtest. Participant F was unable to complete the TEA Telephone Search; he told researcher that he was unable to tell the difference between the symbols on the test materials.

Participant D

Participant D was a 74-year-old male with severe nonfluent aphasia who was 220 months post onset of his stroke. The WAB-R Bedside Screener revealed participant D had slow effortful speech that comprised of only content words. Participant D was able to communicate the main points of his message using nouns, but was unable to use verbs and function words to provide a full message. Participant D required repetition of directions for the Verbal Comprehension and Sequential Commands portions of the WAB-R Bedside Screener. He adequately completed both tasks, and demonstrated self-awareness when he was not able to respond correctly. Participant D was only able to repeat one-word phrases.

Participant D demonstrated difficulty with sustained attention tasks, but his visual processing skills and/or selective attention skills may have prohibited him from accurately completing the tasks. Participant D was able to complete the first maze in CLQT Mazes accurately and efficiently. In the second maze, he took incorrect pathways and mentioned he wished he could erase the lines. Participant D persevered to task completion, but did not recognize that he had finished the exercise. In CLQT Symbol Trails, participant D was unable to identify the smallest circle. He planned out his first four moves before completing the task, but showed no self-awareness of the mistakes made afterward. In the Leiter-R Sustained Attention Subtest, participant completed the first two tasks (single symbols) in an organized fashion. In the last two tasks (when target became symbol patterns), he demonstrated difficulty recognizing correct symbol patterns, and his organization decreased. Participant D did not understand the target of the TEA

Map Search, even when given supplemental instruction. Participant D traced rivers and interstates and circled town names instead of identifying target symbol.

Participant D demonstrated difficulty completing divided attention subtests. Participant D took a long time to process the symbol board in the Leiter-R Divided Attention Subtest while constantly repeating the target symbol to himself. Participant D was still distracted by other symbols on the board. He had slow processing time; his completion of the picture identification and card-sorting tasks was labored. Participant D accurately completed the sustained portion of the TEA Telephone Search, but his performance suffered on the divided attention portion of the subtest. Participant did not attempt to count the string of tones, even when instructed to do so by the examiner.

Participant A

Participant A was a 57-year-old male with severe nonfluent aphasia who was 21 months post onset. The participant exhibited anxiety through out testing. The WAB-R Bedside Screener revealed participant A had effortful, agrammatic speech with a limited repertoire. He had severe anomia, especially through conversational speech. Participant A required ample processing time throughout conversation and completion of subtests within the screener. He also required repetition of directions throughout the screener. Participant A demonstrated good verbal comprehension, but struggled with completion of the Repetition and Sequential Commands tasks. He had difficulty moving to different tasks.

Participant A demonstrated little difficulty completing the sustained attention tasks. Participant A completed the CLQT Maze and CLQT Symbol Trail subtests accurately and efficiently; he maintained concentration through out. Although participant

A did not score as high as others in the Leiter-R Sustained Attention Subtest, he completed the activity with no mistakes. Participant A completed the TEA Map Search accurately and in an organized fashion. He required ample processing time in the completion of the Leiter-R Sustained Attention and the TEA Map Search subtests.

Participant A did demonstrate some difficulty completing divided attention subtests when compared to the ease he had completing sustained attention subtests. Participant A's completion of the divided attention subtests was accurate and efficient. Examiner used language to supplement directions given in the Leiter-R Divided Attention Subtest because the participant believed the two tasks to be connected. He initially held up the number card that corresponded with the number of target pictures on the board. Once the participant understood the requirements of the subtest, he required continuous cues to switch back and forth between tasks. Participant A required repetition of directions for the TEA Telephone Search, but was able to accurately complete the symbol identification in the sustained and divided attention portions. Participant A was not able to accurately count the strings of tones, and often said "end" instead of providing a number at the end of the strings of tones. Although participant was unable to simultaneously carry out tasks, his sustained and divided attention was generally intact.

Participant E

Participant E was a 71-year-old female with severe non-fluent aphasia who was 26 months post onset of her stroke. The WAB-R Bedside Screener revealed that participant had anomic, effortful speech with stereotypic utterances and meaningful intonation. Participant E exhibited apraxic-like symptoms. Participant E demonstrated comprehension of the speaker's message and adequately completed the Verbal

Comprehension and Sequential Commands portions of the screener. Participant E was unable to adequately complete the Repetition portion of the screener due to imprecise, effortful articulation and paraphasias.

Participant E demonstrated difficulty completing sustained attention subtests. In the CLQT Mazes subtest, participant traced the first maze to completion with her finger. Once participant E picked up the writing utensil, she began coloring in the maze. Participant E proceeded to color in the second maze, even after directions were repeated. The CLQT Symbol Trails revealed participant E's impulsiveness; she began writing on the examiner's model before directions were fully given. Participant E understood she was to connect shapes, but did not complete in the directed pattern. Participant E demonstrated difficulty understanding the nonverbal directions given in the Leiter-R Sustained Attention. Participant E attended to the task, but did not discriminate between shapes—she ended the exercise with a larger number of mistakes than target responses. The examiner provided clear instructions to the participant, and asked the participant to locate target symbols on the map with her finger for practice in the TEA Map Search; the participant did so accurately. Once participant E was provided with a pen, she began drawing lines haphazardly on the given map. Participant E did not have adequate sustained attention to tasks.

Participant E was unable to complete the Leiter-R Divided Attention task due to inability to comprehend directions, even when supported with language. In the TEA Telephone Search, participant E became distracted by the names of businesses on the testing material. She was unable to complete the sustained attention portion of the subtest. The divided attention portion was not attempted.

Participant B

Participant B was a 79-year-old female with severe non-fluent aphasia, who was 27 months post onset of her stroke. The WAB-R Bedside Screener revealed that participant B had agrammatic, effortful speech. She used three main phrases throughout the testing period and had difficulty accessing correct vocabulary. Participant B often used related words in order to convey her message to the examiner. Participant B required repetition of directions and ample processing time during the screener. In the Verbal Comprehension section of the screener, participant B had difficulty comprehending complex yes/no questions. Participant B also exhibited difficulty completing the Sequential Commands and Repetition portions of the WAB-R Bedside Screener.

Participant B demonstrated some difficulty completing most of the attention sustained subtests. Participant B was able to complete the first maze of the CLQT Mazes accurately. On the second, more complex maze, participant B was aware she could not complete the activity, and drew an outline around the maze. Participant B was able to complete the first few steps to the CLQT Symbol Trails, but did not exhibit awareness of the mistakes she made through out the rest of the task. The participant self-corrected mistakes made during the Leiter-R, but demonstrated difficulty locating symbol patterns once the task increased complexity. Participant B accurately completed the TEA Map Search without becoming distracted.

Participant B was unable to complete the Leiter-R Divided Subtest. She was given nonverbal and verbal directions, but could not comprehend the tasks were unrelated. No data were collected. Participant B successfully completed the sustained attention portion of the TEA Telephone Search. Her performance suffered in the divided attention portion. Participant B attempted to count tones while circling symbols at the beginning of the task; she demonstrated awareness that she could not complete both activities and ceased counting tones.

Participant C

Participant C was a 67-year-old male with very severe nonfluent aphasia who was 7 months post onset of his stroke. The WAB-R Bedside Screener revealed that participant C used short, rather meaningless utterances, such as, “yes, yes, yes.” This participant was able to adequately complete the Verbal Comprehension portion of the screener. Participant C was unable to follow sequential commands, repeat verbally presented phrases or name objects.

Participant C demonstrated difficulty completing all attention sustained subtests. He could not correctly complete the CLQT Mazes. In the first maze, participant C drew dots without a pattern, although the first dot was drawn on the entrance to the maze, and the last dot at the maze’s endpoint. In the second maze, the participant drew random dots throughout the maze. In the CLQT Symbol Trails exercise, participant C was able to complete the activity, but was unable to follow the necessary pattern. Participant C demonstrated comprehension of the Leiter-R directions, but could not inhibit his selection of symbols other than the target. His search through the template was unorganized and haphazard. In the TEA Map Search, participant C did not refer to the target symbol; he drew meaningless circles throughout the map.

Participant C could not complete the Leiter-R divided due to its complexity. The attention divided subtest was omitted. In the TEA Telephone Search, participant C was distracted by the names on the test material and rarely referred to the symbols; he circled many symbols that did not fit the target's criteria. In the divided attention portion of the TEA Telephone Search, participant C stopped searching through the test template in order to listen to the tones. Participant C responded yes after each string of tones. Participant C did not return to searching for symbols when the compact disk recording ended; examiner accounted for the correct symbols he had identified.

Discussion

The results of this research revealed that attention can be affected in people with nonfluent aphasia to varying degrees. This conclusion supports the definition of aphasia adapted from definitions proposed by Darley (1982) and McNeil (1988). Language centers in the brain are not independent of other brain processes. If an individual has a lesion in or around the main language centers of the brain, the lesion will also affect the cognitive processes that interface with language. The conclusion that attention was affected in persons with aphasia is supported by the findings of a study conducted by Purdy (2002); Purdy stated that persons with aphasia do exhibit some characteristics of impaired executive function.

The Relationship between Severity of Nonfluent Aphasia and Attention Skills

Across these comparative cases, the severity of an individual's aphasia does not correlate with the extent to which attention is affected. Results indicate that participant I, who had the highest language score, had weaker attentional performance. Participant A, with language scores in the severe range, did not appear to have severely affected attentional issues. Participant B, with comparable language scores to participant E, significantly outperformed participant E in all measures of attention.

The current findings that the severity of aphasia does not consistently relate to attentional skills supports prior findings by Vallila-Rohter and Kiran (2013) and Helm-Estabrooks (2002). Vallila-Rohter and Kiran (2013) concluded that persons who appear to have a higher level of language competency do not necessarily have intact cognitive systems. In a 2002 study, Helm-Estabrooks stated that one cannot predict the severity of cognitive deficits based on language scores.

There is a question whether participant C, who had very severe language scores, understood how to complete the tasks at hand. It is unsure whether the severity of the participant's aphasia interfered with the participant's ability to complete tasks or if the participant had underlying cognitive deficits. Nicholas, Sinotte, and Helm-Estabrooks (2005) postulated that a language disorder in conjunction with non-linguistic cognitive functions may be responsible for unsuccessful communication (p. 1053). The hypothesis that cognitive functions interfere with ability to communicate and carry out tasks could apply to participant C, but this does not denote that attention is involved. The results are not conclusive; it is not yet possible to make a statement regarding the cause of participant C's performance.

Participant Performance: Verbal vs. Non-Verbal Directions

The current participants tended to perform better when directions were given verbally for measures of attention. All participants had nonfluent aphasia with relatively intact verbal comprehension, as seen in the WAB-R Bedside Screener. All directions were short and simple, and allowed for clarification. Also, most of the attention subtests had a training period to ensure participant's comprehension. Perhaps participants were more accustomed to receiving directions verbally, and participant comprehension was not facilitated by the unfamiliar gestural way that directions were presented on the attention subtests.

Participant Performance: Sustained Attention vs. Divided Attention

Participants' performance suffered when they were asked to carry out a divided attention task as compared to a sustained attention task. McCallum (2005) stated that when attention is divided into two tasks, performance on each suffers. The current results are supported by Godefroy and Rosseaux (1996), who concluded that task performance decreased as perceptual channels increased. Murray (2012) also found that divided attention showed a decrease in performance when compared to sustained attention skills. Across these comparative cases, participants' divided attention, a skill important in daily life, was affected.

This investigation also found that participants had a long processing time when carrying out tasks, and had a difficult time switching between tasks. The outcomes reflected how taxing performance of both sustained and divided attention subtests can be. For persons with nonfluent aphasia, it can be postulated that these findings directly relate to attention processes within the brain.

Relationship between Language and Attention

Attention acts as a gatekeeper by regulating and prioritizing information processed in the CNS. Without intact attention, individuals would have difficulty learning, remembering, and behaving (Sterr, 2004). Attention has two subsystems—voluntary and involuntary. Voluntary attention is a goal-oriented, active process. Involuntary attention is a passive process where one reacts to the surrounding environment. Also, researchers suggest that there is a diffuse attentional system that is believed to be situated in the frontal lobes of the brain. The attentional system is not well understood (Filley, 2002).

The Limited Capacity Theory states that individuals have a limited attentional capacity, but typical adults can allocate resources to a preferred activity (Murray, 1999). The Central Bottleneck Model, which supports the Limited Capacity Theory, states that there are three stages of attention processing. The precentral and postcentral stages are believed to be processed simultaneously, where the central stage is processed serially. Also, in typically functioning adults, high priority information is automatically passed through the central bottleneck before low priority information (Hula & McNeil, 2008).

Godefroy and Rosseaux (1996) found that attention in those with left hemispheric lesions was affected when the lesion reached areas of the prefrontal cortex and head of the caudate nucleus. Perhaps it can be postulated that the participants in the current study whose attention was affected may have lesions that reached these areas. Since the researcher was unable to obtain case information about participants' sites of lesion, future research is required to investigate attention as related to site of lesion.

It might be possible to question whether the central bottleneck for processing attention is situated within the left prefrontal cortex of the brain. The affected bottleneck may relate to slow processing time in persons with nonfluent aphasia. The system may not be able to automatically prioritize information, which may slow the time it takes for one to complete a task. This leads to wonder about whether the precentral and postcentral stage can process simultaneously; if each stage is carried out serially, an individual's overall processing time will increase. Murray (1999) stated that an individual cannot effectively complete a task if the task's demands exceed an individual's capacity or if an individual's resources are not appropriately used.

Participants' performance on the WAB-R Fluency subtest bore some relationship to the attention subtests. It may be possible to state a future hypothesis that the processes for fluent speech may use or rely on the same pool of resources as attention. If true, the hypothesis could contribute to the slow, labored speech of persons with nonfluent aphasia. Although, because Participant A contradicts this hypothesis, further research is needed.

Significance of the Findings of this Study in the Treatment of Aphasia

The goal of language treatment is to rehabilitate persons with aphasia to the point where an individual can return to premorbid roles, responsibilities, and activities (Meuller and Dollaghan, 2011 p.1052). Clinicians need to consider the distinct possibility that attention is affected in persons with nonfluent aphasia, and regard the limited attentional skills as a barrier to rehabilitation. Basso's (2004) Theory of Aphasia Therapy supported the idea that clinicians should consider factors beyond a client's language impairment that may affect recovery (as cited by McNeil and Copland, 2011 p. 32).

Vallila-Rohter and Kiran (2013) stated that a client's ability to learn is a better predictor of therapeutic success than his or her functioning skills. Since attention is integral to learning, a decline in attentional skills can severely inhibit an individual's ability to recover. Clinicians need to account for an individual's attentional skills and shortcomings and use this knowledge to appropriately plan and execute therapy services.

Limitations of the Current Study

The study had several limitations that did not allow the researcher to collect a desirable set of data. This difficulty may have skewed results. The study did not collect a large enough sample of participants; the conclusions made in this study are not strong due to the lack of participants. There were limited accurate data for the nonverbal divided attention subtest due to participants' reliance on language throughout testing. Also, certain subtests, such as the CLQT Symbol Trails, relied on additional cognitive processes beyond just sustained attention, which may have skewed the results of the subtests. Lastly, not all participants were able to complete all subtests, which may have also skewed results and correlations.

Directions for Future Research

The most telling result obtained by this study was the relationship between the WAB-R Fluency subtest and the measures of attention. Future research should focus on the relationship between participants' language fluency and measures of attention in order to verify or debunk these findings.

Future studies should also account for the selective attention of persons with aphasia, as well as participants' ability to inhibit incorrect responses. This study did not account for selective attention, and some participants may have struggled due to not using selective attention well.

The current study provided pertinent information for the treatment of persons with aphasia. Researchers need to continue to examine the relationship between cognitive processes and language to elucidate the connection and increase knowledge within the field of speech-language pathology.

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APPENDICES

APPENDIX A

SITE APPROVAL FORM

Invitation for CSU Speech and Hearing Program Affiliate Sites to Participate in Research

We are Dr. Monica Gordon Pershey, Associate Professor, and Amanda Wadams, graduate student, in the Speech and Hearing Program in the School of Health Sciences, Cleveland State University (CSU). We are asking you to allow us to visit your site in order to recruit participants for a research study that is the basis of Ms. Wadams' Master's thesis. ***This research concerns the relationship between language and attention in persons with aphasia. This study is meant to help discover methods of more effective speech-language therapy for people with aphasia.*** This study has the approval of the CSU Institutional Review Board for the Participation of Human Participants in Research (IRB).

We are asking you to refer us to persons associated with your facility who have been diagnosed with aphasia who might be willing to participate in approximately 60-90 minutes of language testing.

At this point, we are asking you to devote staff time to liaise with us. The staff member would (1) refer us to the names potential participants, via phone or email conversations; (2) set up a visit date with us for later this winter or in early spring; (3) meet with us briefly when we visit your site and escort us to meet participants (in accordance with your site's policy on visitors), (3) remain present for a few minutes while we explain the testing and obtain written consent from the participant.

We do not need staff presence during testing. As yet, we cannot anticipate the number of visits to your site will be needed until we know how many participants might join the study. We respect your staff's time, and we will work as efficiently as possible.

The testing will consist of one 60-90 minute individual session with each participant in a quiet, comfortable area that is free from distraction. Tests that Ms. Wadams will administer include the *Western Aphasia Battery Bedside* exam and subtests from the *Leiter-3*, the *Cognitive Linguistic Quick Test* (CLQT), and the *Test of Everyday Attention* (TEA).

We look forward to your reply at your earliest convenience, preferably by ***March 7, 2014***. Please contact Amanda Wadams at amandawadams@yahoo.com or 908-448-6740.

Thank you for your consideration of this request.

Amanda Wadams, B.A.
Graduate Student
Cleveland State University

Monica Gordon Pershey, Ed.D., CCC-SLP
Associate Professor
Speech and Hearing Program
School of Health Sciences
Cleveland State University
2121 Euclid Ave.
Cleveland, OH 44115-2214
Phone: 216-687-4534
Fax: 216-687-6993
Email: m.pershey@csuohio.edu

Please initial one of the statements below.

______ I give Dr. Monica Gordon Pershey and Amanda Wadams to recruit and test participants from our facility for the purpose of their study.

_______ I do not wish for our facility to participate in this study.

APPENDIX B

PARTICIPANT CONSENT FORM

Dear Participant:

We are Dr. Monica Gordon Pershey, Associate Professor, and Amanda Wadams, graduate student, in the Speech and Hearing Program in the School of Health Sciences, Cleveland State University (CSU). We are asking you to participate in this research study, which is the basis of Ms. Wadams' Master's thesis. We are researching the relationship between language and attention in persons with aphasia. This study is meant to benefit future creation of more effective speech-language therapy for people with aphasia.

We will ask you to participate in some activities that measure language and attention. All tasks involve listening, speaking, and paper and pencil responses. Your participation will total about 90 to 120 minutes, and you will be video recorded. Every possible effort will be made to minimize risks and discomforts to you. Ms. Wadams will offer you breaks and you may ask for breaks during testing. You may discontinue your participation at any time during the session with no penalties. You can withdraw from the study at any time with no penalties.

Every possible effort will be made to minimize any potential risks to participants' confidentiality. Dr. Monica Gordon Pershey and Amanda Wadams will be the only people with access to your videos and activity sheets. Their computers are password protected and your papers will be kept in a locked office at CSU. Your name will appear only on this consent form. You will be assigned a code number that will be written on your activity sheets and used to log your video. Details of your clinical characteristics will be reported under your assigned code number. No names will be used to report data. All data will be reported in the aggregate.

For further information regarding this research, please contact Dr. Monica Gordon Pershey at (216) 687-4534, email: m.pershey@csuohio.edu; or Amanda Wadams at (908) 448-6740, email: amandawadams@yahoo.com.

There are two copies of this letter. After signing them, please keep one copy for your records and return the other one to Ms. Wadams. Thank you in advance for your cooperation and support for this research. Please indicate your agreement by initialing each line, then signing below.

_________ *I consent to participate in language and attention activities conducted by Amanda Wadams for the purposes of this study.*

__________ *I consent to being video recorded by Amanda Wadams.*

I understand that my participation in this study is voluntary and that I may withdraw my participation at any time, without penalty. I understand the risks and benefits of this research, and agree to voluntarily participate.

I understand if I have any questions about my rights as a research participant, I can contact the Cleveland State University Institutional Review Board at (216) 687-3630.

____

Participant's Printed Name

____

Participant's Signature

____

Date

____

Email Address

____

Phone Number

APPENDIX C

WESTERN APHASIA BATTERY BEDSIDE SCREENER

Name: ______________________ Date: ______________

DOB: ________ Age: ______ ☐ M ☐ F Diagnosis: ______________

Date of Onset: ________ Neuroimaging: ______________

Bedside Record Form — Western Aphasia Battery REVISED

Spontaneous Speech: Content

Directions: Ask the patient these questions and encourage complete responses. Score length and complexity of sentences, word-finding difficulty, and paraphasias.

Item	Score
1. **How are you today?** (1 point = any meaningful response)	(1)
2. **What is your full address?** (2 points = complete address; 1 point = street or city only)	(2)
3. **Why are you here (in the hospital)?** (2 points = complete response; 1 point = incomplete response)	(2)
4. Show the patient a magazine picture of some complexity. Say, **Tell me what is happening in this picture.** (5 points = complete description; 4 points = incomplete description; 3 points = essential items; 2 points = few items only; 1 point = some relevant words; 0 points = no meaningful response)	(5)

Content Score ☐ (10)

Spontaneous Speech: Fluency

Directions: Circle the point value that represents the statement that best describes the patient's speech fluency.

10 = Normal speech
9 = Some hesitations and word-finding difficulty
8 = Circumlocutory, fluent speech with semantic paraphasias and word-finding difficulty
7 = Fluent phonemic jargon, semblance to English syntax and phonology
6 = Logopenic but normal syntax; few, if any, paraphasias; significant word-finding difficulty
5 = Halting, paraphasic, but more complete sentences; significant word-finding difficulty
4 = Agrammatic, effortful; verb-noun phrases, but only one or two propositional sentences
3 = Mostly unintelligible, low-volume mumbling; some single words
2 = Single words, often paraphasias, effortful and hesitant
1 = Recurrent, stereotypic utterances with meaningful intonation
0 = No words or short, meaningless utterances

Fluency Score ☐ (10)

Auditory Verbal Comprehension: Yes/No Questions

Directions: Say, **I'm going to ask you some questions. Answer yes or no.** Patients may respond verbally or gesturally.

Item	Score		Item	Score	
1. **Is your name Smith?**	1	0	6. **Is the door closed?**	1	0
2. **Is your name Brown?**	1	0	7. **Will paper burn in fire?**	1	0
3. **Is your name ______?** (Say the patient's last name.)	1	0	8. **Does March come before June?**	1	0
4. **Are the lights on in this room?**	1	0	9. **Do you eat a banana before you peel it?**	1	0
5. **Are you a doctor?**	1	0	10. **Is a horse larger than a dog?**	1	0

Auditory Verbal Comprehension Score ☐ (10)

Sequential Commands

Materials: Coin, piece of paper, pen

Directions: Place a coin, a piece of paper, and pen in front of the patient. Say, **See the coin, the paper, and the pen? I will ask you to point to them and do things with them. Are you ready?** Read each item.

Item	Score
1. **Point to the coin** (1) **and the pen** (1).	(2)
2. **Point with the pen** (1) **to the paper** (1).	(2)
3. **Point to the pen** (1) **with the paper** (1).	(2)
4. **Put the pen** (1) **on the paper** (1) **and turn over** (1) **the coin** (1).	(4)

Sequential Commands Score ☐ (10)

Repetition

Directions: Ask the patient to repeat the words listed below. Say, **Repeat these words. Say ____.** Subtract 1/2 point for each phonemic paraphasia or word order error.

Item	Score
1. **Bed**	(1)
2. **Window**	(1)
3. **Forty-five**	(1)
4. **The telephone is ringing.**	(2)
5. **No ifs, ands, or buts.**	(2)
6. **The quick brown fox jumps over the lazy dog.**	(3)

Repetition Score ☐ (10)

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Object Naming

Directions: Ask the patient to name objects in the room. Say, **What is this?** or **What is the name of this object?** Score 1/2 point for each correct response.

	Item	Score		Item	Score
1.	bed		11.	hair	
2.	telephone		12.	(arm) chair	
3.	pillow		13.	watch band	
4.	color of an article of clothing		14.	(coat) collar	
5.	elbow		15.	button	
6.	door		16.	light	
7.	magazine/calendar		17.	pen	
8.	shoulder		18.	(drinking) straw	
9.	glass/cup		19.	window/picture	
10.	key		20.	index finger	

Object Naming Score ☐ (10)

Bedside Aphasia Score

Sum the Content, Fluency, Auditory Verbal Comprehension, Sequential Commands, Repetition, and Object Naming scores. Divide the sum by 6; then multiply by 10 to obtain the Bedside Aphasia Score.

Sum of Scores ☐ ÷ 6

× 10

Bedside Aphasia Score ☐

Reading

Directions: Ask the patient to read a paragraph aloud from a magazine. Score up to 5 points for fluent, correct sentences. Deduct 1 point for each significant error or omission. Determine level of reading comprehension by asking questions. Score up to 5 additional points for reading comprehension.

Reading Score ☐ (10)

Writing

Directions: Place a piece of paper and a pen on the table and say,

Item	Score
1. **Write your name.**	(1)
2. **Write your address.**	(2)
3. **Write, "The telephone is ringing."**	(2)
4. Picture description: Ask the patient to write about a picture of some complexity from a magazine. Say, **Write about what is happening in the picture.** (5 points = complete description; 4 points = incomplete description; 3 points = essential items; 2 points = few items only; 1 point = some relevant words; 0 points = no meaningful response)	(5)

Writing Score ☐ (10)

Bedside Language Score

Sum the Content, Fluency, Auditory Verbal Comprehension, Sequential Commands, Repetition, Object Naming, Reading, and Writing scores. Divide the sum by 8; then multiply by 10 to obtain the Bedside Language Score.

Sum of Scores ☐ ÷ 8

× 10

Bedside Language Score ☐

Apraxia (Optional)

Directions: Say, **I'm going to ask you to do some things. Try to do them as well as you can.**

Item	Score
1. **Wave goodbye.**	(2)
2. **Close your eyes.**	(2)
3. **Pretend to blow out a match.**	(2)
4. **Pretend to use a toothbrush.**	(2)
5. **Pretend to knock at a door and open it.**	(2)

Apraxia Score ☐ (10)

Bedside Aphasia Classification Criteria

Directions: To determine the patient's Bedside Aphasia Classification, compare the patient's Fluency, Auditory Verbal Comprehension, and Repetition scores to the three scores associated with each aphasia type.

	Scores		
Aphasia Type	Fluency	Auditory Verbal Comprehension	Repetition
Global	<5	<4	<5
Broca's	<5	>3	<8
Isolation	<5	<4	>4
Transcortical Motor	<5	>3	>7
Wernicke's	>4	<7	<8
Transcortical Sensory	>4	<7	>7
Conduction	>4	>6	<7
Anomic	>4	>6	>6

Adapted with permission from Kertesz & Poole, 1974, *The Canadian Journal of*

APPENDIX D

TEST OF EVERYDAY ATTENTION: MAP SEARCH

APPENDIX E

TEST OF EVERYDAY ATTENTION: TELEPHONE SEARCH WHILE COUNTING

Elegant dining, intimate bar
BRENTLEY, The ....☐○ 387-1972
4 star, Hunter Inn restaurant
Briarwood Inn ....☐X 226-1274
Unbeatable rates
Castlewood Hotel ....✩○ 356-7604
CHARTWELL HOTEL ....○X 608-1192
"All the comforts of home and then some"
Cityfair Hotel ....X☐ 398-6081
Cornwall Manor Hotel ....☐✩ 292-4620
Mary and John Nicholas (proprietors)
Comberley House, The ....X○ 263-3891
"A tradition in the area"
Excellent service
COTTONWOOD MOTEL ....○☐ 433-1677
Buffet breakfast, HBO and
secretarial services
Cutter's Place Hotel ....✩☐ 359-9408
Near I - 95
DEVON Hotel.............................✩○ 389-3666
Dial-Inn Motel ....X○ 660-2693
Central booking, call 800-215-8899
Dominion Place ....☐☐ 353-9480
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Dressler Hotel ....✩○ 226-6221
Roof terrace bar & restaurant
Banquet facilities
Dreyer Hotel, The.....................X☐ 386-2663
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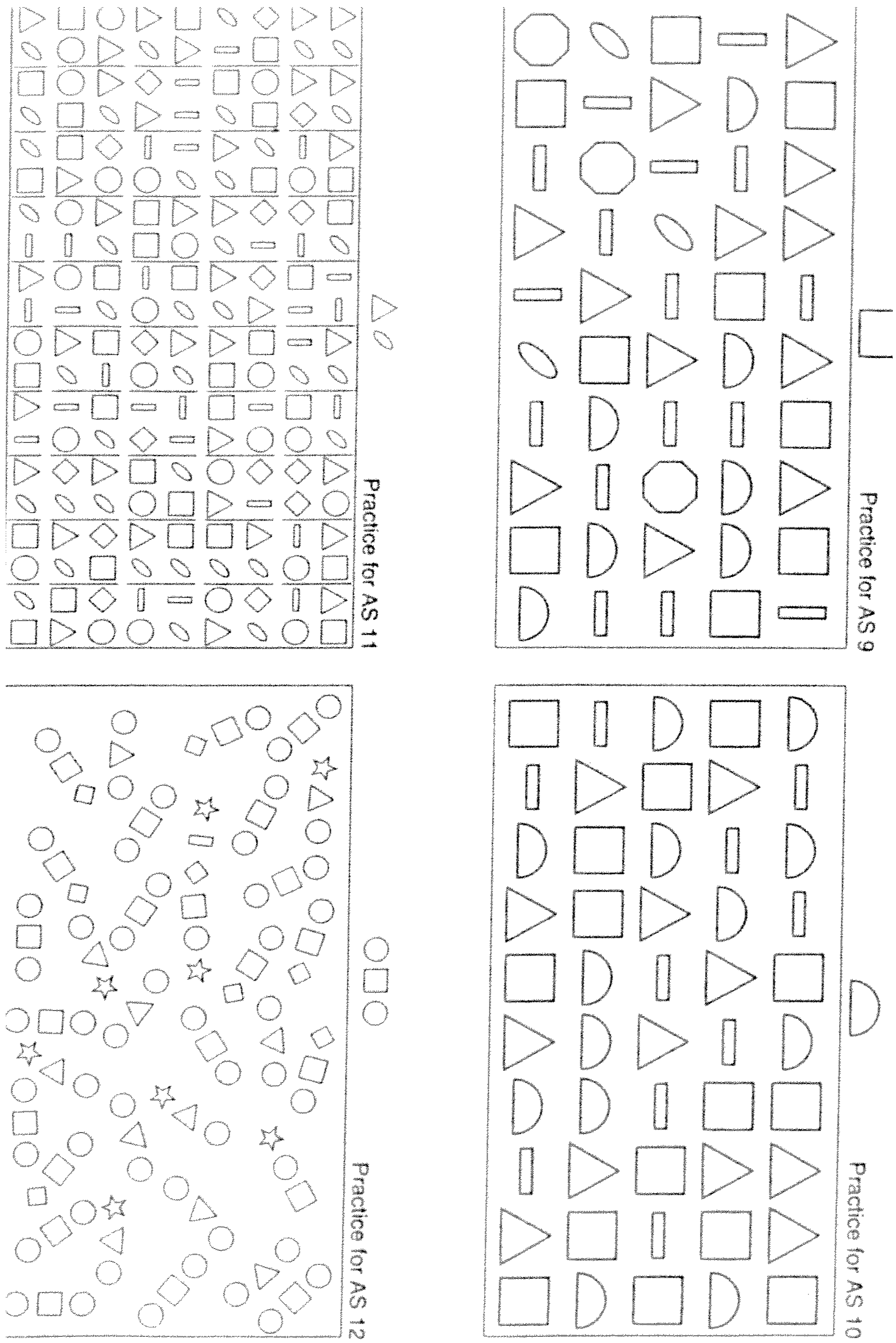
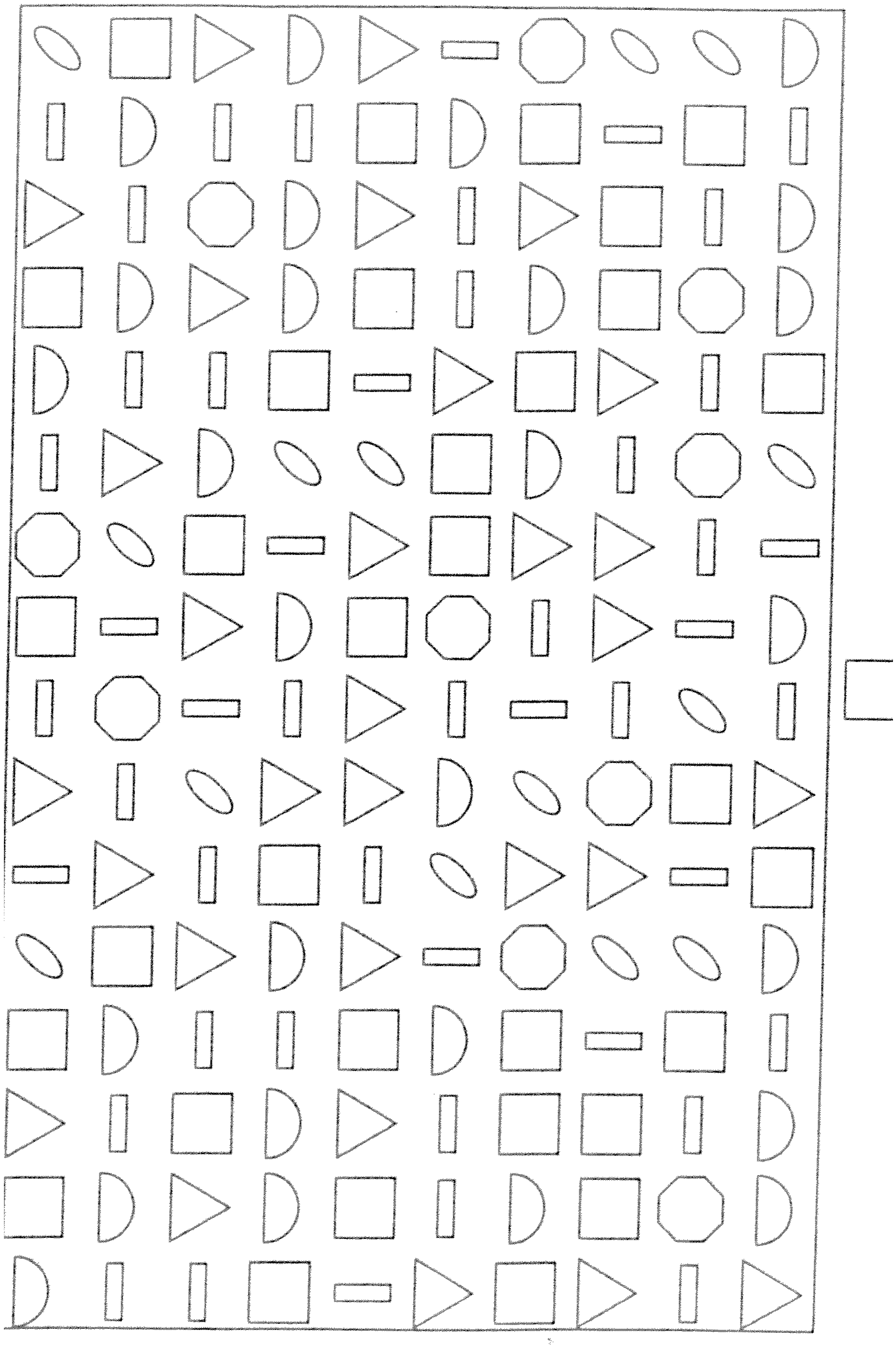
Driscoll Manor Hotel ....☐X 754-1995
"We care for our Guests"
Durreford House Hotel, The ...○✩ 342-3672
Echo Lodge ....✩✩ 337-1839
Eckerd Hall Hotel.....................X○ 538-1291

Hirst Castle Hotel ....XX 727-9694
HAMMOND Garden Hotel........○✩ 665-0955
Harkness Hotel ....☐✩ 552-7433
Hobb Hotel ....○X 389-8055
Outstanding facilities
Lo-group rates
Heatherwood Motel ....✩☐ 238-9366
Heated swimming pool
Children under 12 free!
High Point Hotel ....X✩ 336-6138
Comfort and economy
Close to Wilshire Center
Ideal Inn.....................................○X 377-1679
Bed & breakfast
Indian Pass Motel ....X☐ 332-7927
Modern, natural, woodland setting
Indigo Hotel...............................X✩ 285-4965
Jade Room Restaurant
Reasonable rates
Innsbrook House Hotel ....X☐ 384-4814
"Old world charm – new world facilities"
Inter-city Hotel ....○○ 529-9845
Inn on the Lake.........................X○ 567-9389
Jackson Manor ....X☐ 296-0845
"Ideal for city center visitors"
James Place Hotel....................○✩ 653-5004
Jeeves House, The...................✩○ 418-4930
Daily, weekly, monthly rates
JERGENS Hotel, The...............XX 245-5709
Tea Garden, Ballroom
JONAS HOTEL, The ....✩☐ 371-9485
(see advertisement on page 60)
Karter Mansions Hotel ....○X 627-4449
Large rooms, beautifully appointed

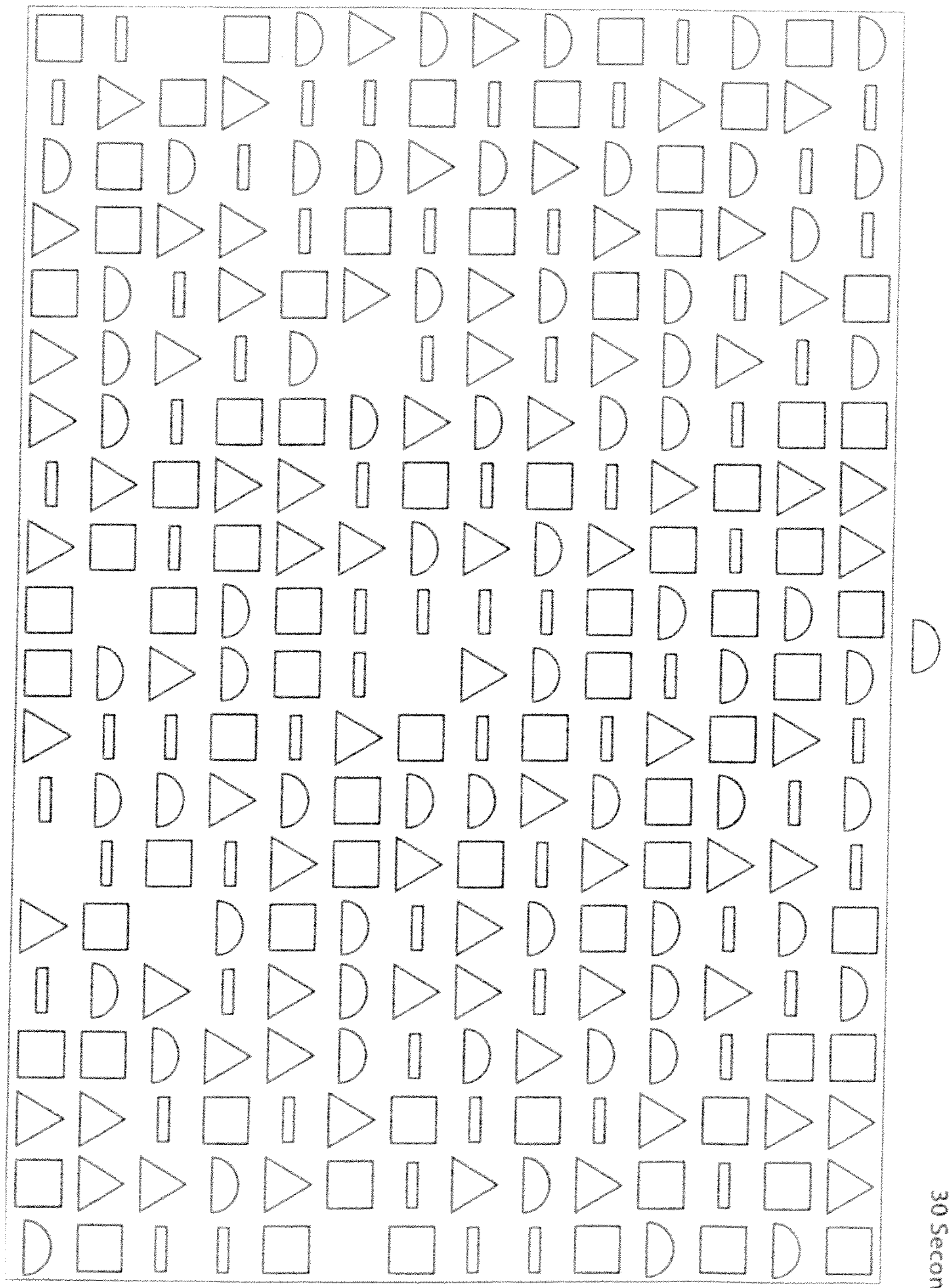
APPENDIX F

LEITER-R SUSTAINED ATTENTION

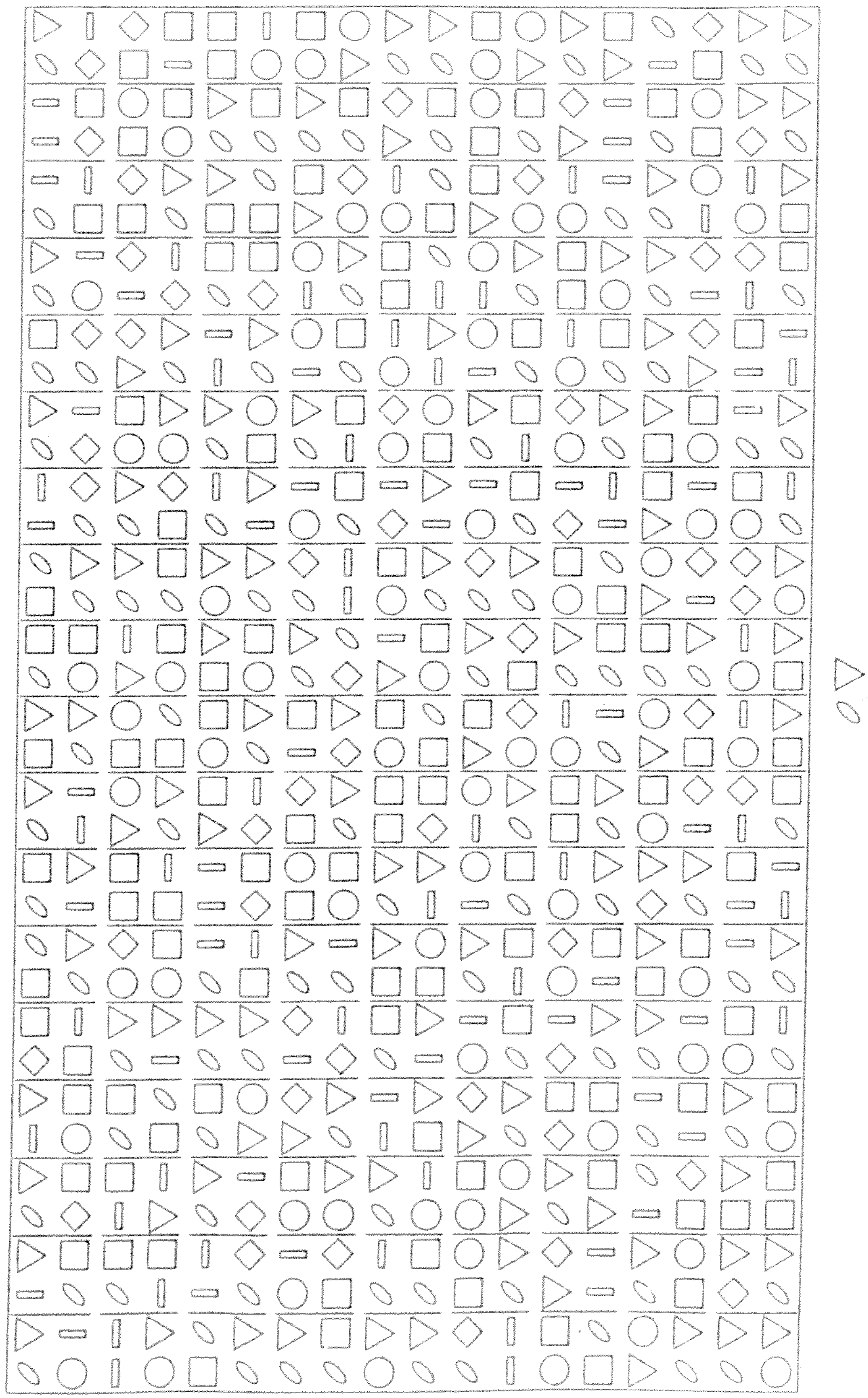


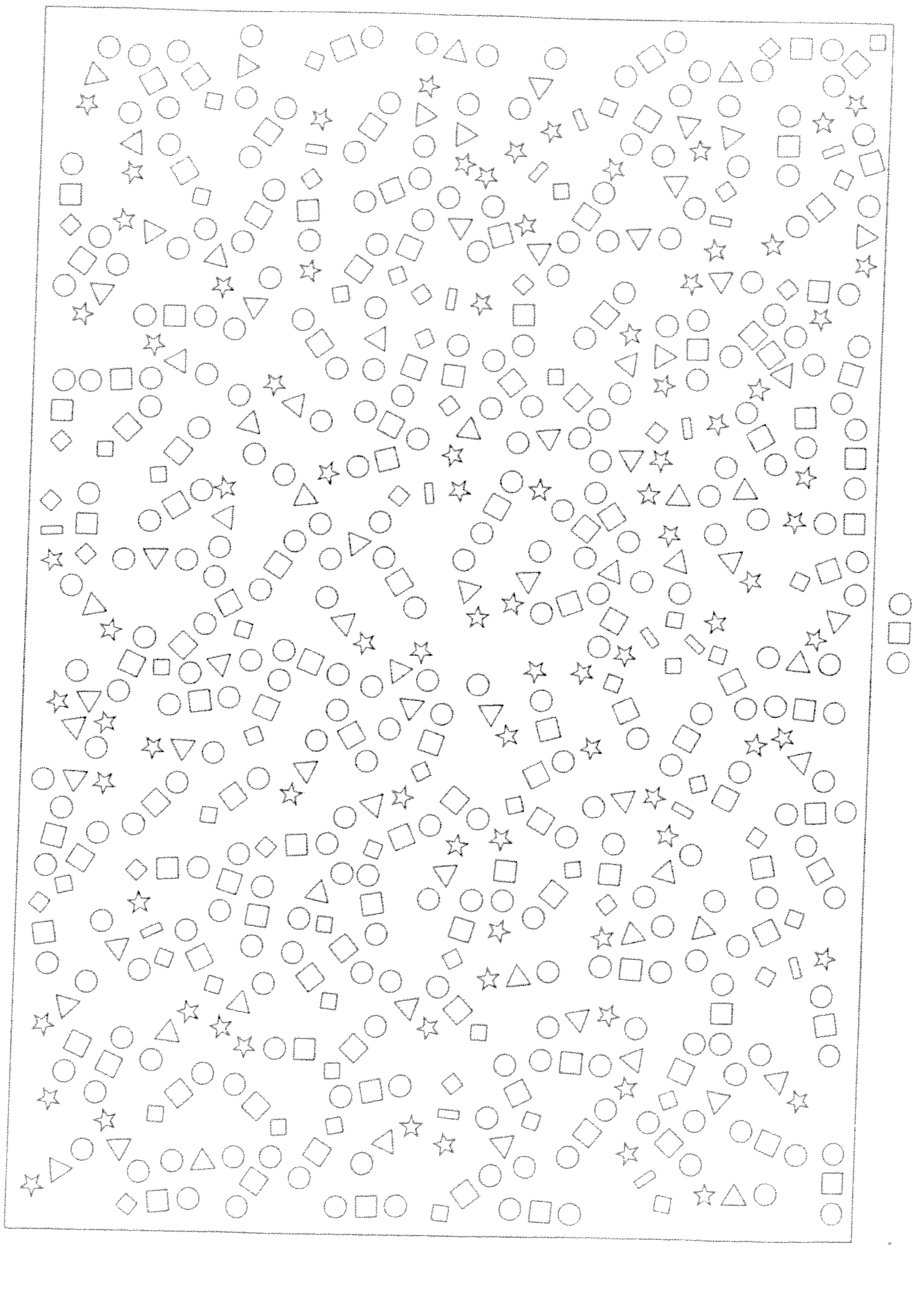


Part 2



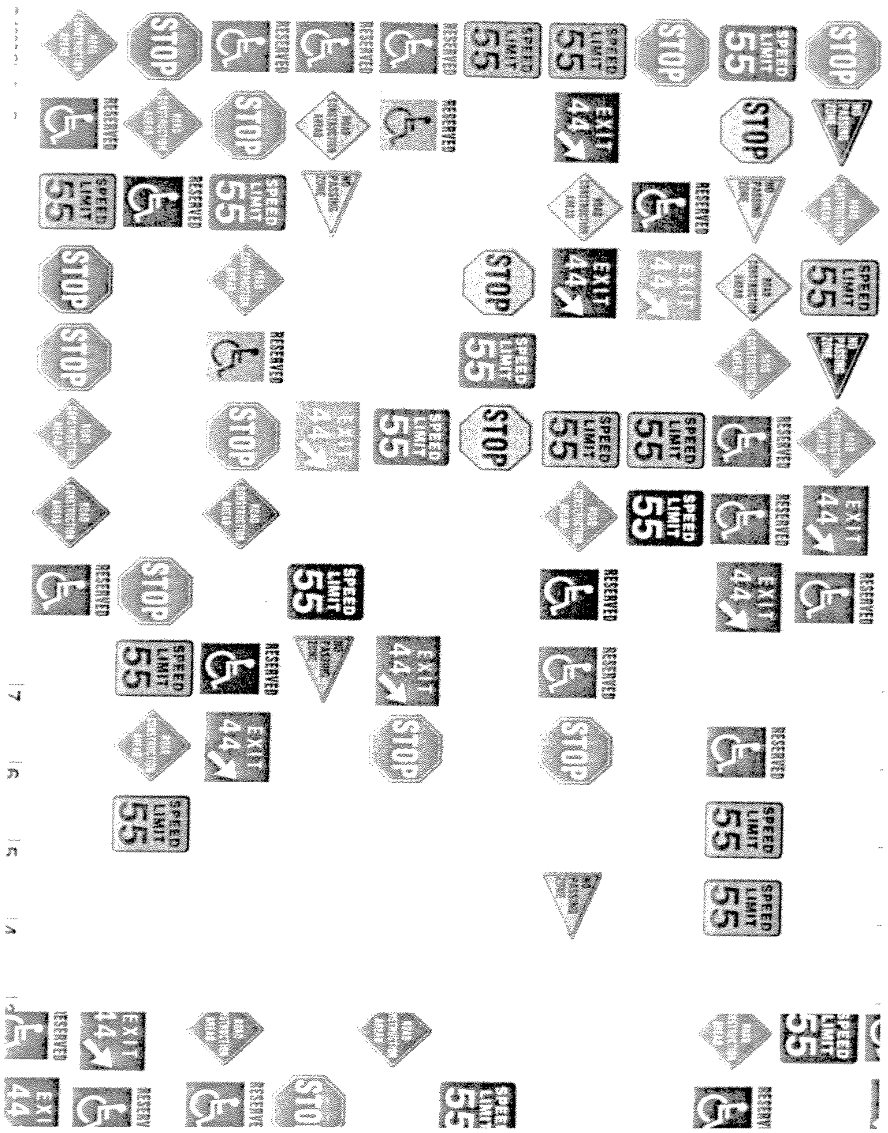
AS 10
30 Seconds

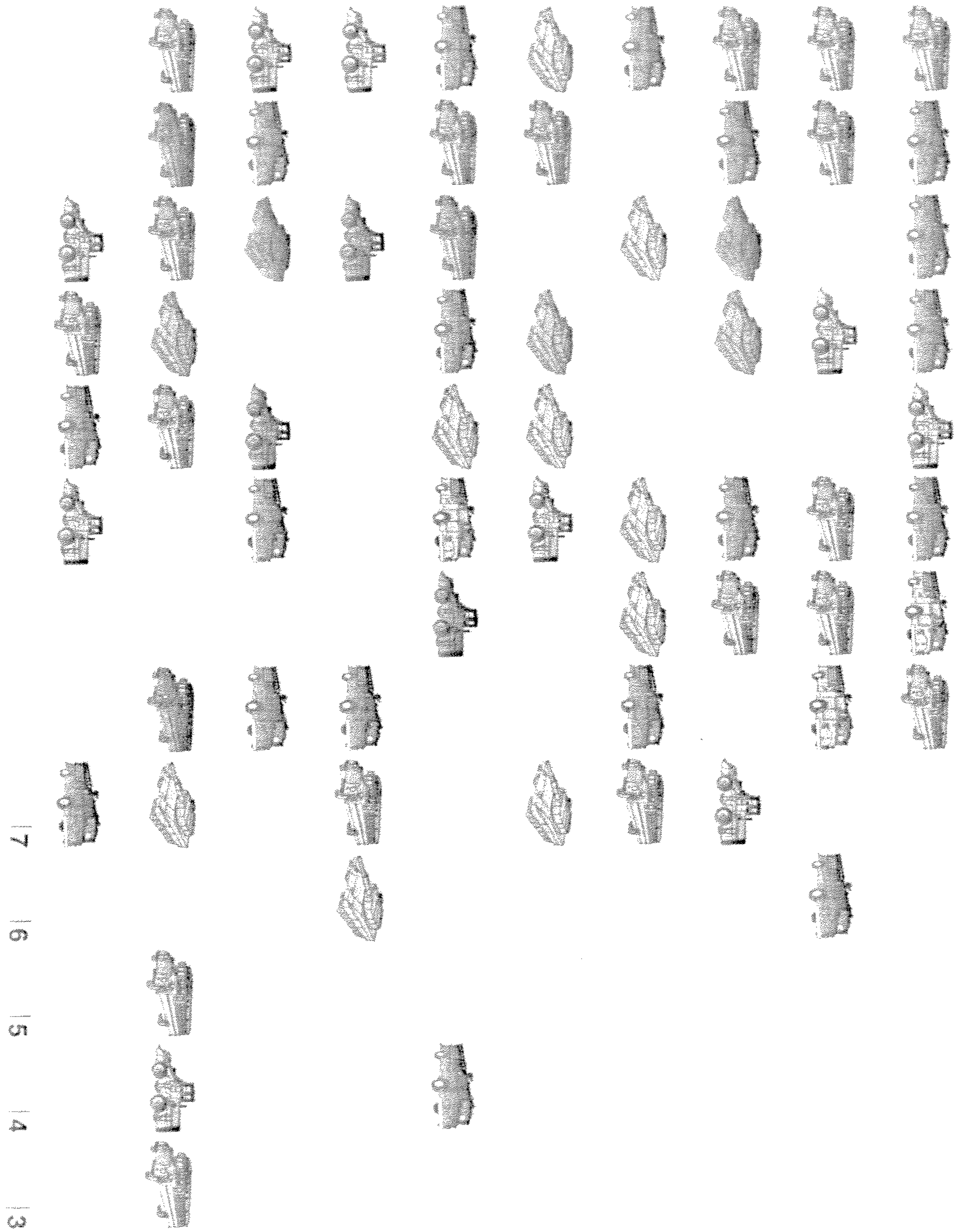




APPENDIX G

LEITER-R DIVIDED ATTENTION

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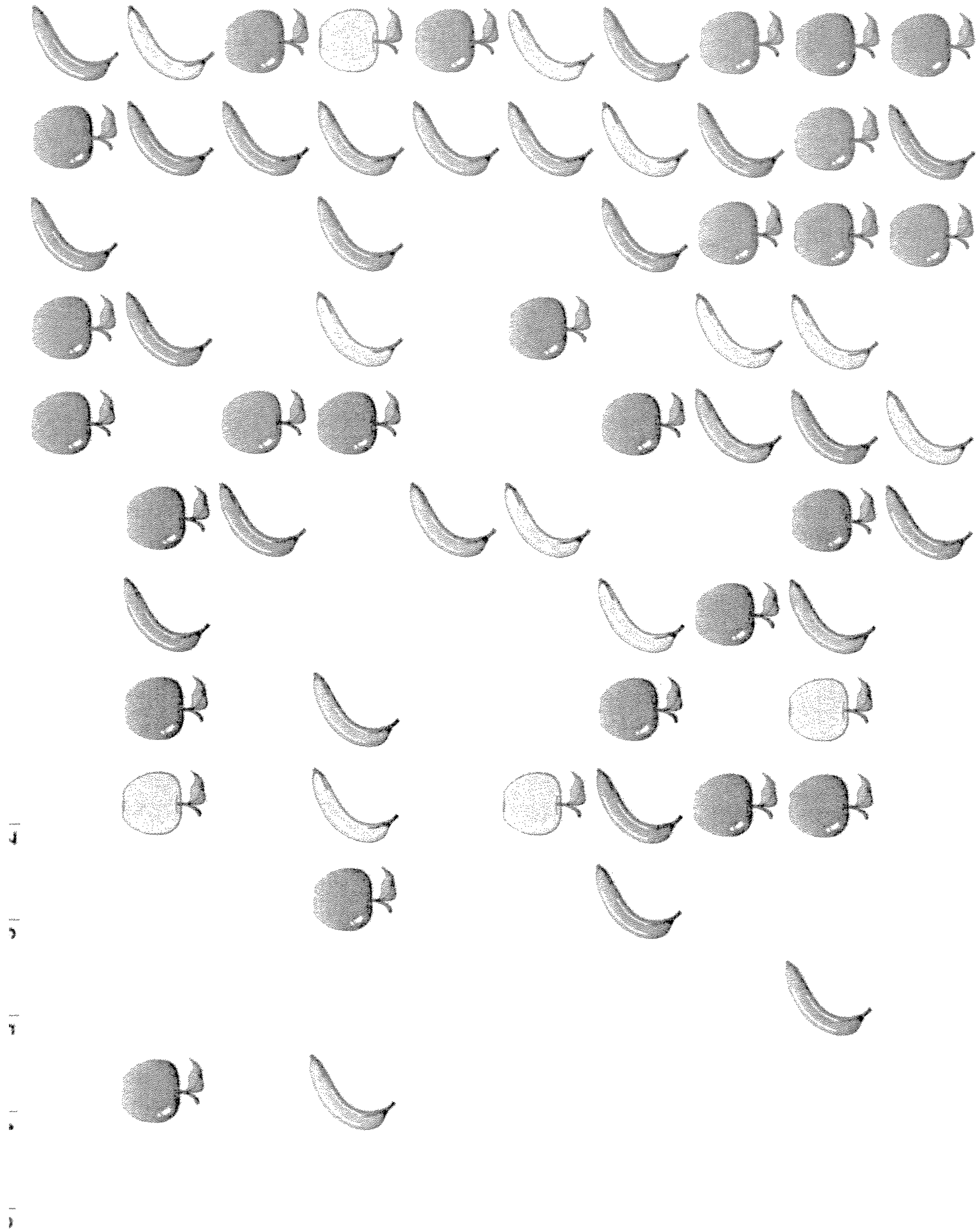
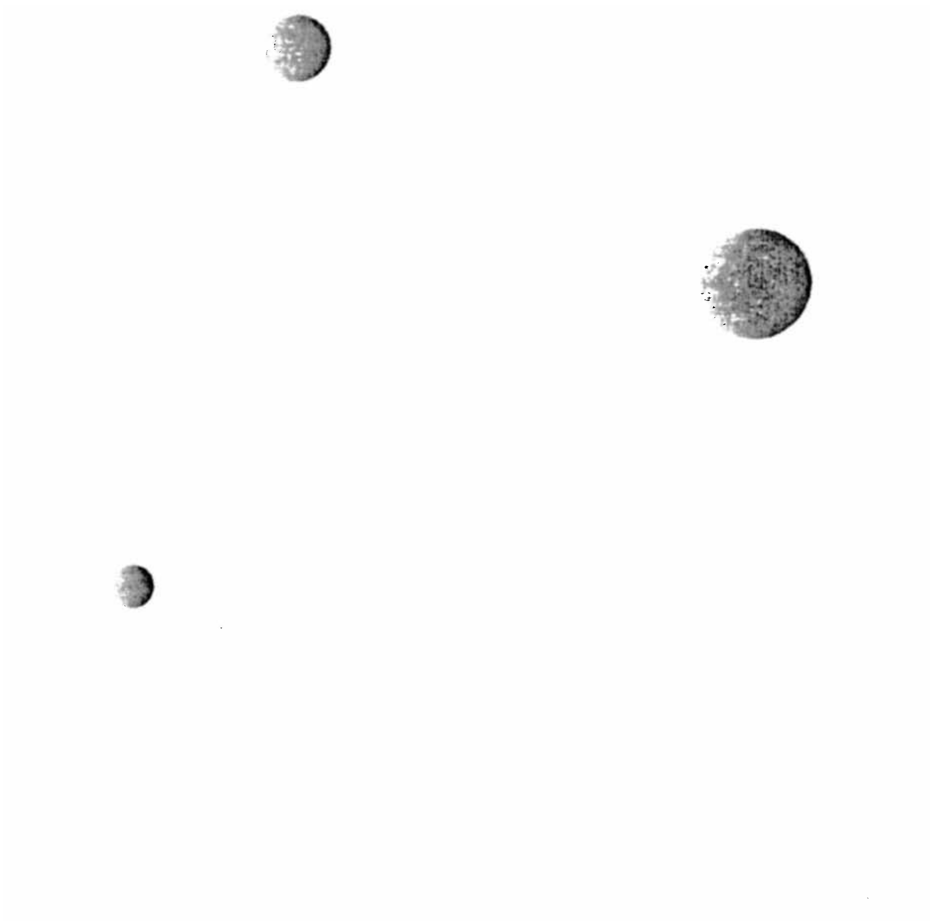
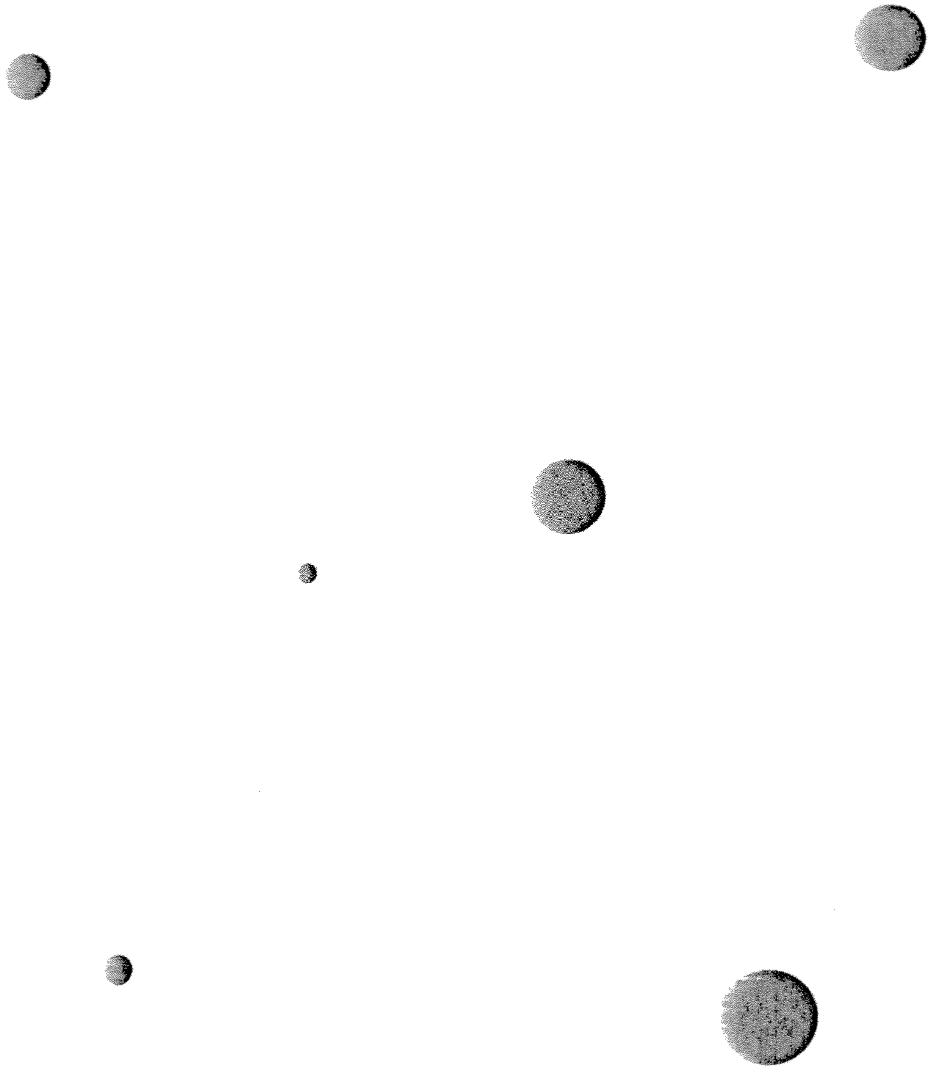
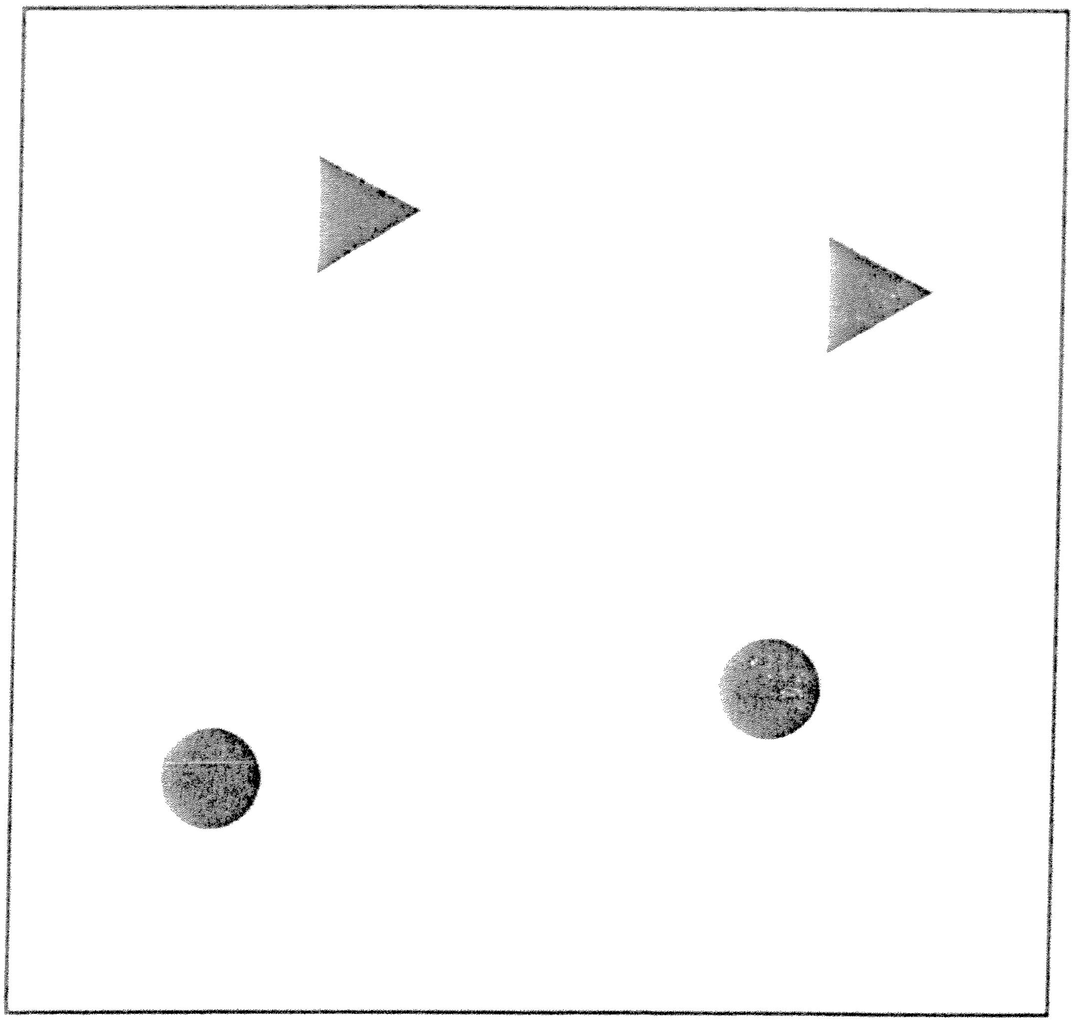


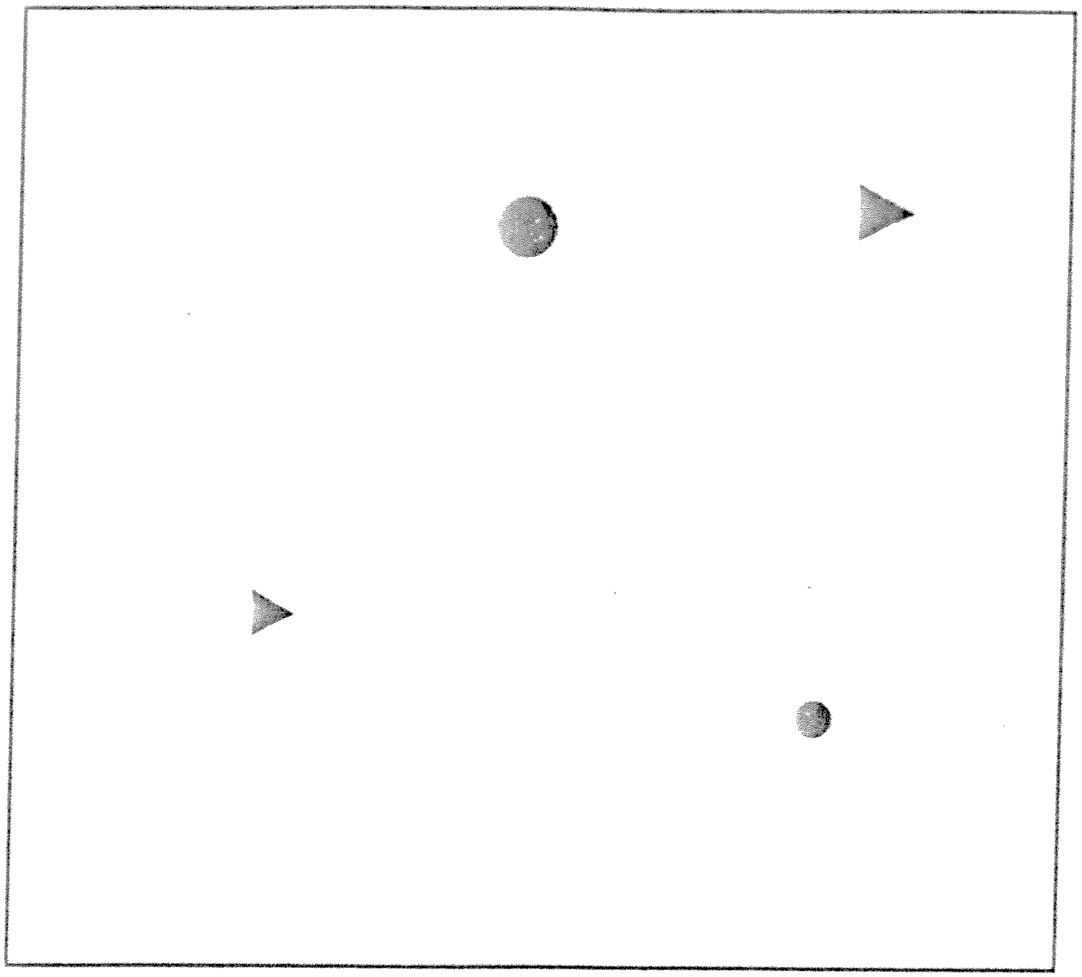
APPENDIX H

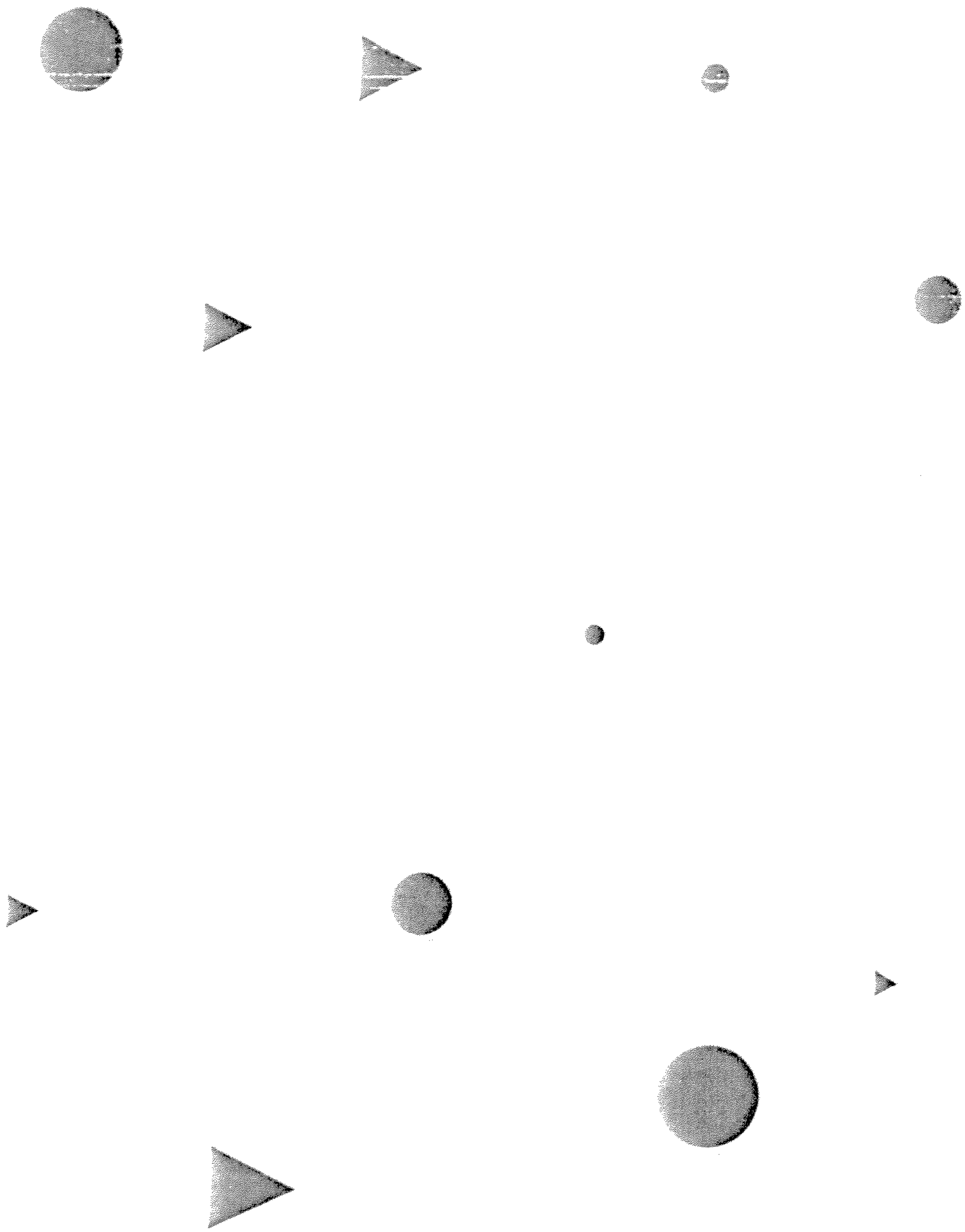
COGNITIVE LINGUISTIC QUICK TEST: SYMBOL TRAILS





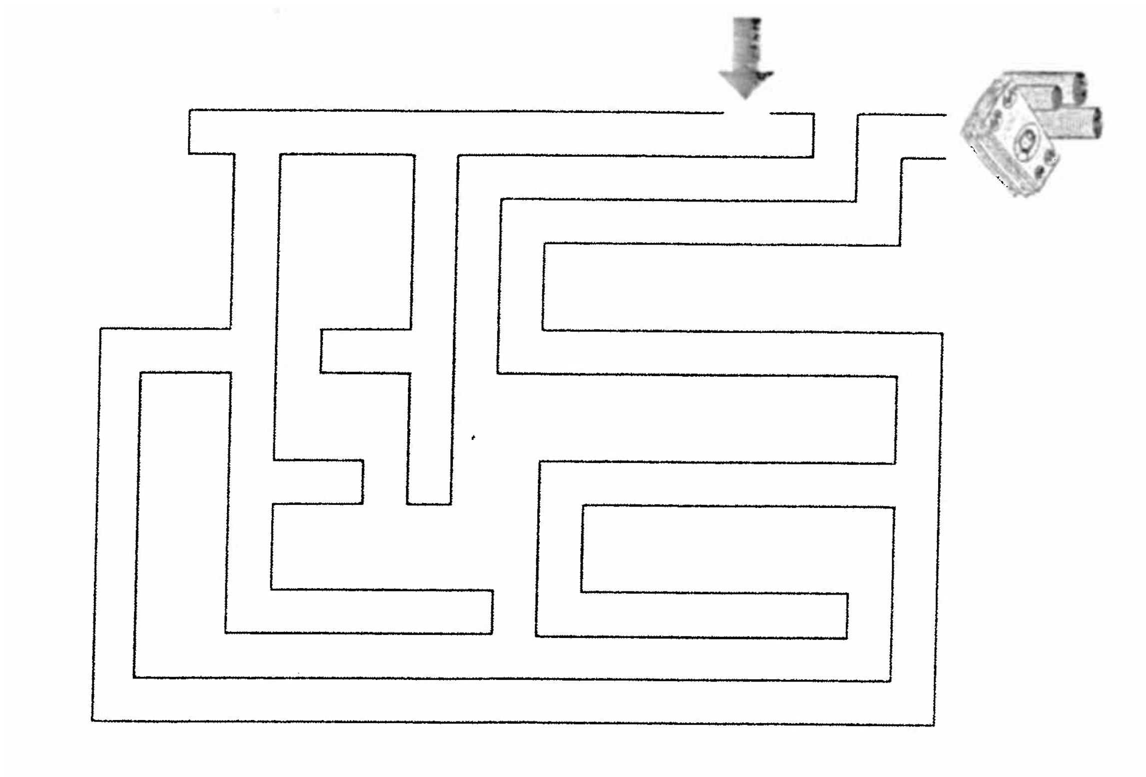


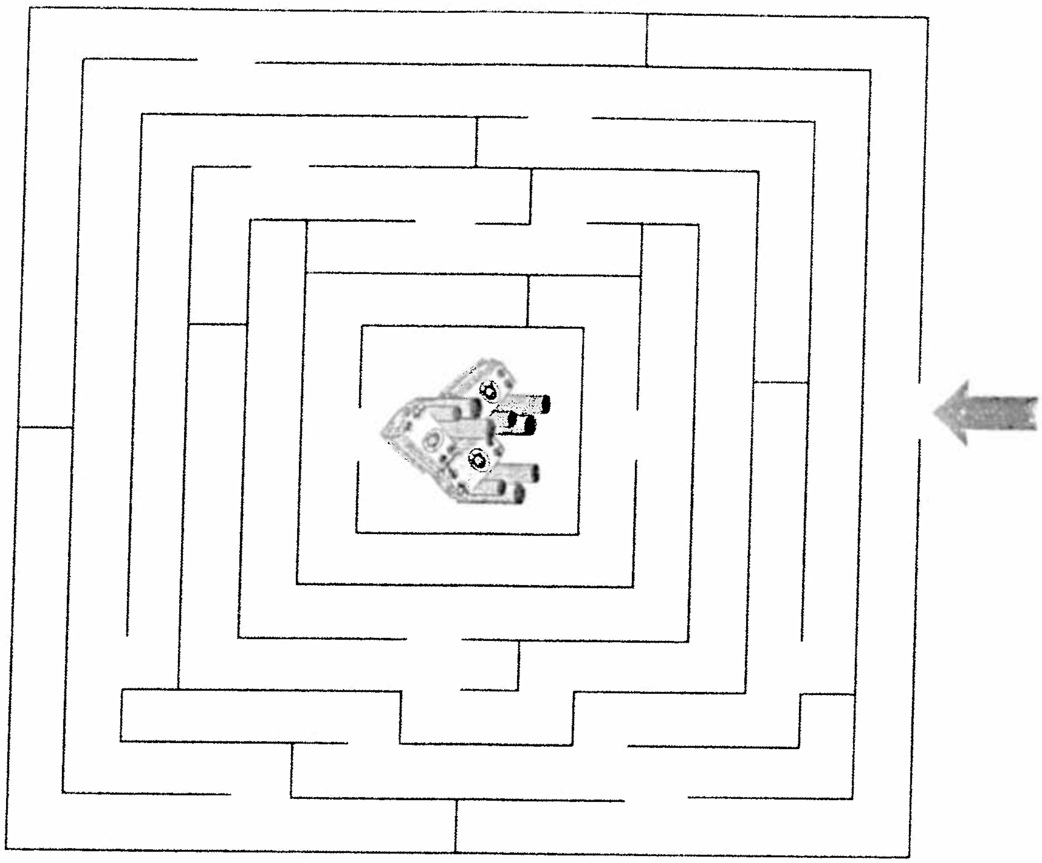




APPENDIX I

COGNITIVE LINGUISTIC QUICK TEST: MAZES





APPENDIX J

TIMELINE

In summary, upon completion, the study entailed the following procedures

1. January 2012-September 2013: Review of literature, preliminary outline for the study, prepare IRB and revise application
2. October 2013: CSU IRB approval received.
3. October 2013-April 2014: Participant recruitment. List of facilities within the Cleveland area compiled. Researcher spoke with representatives at Cleveland State University Speech and Hearing Clinic in order to collect some participants. Researcher made cold calls to facilities (nursing homes, hospitals, other clinics, aphasia support groups) in order to collect participants for study.
4. November 2013: Proposal hearing completed.
5. December 2013: Chapters 1-3 written.
6. January 2014-April 2014: Researcher traveled to different sites within the Cleveland area in order to test participants. Testing took approximately 90 minutes per person (participants were given breaks through out testing as needed).
7. April 2014-June 2014: Chapters 4-5 completed.
8. June-July 2014- Committee review of thesis. Defense completed.