Is a communication event stressful for individuals with expressive aphasia?

Emily E. Warner

University of New Hampshire, Durham

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IS A COMMUNICATION EVENT STRESSFUL FOR INDIVIDUALS WITH EXPRESSIVE APHASIA?

BY

EMILY E. WARNER
B.S., University of Connecticut, 2008

THESIS

Submitted to the University of New Hampshire
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This thesis has been examined and approved.

Barbara Prudhomme White, Ph.D.
Associate Professor
Department of Occupational Therapy
Thesis Director

Stephen Calculator, Ph.D.
Professor and Chair
Department of Communication Sciences and Disorders

Bryan Ness, Ph.D.
Assistant Professor
Department of Communication Sciences and Disorders

July 13, 2010
Date
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ABSTRACT

IS A COMMUNICATION EVENT STRESSFUL FOR INDIVIDUALS WITH EXPRESSIVE APHASIA?

By

Emily E. Warner

University of New Hampshire, September 2010

Objective: This study presents an effort to understand both stress perception and physiologic responses related to expressive communication in individuals with expressive aphasia, acquired as the result of a stroke.

Method: Eight individuals with aphasia and five age-matched, healthy controls participated in a public communication task. Salivary cortisol and perception of stress and mood was measured on one day at home as well as during the ordering task.

Results: A significant difference between groups was found in diurnal cortisol levels in the evening, as well as a non-significant trend in the afternoon measure. Individuals in the aphasia group perceived higher stress around the communication event without evidence of physiologic stress.

Conclusion: In this small pilot study, adults with aphasia perceived a communication event as stressful, but this perception was not supported physiologically. There was a physiological difference in diurnal cortisol expression in individuals with aphasia, suggesting possible higher, chronic daily stress.
CHAPTER I

IS A COMMUNICATION EVENT STRESSFUL FOR INDIVIDUALS WITH EXPRESSIVE APHASIA?

Introduction

Stress is a typical physiological response in human beings that can be triggered in many ways. Individuals often perceive subjective feelings of stress as emotions. For example, a person can perceive a threat, subsequently feel the emotion of fear and those emotions are then supported by activation of the physiological stress response. Therefore, one type of trigger of the physiological stress response may be emotional perceptions of events. Another type of trigger includes actual threats to a person’s safety. While the mechanisms for stress responding are similar in all humans, perceptions of what triggers the stress response vary across individuals. Some individuals have low trigger thresholds, causing the physiological stress mechanism to activate more frequently; while others have high trigger thresholds and a less active internal stress response.

An important consideration in relation to stress responding is that individuals affected by terminal illness, disease, or brain injury may exhibit increased stress levels perceptually and, therefore may be at higher risk for triggering the stress response physiologically (Laures-Gore, Heim & Hsu, 2007). For individuals who have suffered an acquired brain injury with concomitant expressive aphasia, communication is typically difficult due to a loss or impairment in language output. Expressive aphasia is
characterized by nonfluent, labored and halting speech. Initiation of speech is markedly
difficult for individuals with this type of aphasia (Davis, 2007). In the event an
individual suffers from a left hemisphere brain injury, resulting in expressive aphasia, it
could be inferred that communication events would evoke increased perceived and
physiological stress responses. These factors would cause one to assume that the
difficulty of communication events for this population are stress provoking and may be
an enduring source of stress. According to Doyle (2002), it is important to conduct a
comprehensive assessment of individuals with chronic disability, including survivors of
stroke. Assessment parameters should extend beyond disease severity and functional
status to include nonfatal health outcomes such as patient-reported judgments of physical,
mental, social and psychologic functioning. Doyle (2002) stresses the importance of
incorporating comprehensive assessment to intervention to ensure that outcome results in
an improvement in quality of life in social, psychologic, emotional and physical health
perspectives. Since chronic stress can implicate overall health, it would be beneficial to
identify those individuals who are experiencing chronic stress as a result of
communication difficulties.

**Stroke**

According to the American Stroke Foundation, stroke is the number one cause of
adult disability and the third leading cause of death in the United States
(www.americanstrokefoundation.org, 2010). According to the Center for Disease
Control and Prevention (http://www.cdc.gov/stroke/risk_factors.htm, 2010), some
prominent risk factors for stroke include, but are not limited to: high fat diet, high blood
pressure, high cholesterol, heart disease, obesity, diabetes, smoking, prior stroke or
transient ischemic attack, sickle cell disease, age, gender, prior heart attack, and prior stroke. Gender is considered a risk factor on account of a higher incidence of occlusive vascular disorders in men than women.

A stroke, or cerebrovascular accident (CVA), can disrupt blood flow to the brain in two ways. One type of stroke is an ischemic stroke, which is a blockage or occlusion of an arterial vessel that hinders the bloodstream from reaching areas of the brain. The blockage of the vessel can be caused by atherosclerosis, also referred to as high cholesterol. Atherosclerosis is a condition in which an artery wall thickens as the result of a buildup of fatty materials, such as cholesterol (Davis, 2007). Ischemic strokes can be broken down into two categories: thrombolic and embolic. A thrombosis occurs when fatty plaque accumulates on the artery wall at the site of occlusion; therefore, the sites of origin and occlusion are the same. In contrast, an embolism occurs when the platelets and fatty plaques break off one vessel wall and travel within the artery, until they become stuck in a smaller artery. Unlike the thrombolic stroke, the sites of origin and occlusion differ in an embolic ischemic stroke (Davis, 2007).

Hemorrhagic strokes are less common than ischemic, but can result in significant brain damage. A hemorrhagic stroke occurs when an arterial wall within the brain bursts, causing blood to accumulate around nearby brain tissue (Davis 2007). Hemorrhages are classified based on the location of the blood accumulation in the brain. An intracerebral hemorrhage occurs when blood accumulates in deep regions of the thalamus, internal capsule, or basal ganglia. A subarachnoid hemorrhage occurs in the pia-arachnoid space surrounding the brain and can be caused by a ruptured aneurysm near the Circle of Willis or an arteriovenous malformation (AVM) (Davis, 2007).
To prevent the onset of stroke, the CDC recommends making healthy choices, including: eating a healthy diet, maintaining a healthy weight, exercising, quitting smoking and limiting alcohol intake. It is also highly recommended to manage any current medical conditions. For example, it is important to continually check cholesterol levels, monitor blood pressure, manage diabetes, and take medications to monitor and treat present conditions (www.cdc.gov/stroke/prevention.htm, 2010).

Though many individuals survive cerebrovascular accidents, they may be faced with a plethora of impairments and challenges as they recover from the acute phase of brain injury. Due to the obstruction of blood flow to the brain during a stroke, many individuals can present with the following impairments: hemiparesis or hemiplegia, visual deficits including homonymous hemianopsia and left neglect, cognitive impairments such as impaired memory, attention, and executive functioning, and loss or impairment in language, also known as aphasia.

Aphasia

Aphasia, a loss or impairment in language function, is most commonly caused by stroke; however, stroke is not the only cause. Any disease or damage to the parts of the brain that control language can cause aphasia including: traumatic brain injury, dementia, illness and other progressive neurological disorders.

Currently, approximately 1 million people in the United States have aphasia and it is estimated that 80,000 individuals acquire aphasia each year (National Institute of Neurological Disorders and Stroke, 2008). Though aphasia does not manifest the same way in all individuals, it is broadly defined as a partial or complete impairment of language comprehension and expression caused by brain damage; most often the result of
a stroke. Damage occurs in the areas of the brain responsible for language. The type and severity of the language dysfunction depend on the precise location and extent of the damaged brain tissue. Though there are many different types of aphasia, some forms include difficulty expressing oneself through speech, trouble understanding speech, and problems with reading and writing (National Institute of Neurological Disorders and Stroke, 2008).

According to Davis’ *Aphasiology* (2007), the main syndromes of aphasia are differentiated according to three key areas: severity of the comprehension deficit, linguistic features of spontaneous verbal expression, and repetition ability compared to spontaneous expression. The syndromes, or types, of aphasia include: Broca’s aphasia or expressive aphasia, transcortical motor aphasia, Wernicke’s aphasia or receptive aphasia, transcortical sensory aphasia, anomic aphasia, conduction aphasia and global aphasia (Davis, 2007).

**Broca’s Aphasia**

Broca’s aphasia, also referred to as expressive aphasia, is considered a nonfluent aphasia. It is the result of damage to Broca’s area, or Brodmann area 44, which is located in the third frontal convolution anterior to the pre-central gyrus, or the primary motor strip. Because of the proximity to the primary motor strip, the individual with Broca’s aphasia also typically demonstrates a right hemiplegia and a mild right facial weakness. The dominant features of Broca’s aphasia are agrammatism and problems with sentence formulation. Auditory comprehension is slightly or moderately impaired. Expressive aphasia is characterized by nonfluent, labored and halting speech. Initiation of speech is difficult for individuals with this type of aphasia. The individual with this syndrome
usually speaks in short, fragmented phrases and thus has difficulty conveying thoughts through speech and writing. In addition, the individual may present with anomia, which is the most consistent feature of aphasia and one that Davis defines as a broad term for the problem of finding words (Davis, 2007).

A case study by Davis et al., (2008) found that Broca’s area is necessary for a number of language comprehension and production tasks. Results of a case study of an individual with hyperacute stroke to Broca’s area, revealed that decreased blood flow to Broca’s area resulted in: impaired comprehension and production of semantically reversible sentences, impaired spelling, impaired motor planning and programming of speech articulation, impaired grammatical sentence production and intact comprehension of semantically non-reversible sentences.

Due to these factors, it can be hypothesized that communication events are difficult and possibly stress-provoking for individuals with expressive aphasia. Thus, for the purpose of this study, we tested the physiological and behavioral responses of stress specific to this syndrome of aphasia. In particular, we measured the stress levels experienced by this population during an event that requires communication. Though the study described in this thesis focuses on individuals with expressive aphasia, it is important to understand and differentiate between the other syndromes of aphasia.

**Transcortical Motor Aphasia**

A syndrome of aphasia similar to Broca’s aphasia is transcortical motor aphasia (TMA). The feature that distinguishes TMA from Broca’s aphasia is that the individual’s repetition is more intact than would be expected based on difficulty with spontaneous speech production (Davis, 2007). While repetition is a marked impairment for
individuals with Broca’s aphasia, an individual with TMA may struggle to answer a question spontaneously, but can easily repeat back a fifteen word sentence without problems. Lesions with this type of aphasia are usually located in the frontal lobe, superior and anterior to Broca’s area (Davis, 2007).

**Wernicke’s Aphasia**

Wernicke’s aphasia, or receptive aphasia, is the most severe form of fluent aphasia. It is the result of damage to Wernicke’s area, or Brodmann area 22 and neighboring temporal and parietal regions. Individuals with Wernicke’s aphasia often have poor language comprehension, produce jargon, and lack awareness of semantic or neologistic paraphasias. They may require extra time to understand a spoken message and their speech may be difficult to follow as it is often comprised of made up, nonsense words.

**Transcortical Sensory Aphasia (TSA)**

Similar to the TMA and Broca’s aphasia distinction, transcortical sensory aphasia (TSA) presents like Wernicke’s aphasia. However, in TSA the ability to repeat is intact, whereas in Wernicke’s aphasia repetition is nearly impossible. The site of lesion in TSA is usually found at the temporo-occipital border, an area posterior to the common language area (Davis, 2007).

**Conduction Aphasia**

Conduction aphasia is a syndrome of aphasia characterized by significantly impaired repetition that is disproportionately severe relative to comprehension ability and spontaneous speech. In the case of conduction aphasia, it is thought that the arcuate fasciculus, a tract of association fibers, which connects Broca’s and Wernicke’s area, is
damaged. Thus, association tracts, which connect one cortical region within a hemisphere to another, are damaged.

**Anomic Aphasia**

Anomic aphasia is often the least severe form of aphasia and is characterized by slightly impaired comprehension and fluent, syntactically coherent utterances that are weakened by a word retrieval deficit. Individuals with this type of aphasia often engage in circumlocution while trying to think of names for objects. The specific site of damage in this syndrome of aphasia is somewhat elusive, but it is thought that damage to the posterior parieto-temporal juncture, or the angular gyrus, results in anomic aphasia. It is important to note that all individuals with aphasia present with anomic symptoms, or word retrieval difficulties of some kind; however, only some are considered to have the diagnosis of anomic aphasia.

**Global Aphasia**

Global aphasia is characterized by a severe depression of language ability in all modalities (Davis, 2007). Individuals with global aphasia have limited language comprehension as well as an inability to speak and write. Brain damage in this syndrome of aphasia is extensive and is thought to cover the entire perisylvian region including Broca’s and Wernicke’s areas as well as reach deep into white matter beneath the cortex. According to Davis, “a diagnosis of global aphasia should be reported after careful consideration, because it can diminish the likelihood of support for speech-language treatment” (Davis, 2007, p. 34).
**Stress**

Regardless of the presence or type of aphasia, brain injury can be stress provoking in itself and is likely exacerbated when communicative impairments are also present. Stress can be defined as a “psychological condition in which the individual perceives or experiences challenges to physical or emotional well-being as overwhelming their ability and resources for coping” (Gunnar & Quevedo, 2007, p. 147). Though stress can result from a perceived or experienced challenge, it also occurs naturally in every individual’s life and is beneficial to human stability. The stress response involves activation of neurobiological systems that preserve viability through allostasis. Allostasis is the process of achieving stability through physical or behavioral change (Gunnar & Quevedo, 2007). Allostatic changes serve vital functions by allowing individuals to react to environmental demands; therefore allostatic stress responses are both a necessary and beneficial part of everyday life. However, frequent neurobiological stress responses, termed “allostatic load”, increase the risk of physical and mental health problems (Gunnar & Quevedo, 2007).

According to Bauer, Quas and Boyce (2002), the systems responsible for maintaining stress responses can become dysregulated following frequent and excessive activation. Over time this dysregulation can contribute to the pathogenesis of disease including psychiatric disorders and behavioral precursors to the disorders. Despite this potential for disease and disorders as a result of chronic stress, individuals vary in their reactivity to stressful events. Therefore, individual differences in physiological responses to environmental challenges lead to differences in the corresponding allostatic load, and the subsequent susceptibility to health and behavior responses (Bauer, Quas & Boyce,
2002). In other words, variability in the stress response across individuals may deem some more susceptible to the effects of chronic stress than others.

In an article by Ellis, Jackson and Boyce (2006), the authors determined that individual differences in the reactivity of the stress response systems emerge through various forms of gene-environment interaction. Therefore, variations in stress reactivity can be explained, in some part as the result of individuals with different genotypes encountering different environments and/or responding differently to the same environments. A later study done by Ellis and Boyce (2008), found that developmental experience, heritable variation and individual differences in stress reactivity underlie broad variability in the link between stress and illness and the susceptibility to stressful challenge.

**Neuroanatomy and Physiology of Stress**

Though stress is often studied as a psychological construct, it is important to consider stress from a biological perspective. According to Ellis, Jackson and Boyce (2006), a complex, integrated system of central neural and peripheral neuroendocrine responses is designed to react to psychological stressors and prepare the organism for challenge or threat. In addition to an individual’s reactivity to stress, there is also what Ellis, Jackson and Boyce (2006) have deemed a human nature component of the stress response system. This component is comprised of the primary stress response axes, as well as their central and peripheral components, which have been conserved in the evolutionary history of vertebrate and mammalian species and appear early in phylogeny.

Two distinct but interrelated systems affects stress response in mammals: the sympathetic-adrenomedullary (SAM) system and the hypothalamic-pituitary-
adrenocortical (HPA) system. According to Bauer, Quas and Boyce, the SAM and HPA systems are anatomically and physiologically connected in the central nervous system. However, much remains to be determined about the nature of the systems’ coordination at both the physiological response level and the behavioral consequences of this coordination or disruption in the coordination (2002). A later study by Gunnar and Quevedo (2007) determined that regulation of both systems converges at the level of the hypothalamus, which integrates autonomic and endocrine functions with behavior. In addition, SAM and HPA integration involve cortico-limbic pathways, which constitute the neural substrate for emotion, motivation, emotional learning, and regulation.

**Sympathetic Adrenomedullary (SAM) axis**

The SAM system is a component of the sympathetic division of the autonomic nervous system, which is responsible for the fight/flight response. The SAM is a primary biological system controlling stress response. This system releases epinephrine (Epi AKA adrenaline) and some norepinephrine (NE), when stimulated. An increase in circulating epinephrine facilitates rapid mobilization of metabolic response and orchestration of the fight/flight response. This response causes increased heart rate and cardiac output, vasodilation in muscles and constriction of blood vessels in the skin and gut to ensure that blood is being pumped primarily to the brain and muscles. For quick responding, epinephrine stimulates glycogenolysis in the liver, resulting in increased serum levels of glucose and therefore energy to fuel defensive responses (Gunnar & Quevedo, 2007). According to Gunnar and Quevedo, the SAM works in conjunction with activation of the HPA arm of the mammalian stress system to support vigilance,
arousal and narrowing of attention in response to psychosocial threats (2007).

Ultimately, the SAM response is an immediate, rapid, acute response to a stressor.

**Hypothalamic-pituitary-adrenocortical (HPA) axis**

The hypothalamic-pituitary-adrenocortical (HPA) is responsible for sustaining the stress response for longer periods. This system produces glucocorticoids (GCs) hormones (cortisol), which take approximately 20-25 minutes to produce peak levels in saliva. This differs from the production of epinephrine and norepinephrine in the SAM, which are produced almost instantly (Gunnar & Quevedo, 2007). Although GCs are produced at a slower rate, they remain in the system for a longer period than the Epi and NE (Gunnar & Quevedo, 2007).

Appraisal of threats that lead to production of cortisol by the adrenal cortex begins with the release of corticotrophin-releasing hormone (CRH) in the nuclei of the hypothalamus. This, in turn, stimulates the release of adrenocorticotropic hormone (ACTH), the anterior pituitary hormone, which then signals the adrenal cortex to release cortisol. Cortisol is released within 10-30 minutes after a stressor, but its effects may not manifest for over an hour and may continue to exert effects on physiology and behavior for prolonged periods (Gunnar & Quevedo, 2007). HPA axis activation has been termed a “defeat reaction”, being most likely to occur among individuals who tend to perceive challenges as unpredictable or threatening or feel that they lack the resources to manage threats (Gunnar & Quevedo, 2007).

In healthy individuals, cortisol is released in pulses or surges throughout the day and night as part of a circadian cycle, as well as in response to both internal and external events (White & Mulligan, 2009). By 2-4 months in human infancy, a characteristic
pattern of cortisol expression emerges and appears similar to adult patterns by early childhood. According to White and Mulligan (2009), the circadian pattern shows peaks at four different times of the day. The first peak occurs immediately upon waking, followed by another peak within the first hour after waking. The third response in the pattern is shown by a decrease in cortisol in late afternoon/early evening and the final response is an even lower response at bedtime. Levels of cortisol generally increase to salient and challenging environmental events and return to baseline levels when challenges subside. According to Gunnar and Quevedo (2007), short-term, robust and well-orchestrated activations of the two systems tend to support adaptive functioning. However, over prolonged periods of chronic activation, the elevated GCs have suppressive effects and the wear and tear of frequent SAM responses can have detrimental effects on physical and mental health. Concurrently, a study by Wetherell et al., (2006) reports that, dysregulation of the SAM and HPA systems has been associated with a wide variety of conditions. The authors go on to discuss that HPA hyporeactivity has been linked to the development of autoimmune disorders. Hyperactivity of this system has been implicated in increased susceptibility to infectious disease, the development of mood disorders, cognitive dysfunction and a cluster of cardiovascular disease risk factors.

**How Stress is Measured**

Stress can be measured via elicitation of individual perceptions coupled with physiological biomarkers. Perceptions of stress can be measured with questionnaires and surveys that evoke individual responses. Physiological biomarkers of stress (cortisol) can be measured through blood, urine and saliva. Research is moving in the direction of
understanding stress by utilizing dynamic measures that capture context, perception of environment, person-capacities and physiologic responses when measuring stress (White, 2009). This is enhanced based on results of studies showing individuals with marked peaks in cortisol demonstrating greater levels of negative characteristics including, reduced self-esteem, harm avoidance and depressed mood when compared to individuals with typical cortisol responses (Wetherell et al., 2006).

A study by Kirschbaum and Hellhammer (1994), determined that the noninvasiveness and laboratory independence of sampling has allowed salivary cortisol to be measured at almost unlimited frequency under a wide variety of clinical and field settings. Kirschbaum and Hellhammer (1994) also found that cortisol enters saliva by passive diffusion, causing cortisol levels in saliva to be unaffected by salivary flow rate. Another benefit of measuring stress through salivary cortisol is that cortisol levels in saliva have been found to correlate with blood levels. This furthers the favorability of this method in field studies and natural environments as it is noninvasive and results are comparable to more invasive and technical methods (White & Mulligan, 2009).

Wetherell et al., (2006) concur with the findings that salivary cortisol is a widely used measure and accurate marker of HPA activity and is representative of cortisol concentrations in blood.

Kirschbaum and Hellhammer (1994) reviewed studies on interindividual differences of cortisol responses and determined genetic factors, sex differences and smoking, to be the three most prominent contributing factors. Genetic factors were found to be influential when intrapair correlation revealed a high resemblance of baseline cortisol levels and peak responses in monozygotic twins, as compared to dizygotic twins.
Four studies reviewed by Kirschbaum and Hellhammer (1994) showed consistent differences in stress response between healthy males and females. Males and females start at similar baseline levels; however, males were found to release 1.5-2 fold more cortisol than females following psychological stress. Finally, smoking was shown to affect stress response, as nicotine is a potent stimulator of the HPA axis. Therefore, repeated exposure to nicotine could lead to chronically elevated cortisol levels. When using salivary methods for cortisol measurement, these factors are important to consider during analysis of results.

Salivary cortisol can be obtained through various methods, including free drool or the use of cotton rolls or sponges ("salivette"). Once saliva samples are collected, they remain frozen until they are assayed for salivary cortisol levels. Samples are analyzed using substances that bind to the cortisol and give a value for the amount of cortisol present in the sample. White and Mulligan (2009) noted that these values should be compared with control samples from the study, as there has not yet been an effort to gather control sample values across studies to create one accessible normative database. However, when researchers are sure to collect baseline samples and daily circadian samples from each participant in the study, as well as control for how experimental samples are obtained, stored and analyzed, the comparisons between participants can be highly informative about potential stress response pattern differences (White & Mulligan, 2009).

**Stress and Aphasia**

Individuals with certain forms of aphasia may experience stress due to their difficulty with expression and/or comprehension of language. A review of the literature
revealed few studies that have delved into the link between physiologic stress responding and aphasia. However, a study by Laures-Gore, Heim and Hsu (2007) indicated the importance of attending to stress-related reactions in individuals with aphasia including anxiety, frustration, depression and social isolation. New research has supported this. A study by Hilari et al., (2010) found that aphasia was associated with high levels of distress at three months post stroke. Other findings from this study determined that individuals with high distress at baseline were seven times more likely to be distressed at six months. However, the authors suggest that current evidence regarding the long-term effects of aphasia on post stroke distress is conflicting.

Laures-Gore, Heim and Hsu (2007) state that despite reports of stress in individuals with aphasia, physiologic stress response associated with linguistic tasks in a social context has not been systematically studied in that population. Instead, current studies have focused on measuring general stress levels in the acute phase of traumatic brain injury. Those methods do not isolate individuals with expressive aphasia while in the context of linguistic tasks. Our approach isolates those variables as our methods measure stress levels both perceptually and physiologically in individuals with expressive aphasia during a naturalistic linguistic task.

The study by Laures-Gore, Heim and Hsu (2007) used salivary cortisol measures to compare physiologic and perceived stress levels between 15 individuals with aphasia and 15 peer-matched controls. Each participant was asked to participate in both a linguistic task involving speaking to an unfamiliar listener and a nonlinguistic task comprised of the Mirror Drawing Test (Starch, 1910). Following a 30-minute baseline period, salivary cortisol levels were taken by having the participants chew on a Salivette
at the beginning and end of each task and at 10 minute intervals throughout the post-task period. Participants were asked to rate their perceptions of stress using a rating scale of 1-7 (1 being calm and 7 being stressed). Results of this study found that the adults with aphasia perceived greater stress than did the healthy adults as evidenced by their responses on the stress rating scale. However, cortisol reactivity in the experimental group was not higher than the control group, in fact, the control group showed higher cortisol reactivity following the linguistic task than the aphasia group. Laures-Gore, Heim and Hsu (2007) attributed these findings to possible psychosocial variables that are important in modulating stress, habituation to HPA reactivity in the experimental group, or possible dysregulation in the HPA axis due to neurological changes poststroke.

Another consideration relative to the lack of cortisol reactivity in the individuals with aphasia is that the communication task selected by the authors in this study was not naturalistic. Therefore, it is important to consider that lab-based communication tasks may or may not elicit valid stress responses.

Another study by Laures-Gore and Hamilton (2007) examined coping resources and perceived stress in individuals with aphasia. Findings of this study revealed that the control group had significantly greater overall coping resources than the group with aphasia, and the control group perceived less stress than the group with aphasia.

**Psychosocial Factors Following Stroke**

A study by Thomas and Lincoln (2008) determined predictors of emotional distress following stroke to be namely depression and anxiety. The investigators recruited one hundred patients who were in a hospital at one month after stroke and assessed those individuals on measures of communication impairment, personal activities
of daily living, and emotional distress. Participants were then reassessed on the same measures six months after stroke. Findings from this study revealed that expressive communication impairment and dependence in personal activities of daily living were predictors of levels of distress (depression and anxiety) at one month post-stroke. The same factors were predictive of levels of distress six months after stroke. As mentioned before, hyperactivity of the HPA system can lead to mood disorders such as depression and anxiety. The results of this study revealed that expressive communication impairment is a predictor of levels of distress both one month post stroke and six months post stroke. This finding is pertinent to the current study, as our participant pool is comprised of individuals with expressive aphasia. The current study will analyze both physiologic and perceived stress levels in individuals with aphasia during a communication event, as compared with peer-matched controls.

**Stress and Traumatic Brain Injury**

Some studies have looked at the link between stress and individuals with traumatic brain injury. Individuals with traumatic brain injury may have diffuse cortical damage that could contribute to increased or decreased stress responses due to variables beyond communication, including deficits in awareness, attention, memory, and executive functioning. Therefore, stress responses in these individuals may not entirely correspond to individuals with left hemisphere brain injury. However, because there is limited research isolating the link between stress and aphasia, it is important to consider stress responding in a related population, such as those with traumatic brain injury. A review by Behan, Phillips, Thompson and Agha (2008) investigated the presence of neuroendocrine disorders after traumatic brain injury. Findings revealed adrenal (ACTH-
cortisol) insufficiency in the acute phase of TBI, also referred to as post-traumatic hypopituitarism (PTHP). The authors found abnormal cortisol response in 16% of the patients with TBI in the acute phase. This PTHP was also found to be persisting in long-term survivors of TBI. Behan et al. state, “...there is a broad agreement that PTHP is a common finding after head injury with an estimate of about 25% among long-term survivors” (2008, p. 755). The clinical consequences of PTHP include impaired recovery and rehabilitation, which adds significantly to the high morbidity seen in TBI and head injury. PTHP has also been associated with poor quality of life, abnormal body composition and adverse metabolic profile. The authors recommend an increase in PTHP screening programs as part of standard clinical care for patients with head injury.

Broomhall et al., (2009), investigated the course of acute stress disorder (ASD) in 1116 individuals following mild traumatic brain injury. Investigators found that 4.62% of individuals with MTBI experienced ASD; however, there were limitations to this study despite its large sample size. For example, symptoms of acute stress disorder often overlap with symptoms of postconcussive syndrome (PCS). Therefore, it is unknown whether the symptoms experienced by the individuals tested are truly due to ASD or correlated with PCS. However, it is still evident from the study that individuals following mild TBI experience the following symptoms: re-experiencing the event; avoidance of thoughts, feelings, people and places; impairments in arousal related to sleep disturbance, irritability and concentration problems; dissociative symptoms such as loss of interest, detachment, restricted affect, and reduced awareness; feelings of guilt, distress and impaired social functioning. All of the above symptoms are predictive of chronic stress if they continue to persist beyond the acute stage.
Results of a study done by Tanriverdi, et al (2006) revealed that out of 52 TBI patients, 9.8% had adrenocorticotropic hormone (ACTH) deficiency in the acute phase of recovery and 19.2% had ACTH deficiency one-year post trauma. Consequently, a study by Savaridas, Andrews and Harris (2004) investigated cortisol dynamics following acute severe brain injury and found lower total cortisol measurements than would be expected following trauma. Their findings revealed total cortisol measurements that were within the accepted reference range for healthy non-stressed individuals. The authors conclude that patients with more severe injuries have impaired cortisol secretion because central nervous system activation is an integral part of cortisol regulation. In addition, a study by Bay, Hagerty, Williams and Kirsch (2005) used salivary cortisol to determine cortisol levels in 53 post-TBI survivors within 2 years of their original injury, living in the community. The results of this study revealed typical circadian rhythms of cortisol and no sustained abnormal cortisol levels despite evidence of chronic stress and depression. The apparent lack of measured relationship between cortisol and chronic stress in this population could be due to a number of factors including: habituation to stress, pharmacological management of stress by way of antidepressants, and high levels of social support.

**Conclusion**

A review of the research has indicated that individuals with aphasia perceive higher levels of stress following communication. Therefore, it is imperative that speech-language pathologists and other members of the rehabilitation team put forth efforts to increase coping resources as a means to lessen the interfering effects of stress on language skills, overall health and quality of life in individuals with aphasia.
To the best of our knowledge, this study is among the first to measure salivary cortisol response in individuals with expressive aphasia during a naturalistic communication event. As mentioned before, cortisol is produced by the hypothalamic-pituitary-adrenocortical system as both a natural part of human physiology and also in response to stressful or arousing events that require sustained alertness and adaptive behavior. It takes approximately 20-25 minutes for this system to produce peak levels of cortisol that are detectable in saliva; however, they remain in the system for a longer period of time. The delayed release of cortisol following a stressor continues to exert effects on physiology and behavior for prolonged periods. Because the cortisol response is not one that is invoked over acute or “trivial” events, this system is more likely to be activated in response to extreme stressors that are perceived to require some degree of sustained activity on the part of the individual. In other words, cortisol is produced over baseline levels when the perception of threat requires action beyond just a few minutes, and is therefore not trivial.

Overall, current research has focused on stress levels in individuals with traumatic brain injury, but has not adequately delved into the relationship between stress and left hemisphere brain injury. In addition, little is known about how heightened stress levels impact communication in individuals with aphasia or its impact on an individual’s ability to regain communication skills post stroke. These areas that are lacking justify the need for further investigation of physiologic stress reactivity in relation to aphasia and possible consequences of such.

The purposes of the current study were to compare whether there existed group differences between perceived stress levels and physiological indicators of stress in
participants with expressive aphasia and healthy controls without expressive aphasia in both naturalistic settings and during a naturalistic communication event. The investigators of the current study hypothesize that individuals with expressive aphasia will perceive higher stress levels and show an increase in cortisol reactivity following a naturalistic linguistic task as compared with peer-matched controls. Further the researchers hypothesize that those individuals with expressive aphasia who perceive higher stress would also show higher levels of cortisol in their diurnal patterns.
CHAPTER II

PROCEDURES

Purpose

The purpose of this study is twofold: first, to compare whether there is a correlation between perceived stress levels and physiological indicators of stress in participants with expressive aphasia; and second, to determine whether a difference is evident between the stress levels of participants with expressive aphasia and matched controls without expressive aphasia during a communication event. Specific research objectives were: to determine whether baseline patterns of cortisol differ in daily expression between individuals with expressive aphasia and matched controls without expressive aphasia; and to compare physiological patterns and perceived responses to a potentially stressful communication event between those with expressive aphasia and controls.

Participant Description

Convenience sampling was used to enroll 13 subjects in this study. The intended target was 20 subjects, 10 with expressive aphasia and 10 matched controls; however, we were only able to recruit 13 participants. Participants ranged in age from 40 to 75. Of these participants, 8 individuals comprised the experimental group and were recruited from the Krempel's Center (previously known as the Stepping Stones program) for individuals with brain injury in Portsmouth, NH. The remaining five participants were recruited through word of mouth and made up the control group. These participants were
healthy individuals without any prior health concerns, as evidenced by responses to a health data form. In addition, they lacked communication difficulties or expressive aphasia, as evidenced by fluency of spontaneous speech production and self-report of no history of stroke on demographic information sheet.

Demographics of all participants are included in table 1 of appendix A. There were no significant differences between the average ages of the participants. An independent samples t-test was run using SPSS 17, which revealed a mean age of 62 for the aphasia group (n = 8) and a mean age of 56 for the control group (n = 5). There were 2 females in the control group and none in the aphasia group. Participants were selected by convenience and we were able to recruit two females in the aphasia group; however, they were unable to complete the study. Due to financial limitations we elected to recruit only five control participants to control costs of salivary analyses. In healthy individuals, diurnal patterns tend to be expressed within the typical ranges; therefore, we felt that fewer control participants would provide an adequate means for comparison. Matching was based on gender and age.

Experimental group participants were screened for the existence of expressive aphasia by administering the Western Aphasia Battery as part of the inclusion process. Control group participants followed the same methodology with two exceptions. They were not screened for aphasia using the WAB and they did not complete a survey called the Communicative Effectiveness and Stress Rating Scale (CEASRS); a survey specific to individuals with aphasia.
Methods

Upon recruitment, all participants were asked to complete a consent form. Some pertinent information was given in the consent form, including number and type of questionnaires to be completed, information about saliva collection and an overview of the trip to McDonald’s. However, participants were blind to the topic of this study. Participants were initially told that the study aimed to measure behavioral responses following communication. All participants were debriefed once data collection was complete. The purpose for blinding participants to the rationale of the study was to avoid any potential bias regarding their perceptions of stress and effort while ordering food in a public setting. At the end of the study, participants were debriefed by the principal investigator and able to ask questions. At this time, participants were provided the choice to withdraw from the study if they felt so inclined.

The experimental group participants were screened using the Western Aphasia Battery-Revised approximately one week before the communication event. The test takes approximately one hour to administer. Clinicians use this test to sensitively and reliably diagnose the type and severity of the aphasia. The WAB-R was chosen for its ability to distinguish type and severity of aphasia via analysis of scores on separate subtests including: spontaneous speech, auditory verbal comprehension, repetition and naming and word finding. According to the WAB-R, a classification of Broca’s Aphasia is consistent with the following score breakdown: fluency (spontaneous speech) score <5, auditory verbal comprehension score >3, repetition score <8, naming and word finding score <9 (see table 2 in appendix A for score breakdown).

Following administration of the WAB to experimental group participants, all
members of the experimental group responded to a demographic information sheet (see appendix table 1) and a health data sheet. Overall health was determined based on participant-report on a scale of 1 to 10, 1 being not at all healthy and 10 being extremely healthy. Participants then responded to the following surveys.

The *Perceived Stress Scale* (PSS) (Cohen, 1983) is a 10-item self-report instrument that measures perceived stress levels on a five-point scale. The Perceived Stress Scale is a tallied questionnaire containing ten questions. Four questions are reversed scored (4, 5, 7, 8). The sum of all ten provides the total stress score. This tool has been used in a variety of studies and has fairly robust psychometric analyses. Normative values were collected by Cohen (1988) based on prior research. The test is normed for gender, age (18 to 65) and diverse populations.

*The Life Orientation Test-Revised* (LOT-R) (Scheier & Carver, 1992) is a 10-item self-report instrument that measures optimism and pessimism on a five point agree or disagree scale. The Life Orientation Test-Revised asks ten questions. Of the ten, three questions (1, 4, 10) tally an optimism score and three (3, 7, 9) tally for a pessimism score. The remaining four questions are fillers. This tool has been used in a variety of studies investigating optimism, pessimism, anxiety, self-esteem and health (Scheier, Carver & Bridges, 1994; Moyer et al., 2009; Kubzansky, L., Sparrow, D., Vokonas, P. & Kawachi, I., 2001) Normative values have been collected based on prior research by Scheier, Carver & Bridges (1994), Ey, et al., (2005), and Herzberg, Glaesmer & Hoyer (2006).

*Communicative Effectiveness and Stress Rating Scale* (CEASRS) (Carozza, Olea-Santos, & Abesamis, 2005) was only given to those participants with aphasia. This is a 14-item self-report instrument used to assess the role of stress and communicative
effectiveness as perceived by individuals' with aphasia. The Communicative Effectiveness and Stress Rating Scale uses a five-point pictorial Likert scale to rate both stress and communicative effectiveness on 14 situational prompts (e.g.: availing services in public). Pictorial scales for stress are assigned a ranking from relaxed to extremely stressed. Pictorial scales for communicative effectiveness are assigned a ranking from completely effective to totally ineffective. Those we then assigned numbers (1-5) to provide a numeric rank to compare with other results on SPSS. This is a pilot tool for which psychometric data are currently being collected as per personal communication with Dr. Linda Carozza, Therese Abesamis and Tricia Olea-Santos.

The control group completed the above questionnaires at McDonald’s on the day of the event prior to ordering food (see appendix A table 3). Saliva was collected from all participants using the free drool protocol. This protocol involves pooling spit in the mouth, swishing it around to bring it to the front of the mouth and then spitting it through a straw into a cryotube used for collecting saliva samples. In the event that participants in the experimental group reported coexisting apraxia, hindering their ability to provide passive drool through a straw, they used the same protocol, but were provided sponges to absorb saliva in the mouth. One participant required sponges

**Procedures**

In order to determine the participants’ stress levels during communicative events, participants traveled to McDonald’s where they ordered food. Compensation in the form of $10 gift certificates to McDonald’s was provided for the purpose of ordering food.

Participants in the experimental group traveled either independently, with a caregiver or as is customary to Krempel’s Center. The control group participants traveled
to McDonald’s independently. Upon arriving at the McDonald’s, a baseline saliva sample was obtained in order to determine baseline level and to orient the participants to the saliva collection protocol. Ordering food was hypothesized to evoke stress in the participants with expressive aphasia, as they were put in a situation in which they had to communicate with an unfamiliar person, without support from a therapist or family member. Once the participants ordered food, we obtained saliva samples 10 and 20 minutes after the supposed stressful event. All participants were taken to McDonald’s at the same time; for example, collection at the McDonald’s occurred between the hours of noon and 1pm. Attending at this time allowed us to control the environmental setting that each participant experienced, by going to McDonald’s when busy lunchtime crowds were present. Further, maintaining the same time of day allowed for cortisol samples to be taken during the same time period within the natural diurnal rhythm of each individual’s cortisol expression. Prior to the communication event, we consulted with McDonald’s to delay the delivery of the food after ordering for 20 minutes, to ensure that the salivary samples were untainted by food and drink and that participant meals were hot upon receipt. Following collection of both saliva samples, the participants were able to consume what they ordered.

For the diurnal samples, participants were sent home with four vials to collect saliva samples at home during the course of one day. They were asked to provide a saliva sample upon waking, 30-45 minutes after waking, at 4 PM, and between 7 and 8 PM. This provided an analysis of baseline stress hormone expression on an average day. In order to ensure that this part of the study was completed, participants were sent home with a handout reminding them of what times they need to provide saliva samples.
Participants were also consulted as to which day of the week this part of the procedure would be easiest to complete and were provided a reminder phone call.

All diurnal salivary samples were stored in participants' home refrigerators until brought to the university. McDonald's salivary samples were collected by the principal investigator and stored in a cooler until brought to the university where they were placed in an -80°C freezer. Samples were stored there until they were batched for analysis without thawing, and replaced in the freezer until assayed. Samples were thawed, centrifuged and then assayed for cortisol using an Expanded Range High-Sensitivity Salivary Cortisol Enzyme Immunoassay (Salimetrics, State College, PA), following a standardized lab protocol (http://www.salimetrics.com/products_and_services/salivary_assays/). The intra-assay coefficient of variation was less than 15% on all samples, or within 0.03 μg/dL \((x10^{-1})\) on duplicate samples. Intra-assay coefficients of variation were within 10%, based on calculations of control samples placed within sample batches.
CHAPTER III

RESULTS

All statistical analyses used to analyze the data were completed with SPSS 17. In order to analyze whether there were differences between groups on the self-report measures, including perceived stress (PSS), mood orientation (LOT-R; optimism/pessimism), overall health rating and stress perception during communication, we ran a non-parametric version of a one-way ANOVA (Kruskal-Wallis test) on five variable comparisons and found a significant difference between groups on perceptions of communication stress. We used a non-parametric test due to the small sample size and the rank ordered nature of two variables (overall health and communication stress). The Kruskal-Wallis test revealed only one significant difference in variables by group. Participants in the aphasia group reported more stress around communication events, as would be expected \( (\hat{P} = 6.09 \ (1), \ p = .01) \) (See appendix table 4).

Investigation of responses of the CEASRS (for only individuals with aphasia) revealed that perceptions of stress in these persons varied from context to context, and were not related to mood orientation. Stress perceptions regarding specific events did not appear to correlate with overall stress perception nor with communication effectiveness. Analysis of the correlation between communicative effectiveness and stress perceptions in the aphasia group revealed that, at least in this small sample, only a few individuals with aphasia perceived stress as a possible detriment to their perceptions of their ability to communicate effectively.
All cortisol data were log-transformed as is customary when using physiologic data. Log-transformation is done in order to normalize the data for parametric statistical analyses (Gunnar & White, 2001). A graph was developed to visually represent individual diurnal cortisol patterns of each participant at each time point (see appendix table 5). This graphical representation caused us to remove participant 31’s (control group) diurnal cortisol responses. When compared with the rest of the data, participant 31’s diurnal cortisol pattern appeared to be an extreme outlier beyond normal human values. This could have been caused from a sample tainted by food particles (milk, cheese, etc) or blood that may have been present in the saliva, elevating the sample. Another graph was then developed to visually represent all diurnal cortisol patterns, with the exception of participant 31 (see appendix table 6).

An independent samples $t$ test was performed to analyze group differences of diurnal salivary cortisol at each different time point. A $t$ test was used because this is interval data and only four comparisons were analyzed. We do acknowledge that this analysis should be viewed with caution, as this pilot data has been generated from a small sample. Only one time point showed significant differences by group ($t = -3.29$ (9), $p = .009$). This was in the evening sample (between 7 and 8 pm). The mean cortisol values for the aphasia group were lower than the control group values. There was a non-significant trend for group differences in the 4 pm sample ($t = -2.30$ (6) $p = .06$). This may be because only 8 participants between both the control group and the aphasia group had measurable afternoon cortisol samples (see appendix table 7).

The sampling at the communication event (McDonald’s) only yielded complete data on three control participants and four participants with aphasia. Comparisons on this
very small data set did not support that the aphasia group’s stress perception was enough
to elicit cortisol, an indicator of significant threat. Indeed, no differences in cortisol
expression were identified between groups during the communication event, and no
individuals showed an increase in cortisol. However, because of the small sample,
analyses should be considered as exploratory only.
CHAPTER IV

DISCUSSION

In the current study, we assessed stress in individuals with aphasia and in healthy controls through exploration of diurnal cortisol patterns and cortisol reactivity during a naturalistic communication event. Additionally, we investigated whether cortisol reactivity during these tasks were associated with perceptions of stress in adults with aphasia and healthy controls. Salivary cortisol was measured at four time points during the course of one day, to explore diurnal patterns, as well as following a naturalistic communication event. Perceptions of stress were scaled using formal surveys.

We hypothesized that individuals with aphasia would perceive higher stress overall and possibly show higher physiologic diurnal stress patterns. We identified an interesting difference between these two measures. Differences between groups were not identified on the perceived stress scale; individuals with aphasia did not appear to perceive any higher life stress than control participants. However, there is some suggestion that physiologically, individuals with aphasia may be experiencing higher stress levels. When analyzed, all participants displayed normal patterns of cortisol expression over the course of one day, except for one individual whose samples were extremely high. This individual’s samples may have been tainted and were eliminated from analyses. However, comparisons of diurnal patterns between groups yielded a significant difference in cortisol at the evening time point. This finding of increased cortisol activity in the evening, when otherwise it is expected to be low, provides preliminary suggestion
that individuals with aphasia may have a higher physiologic stress load. However, there were only eight participants in the aphasia group and these findings should be viewed tentatively. This supports the need for further research in this area.

We also hypothesized that individuals with aphasia would perceive higher stress and present with higher physiologic stress response during the communication event than matched control participants. Comparisons of stress perception differences between groups revealed that, in fact, the aphasia group members did perceive higher stress around communication events than did the control group. Though there was a significant difference between groups related to stress perception around communication, this did not appear to be supported physiologically. Comparisons between groups revealed that, in this small sample, the group with aphasia did not show significant differences in cortisol following the communication event as compared with matched controls. Despite differing methodologies, our results are somewhat consistent with the Laures-Gore, Heim & Hsu (2007) study. That study did not explore diurnal cortisol patterns; however, findings from that study revealed that aphasia group participants, after participating in a lab-based linguistic task, also did not present with an increased cortisol response when compared with healthy controls. In addition, the findings of the study by Laures-Gore, Heim and Hsu (2007) did not find higher perceptions of stress in individuals with aphasia when compared with matched controls. This may differ from our findings of increased perceived stress in aphasia group participants because the communication event in the current study was more naturalistic.

The current study was designed to examine both cortisol and perceptions of stress following a believed stressful event for persons with aphasia, as well to examine baseline
levels of cortisol on a typical day. Baseline samples are often used to assess an individuals’ overall stress “load” in order to make inferences if they may be under conditions of enduring stress. Conceptually, it appeared plausible that persons with aphasia would have an added stress burden if much of their daily living were experienced with limited communication ability. Further, we hypothesized that persons with aphasia would be additionally burdened or stressed by having to order food in a public setting, without supports.

The reasons for not identifying any differences in cortisol might lie in the fact that individuals with aphasia in reality do not experience stress either in anticipating speaking, or actually speaking, in public. However, this did not make sense to our clinical experience, as it has been reported, both anecdotally and documented by research that individuals with aphasia feel anxious and “stressed” by communication expectations (Doyle, 2007; Laures-Gore, Heim & Hsu, 2007). This made us consider what else may have potentially affected the results.

A possible explanation for the lack of differences in cortisol expression between groups is that the communication event did not possess an adequate degree of perceived threat, a variable that is highly associated with large increases in cortisol. Participants also may have felt a sense of control as the locations of both McDonald’s restaurants were within participants’ local communities, and were venues that they had previously visited. These factors are supported by the experimental group perceptions of overall stress on the PSS, which suggested they did not perceive themselves as stressed.

It is also important to consider the possibility of habituation to repetitive stressors. Aphasia group participants of this study averaged seven years from date of injury;
therefore, it is possible that these individuals have been repeatedly exposed to the stressor of communication, which has resulted in habituation of the HPA axis. Additionally, all participants with aphasia in the study were extremely well supported and had received extensive speech, occupational and physical therapy during the course of recovery. All participants were also members of Krempel’s Center, which has a unique and pervasive support system in place for individuals who are brain injury survivors and no longer have the option of traditional therapy.

The fact that the participants in the current study were well supported may imply resilience to some degree. Resilience is defined as the individual’s capacity for coping successfully and functioning competently despite experiencing chronic stress or adversity or following exposure to prolonged or severe trauma (Cicchetti & Rogosch, 2009). In this article by Cicchetti & Rogosch (2009) the concept of resilience is investigated in the context of maltreated children. The authors explained that resilience is a complex and intriguing phenomena of human development, in which the pathways to resilience are influenced in part by a complex, integrated matrix including: genetics and neurobiology, the individual's level of biological and psychological organization, experience, social context, timing of adverse events and experiences, and developmental history. If the social context component of the resilience matrix is isolated, the fact that the participants in this study were well supported may aid in their resilience to living with the sequelae from brain injury including, for some, expressive aphasia.

These characteristics of the aphasia participants were underestimated by the researchers and posed significant limitations to the objectives of the study. This speaks to the method of subject selection utilized in this study. Perhaps a broader recruitment
strategy would have elicited subjects with shorter time post date of injury and less-supports and strategies in place to enhance communication.

In this current study, we only used a neuroendocrine measure in response to the event; therefore, changes in other physiological stress response systems, including alterations in blood pressure, heart rate and perspiration rate are unknown for this sample. In addition, the saliva samples were not analyzed for alpha amylase, the more acute stress response. The researchers opted not to test this response, as there is limited research available regarding the assay procedures for this hormone. However, had this hormone been assayed and analyzed, the findings may have indicated higher acute stress responses in the experimental group. However, by perception, none in the aphasia group reported significant perceptions of stress making increased alpha amylase unlikely.

In addition, there are possible confounding variables associated with data collection and analysis. As mentioned before, saliva sampling at the communication event (McDonald’s) yielded complete data for salivary cortisol analysis on only a small number of participants. This could have been the result of inadequate amounts of saliva collected from participants to yield adequate analysis.

**Implications for Future Research**

Findings from this study speak not only to the need for basic research in this area, related to whether individuals with aphasia are likely to be stressed by perception as well as by physiology, but also that this measure could be used as a way to document intervention effectiveness. While it is impossible to know from this study, we surmise that our findings, suggesting no significant stress in individuals with aphasia, is a degree of how effective intervention has been in supporting these individuals. We believe that
future studies will benefit from this pilot by enrolling individuals earlier in their
disability, just as they begin interventions. By so doing, researchers may be able to
document both the validity of chronic stress early in the recovery phase of brain injury
with aphasia, as well as the possible mediating effects of intervention on chronic stress. It
may also be possible to study individuals who are less well supported and compare their
results. Larger numbers of participants, if possible to obtain, would also strengthen future
work in this area.
APPENDICES
### Table 1 Demographic Information

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<th>Stroke</th>
<th>Date of Injury</th>
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<td>Aphasia Quotient (out of 100)</td>
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<td>4.8</td>
<td>8.4</td>
<td>62.6</td>
<td>Broca’s Aphasia mod</td>
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</tr>
<tr>
<td>5</td>
<td>3</td>
<td>5.05</td>
<td>4.2</td>
<td>3.7</td>
<td>31.9</td>
<td>Broca’s Aphasia severe</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>15</td>
<td>8.7</td>
<td>3.4</td>
<td>8.3</td>
<td>70.8</td>
<td>Broca’s Aphasia mod</td>
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</tr>
<tr>
<td>7</td>
<td>11</td>
<td>10</td>
<td>9.6</td>
<td>8.2</td>
<td>77.6</td>
<td>Broca’s Aphasia mild</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>12</td>
<td>9.5</td>
<td>8.6</td>
<td>7.5</td>
<td>75.2</td>
<td>Broca’s Aphasia mild-mod</td>
<td></td>
</tr>
</tbody>
</table>

* 2 participants with mild Broca’s aphasia
* 1 participant with mild-moderate Broca’s aphasia
* 3 participants with moderate Broca’s aphasia
* 2 participants with severe Broca’s aphasia
Table 3  PSS, LOT-R scores and Overall Health rating (all participants)

<table>
<thead>
<tr>
<th>Participant #</th>
<th>PSS Score</th>
<th>LOT-R Optimism score</th>
<th>LOT-R Pessimism score</th>
<th>Overall Health Rating (out of 10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>9</td>
<td>12</td>
<td>7</td>
<td>8</td>
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<tr>
<td>32</td>
<td>14</td>
<td>12</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>33</td>
<td>17</td>
<td>9</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>34</td>
<td>5</td>
<td>13</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>35</td>
<td>9</td>
<td>15</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>1</td>
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<td>9</td>
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<td>6</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>11</td>
<td>9</td>
<td>10</td>
</tr>
<tr>
<td>4</td>
<td>10</td>
<td>13</td>
<td>6</td>
<td>8</td>
</tr>
<tr>
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<td>9</td>
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<tr>
<td>8</td>
<td>12</td>
<td>12</td>
<td>7</td>
<td>7</td>
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</table>
Table 4 Kruskal-Wallis test – between group perceptions

<table>
<thead>
<tr>
<th></th>
<th>Groups*</th>
<th>N</th>
<th>Mean Rank</th>
<th>$\chi^2$ Square (df)</th>
<th>$p$ value</th>
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<tbody>
<tr>
<td>Communication stress</td>
<td>1.00</td>
<td>5</td>
<td>4.00</td>
<td>6.094 (1)</td>
<td>.014</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>8</td>
<td>8.88</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Total</td>
<td>13</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>PSS Score</td>
<td>1.00</td>
<td>5</td>
<td>5.70</td>
<td>.921 (1)</td>
<td>.337</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>8</td>
<td>7.81</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>Total</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOT-R Pessimism</td>
<td>1.00</td>
<td>5</td>
<td>7.20</td>
<td>.023 (1)</td>
<td>.880</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>8</td>
<td>6.88</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LOT-R Optimism</td>
<td>1.00</td>
<td>5</td>
<td>6.60</td>
<td>.089 (1)</td>
<td>.766</td>
</tr>
<tr>
<td></td>
<td>2.00</td>
<td>8</td>
<td>7.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Overall Health</td>
<td>1.00</td>
<td>5</td>
<td>6.90</td>
<td>.006 (1)</td>
<td>.938</td>
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<tr>
<td></td>
<td>2.00</td>
<td>8</td>
<td>7.06</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*1 = control; 2 = aphasia
Table 5 Diurnal patterns of each participant

Scatterplots of daily cortisol for each participant.
Table 6 Between Group Comparisons of Diurnal Patterns for each participant

Salivary cortisol concentration in (g/dL) ($x10^{-1}$)

1 - Wake up      2 - 2nd am      3 - afternoon      4 - evening
Table 7 Between-group t test comparing diurnal time points

<table>
<thead>
<tr>
<th>Time</th>
<th>N</th>
<th>Mean (sd)</th>
<th>t (df)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morning 1</td>
<td>1</td>
<td>-.420 (.33)</td>
<td>-.205 (7)</td>
<td>.844</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-.388 (.16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morning 2</td>
<td>1</td>
<td>-.351 (.07)</td>
<td>-.127 (8)</td>
<td>.902</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-.340 (.16)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 pm</td>
<td>1</td>
<td>-1.34 (.58)</td>
<td>-2.30 (6)</td>
<td>.061</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-.587 (.29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening (7-8 pm)</td>
<td>1</td>
<td>-1.31 (.12)</td>
<td>-3.30 (9)</td>
<td>.009</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-.971 (.18)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
University of New Hampshire

Research Integrity Services, Office of Sponsored Research
Service Building, 51 College Road, Durham, NH 03824-3585
Fax: 603-862-3564

31-Mar-2009

Warner, Emily
Com.Sciences & Disorders, Hewitt Hall
11 Muirfield Drive
Stratham, NH 03885

IRB #: 4522
Study: Is a Communication Event Stressful for Individuals with Expressive Aphasia?
Approval Date: 11-Mar-2009

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved the protocol for your study.

Approval is granted to conduct your study as described in your protocol for one year from the approval date above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects in this study. If your study is still active, you may request an extension of IRB approval.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the attached document, Responsibilities of Directors of Research Studies Involving Human Subjects. (This document is also available at http://www.unh.edu/osr/compliance/irb.html.) Please read this document carefully before commencing your work involving human subjects.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-862-2003 or julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

Julie F. Simpson
Manager

cc: File
White, Barbara Prudhomme
Fraas, Michael
04-Mar-2010

Warner, Emily
Com.Sciences & Disorders, Hewitt Hall
11 Muirfield Drive
Stratham, NH 03885

IRB #: 4522
Study: Is a Communication Event Stressful for Individuals with Expressive Aphasia?
Review Level: Full
Approval Expiration Date: 11-Mar-2011

The Institutional Review Board for the Protection of Human Subjects in Research (IRB) has reviewed and approved your request for time extension for this study. Approval for this study expires on the date indicated above. At the end of the approval period you will be asked to submit a report with regard to the involvement of human subjects. If your study is still active, you may apply for extension of IRB approval through this office.

Researchers who conduct studies involving human subjects have responsibilities as outlined in the document, Responsibilities of Directors of Research Studies Involving Human Subjects. This document is available at http://www.unh.edu/osr/comDliance/irb.html or from me.

If you have questions or concerns about your study or this approval, please feel free to contact me at 603-852-2003 or Julie.simpson@unh.edu. Please refer to the IRB # above in all correspondence related to this study. The IRB wishes you success with your research.

For the IRB,

[Signature]

Julie F. Simpson
Manager

cc: File
    White, Barbara Prudhomme
    Ness, Bryan
APPENDIX C INFORMED CONSENT

Behavioral Responses Following Communication: Consent to Participate in Research

You are being invited to participate in a research study regarding behavioral responses following communication. If you decide to participate in this study, you will be asked to complete 4 questionnaires and a series of 7 saliva samples will be collected from you. In addition, you will travel to McDonald’s between the hours of noon and one o’clock PM, where you will order a food product or beverage of your choice. The initial saliva sample will be taken prior to ordering food to give you an idea of the salivary collection procedures. Two additional saliva samples will be collected 10 and 20 minutes following the order. Lastly, you will be provided with 4 vials and asked to independently provide 4 additional salivary samples on a day of your choice. The study will be conducted by Emily Warner, a graduate student at the University of New Hampshire under the mentorship and supervision of her faculty advisor, Barbara Prudhomme White, Ph.D., OTR/L.

After reading this, if you elect to participate, you will be asked to sign this consent form and you will be assigned a participant number that will be used on all further questionnaires and samples. If after reading this, you provide your consent and elect to participate, we will ask you to do the following things:

Experimental group participants will be screened using the Western Aphasia Battery. This test can be given in approximately 60 minutes, and sensitively and reliably diagnoses the type of aphasia. The WAB will be run on the experimental group, prior to the communication event.

1. Complete a Life-Orientation Questionnaire. This questionnaire takes approximately five minutes to complete and will require you to respond to 10 statements.
2. Complete a Perceived Stress Scale questionnaire. This questionnaire consists of 10 statements to which you will respond. This questionnaire is expected to take up to five minutes to complete.
3. Complete a Communicative Effectiveness and Stress Rating Scale. This will require you to respond to 14 statements, and will take approximately 10 minutes to complete.
4. Additionally, you will be asked to complete a demographic information sheet and a health data sheet.
5. Collect saliva 4 times at home on one day. Four samples will be taken on one day at specified times (morning waking, half an hour after waking, 4 pm, and between 7-8pm). We will teach you how to do this.
6. Collect saliva 3 times on the study day. One baseline sample will be obtained as you arrive at McDonald’s, and two samples will be collected after you have ordered food at McDonald’s.
The research presents minimal risks to participants. The primary risk is confidentiality, and we are ensuring that all information associated with your participation will not be disclosed in any identifiable form, including presentations, reports, and publications. There is inherent risk due to possible behavioral responses from some participants. If you express an extreme behavioral response to the event, you will be referred to a SteppingStones faculty member, with whom you are familiar and comfortable, for counseling.

It is our hope that information obtained from this study will benefit future clinical practice and research. What we learn will contribute to a better understanding of how individuals respond behaviorally to communication events. In turn, speech-language pathologists and other members of the rehabilitation team will become more aware of possible responses to communication and can then incorporate compensatory strategies and management techniques when providing therapy.

Participation in this study is entirely voluntary, and you may withdraw from the study at any time without penalty. There are no consequences to withdrawing from this research. Gift certificates in the amount of $10 will be provided to McDonald’s for the purpose of ordering food. Once data has been collected, each participant will be assigned a number and no identifying information will be shared.

All study information will be stored in a locked office at UNH. If the results of the study are published, your name will not be used and no information that discloses your identity will be released or published.

The researchers will answer any questions you have regarding the study, and the principal investigator, Emily Warner, can be reached by email at eeq33@unh.edu or at (603) 944-1313. If you would like to speak with someone other than the investigators about the study as a participant, you may call the UNH Office of Sponsored Research at (603) 862-2003.

I agree to participate in this study:

Signature ___________________________ Date ___________________________

Participant Number ____________________________________________________
APPENDIX D DEBRIEFING DOCUMENT

Debriefing Form

Thank you for participating in the preceding research. The study team needs to tell you some important information regarding your decision to be in this study.

We did not tell you everything about this study. We told you that we were interested in observing behavioral responses during communication; but we were really interested in whether persons with aphasia experience stress while speaking in public. We collected your perceptions of stress, and we also collected saliva from you so that we can assess whether you produced stress hormones. The primary hormone we are interested in is called “cortisol”. This hormone is produced whenever a person experiences something that he/she perceives to be stressful. We did not tell you our real purpose for the study because we did not want to add to any stress you might experience.

The real focus of this study was to examine whether there is a correlation in perceived stress levels and physiological indicators of stress in participants with expressive aphasia. In addition, our focus was to determine whether a difference is evident between the stress levels of participants with expressive aphasia and those without expressive aphasia, during a communication event.

It is our hope that information obtained from this study regarding the stress levels in this population will be useful in future clinical practice and research. What we learn will contribute to a better understanding of how people with expressive aphasia feel upon communicating in public settings. This study will provide information regarding the amount of stress a person with expressive aphasia may experience during communicative events. In turn, it will raise awareness among speech-language pathologists and other members of the rehabilitation team to incorporate compensatory strategies and stress management techniques when providing therapy to this population.

If you feel a need to speak to a professional concerning any uncomfortable feelings from your participation in this research, you may contact the UNH Office of Sponsored Research at (603) 862-2003.

You now have the choice of either having your data included in the research study, or to be withdrawn from the research study. As mentioned in the consent form, if the results of the study are published, your name will not be used and no information that discloses your identity will be released or published.

If you choose to withdraw from this research study, your data will be shredded and disposed of in your presence.
I have been fully debriefed and the study team has offered to answer any and all of my questions related to this research study.

Print Name__________________________________________

Sign Name__________________________________________

Date___________
LIST OF REFERENCES


