

THE EFFECTS OF YOGA ON APHASIA REHABILITATION

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by
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Abstract

THE EFFECTS OF YOGA ON APHASIA REHABILITATION

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Yoga therapy is currently recognized as a complimentary and alternative medicine, providing benefit to individuals with a variety of disorders. Research has shown that yoga can improve emotional states, improve cognition, and encourage neuroplasticity. This study aims to explore the potential relationship between yoga therapy and language restoration for individuals with aphasia due to stroke. A single subject experimental pretest-post-test design was implemented with skilled yoga therapy as the intervention technique.

A single participant was assessed using the Western Aphasia Battery – Revised (WAB-R; Kertesz, 2006) and the World Health Organization Quality of Life – BREF (WHOQOL-BREF; World Health Organization, 2004) prior to and following intervention. Data analysis yielded mixed results with an improvement in WAB – R scores and a decline in WHOQOL – BREF values. The case study limits the generalizability of results, but improvement in post-test language assessment and positive feedback from the participant suggests that further research is warranted to examine the ameliorative effects of yoga therapy on aphasia rehabilitation.

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A Thesis

“The practice of yoga is embraced in order to achieve experiences beyond the reasoning mind” (Chaoul & Cohen, 2010).

Introduction and Literature Review

Introduction

The intention of this review is to report on relevant information connecting yoga therapy to language recovery for adults who have suffered from a stroke. While yoga’s existence far precedes that of most other therapies, it has only recently been studied as a therapy either on its own or as a compliment to more traditional methods. Studies of yoga have shown that a regular practice can benefit emotional states including stress, depression, and anxiety (Behere et al., 2011; Buckley-Reen, 2008; Diamond, 2012; Douglass, 2011; Novotny & Kravitz, 2007). Research has also shown that a yoga practice can benefit the practitioner cognitively (Ristuccia & Ristuccia, 2010; Rocha et al., 2012; Velikonja, Čurić, Ožura, & Jazbec, 2010), and several studies have found a connection between yoga and improved attention and memory (Douglass, 2011; Rocha et al., 2012). Finally, using information from the field of neurology, inferences can be made regarding the benefits of yoga practice on language learning and therapy. Exploration of these three areas provides insight into how yoga has the potential to increase the benefit of language therapy for individuals suffering from a stroke.

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Definition of Yoga

The practice of yoga originated more than 5000 years ago in India. It is now estimated that anywhere from 30 to 40 million people around the world practice yoga (Feuerstein, 2003). The word *yoga* is derived from the root *yuj* meaning “to yoke” or “union” (Feuerstein, 2003). In its most traditional form, yoga is a way of life, an all-encompassing practice. Therefore, defining yoga is a difficult task. Patanjali, author of the *Yoga Sutras*, a foundational text defining yoga’s practices, asserts in sutra 1.2: “Yogas citta vritti nirodah” meaning “yoga is the mental modifications of the mind” (Satchidananda, 1990). In a National Center for Health Statistics Report, yoga is defined as a discipline that combines breathing exercises, physical postures, and meditation to calm the nervous system and balance body, mind, and spirit (Barnes, Bloom, & Nahin, 2008).

Yoga tradition has always been highly malleable and different forms and approaches have originated and morphed throughout the years. The Western approach to yoga typically stems from Hatha yoga, an approach that is defined by self-realization through the physical body and its energetic abilities (Feuerstein, 2003). Today’s yoga is mainly concerned with asana (postures) and pranayama (breath control). The purpose of pranayama is to cleanse and nourish the physical body. Pranayama helps to connect the body to the solar plexus, the body’s potential energy storage center (Sivananda Yoga Vedanta Centre, 2008). Asana are designed to promote a state of mental and physical wellbeing. While Western culture generally uses yoga as a tool for physical fitness and

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flexibility, yoga was created for a more holistic purpose and the ancient tradition's therapeutic abilities cannot be discounted.

Yoga as Complementary Therapy

Several researchers have studied yoga as a complementary and alternative medicine (CAM) in many facets (Douglass, 2011; Gangadhar & Varambally, 2011; Kaley-Isley, Peterson, Fischer, & Peterson, 2010; Ristuccia, Ristuccia, & Gretsche, 2011; Wojciechowski, 2008). Douglass (2011) discusses the benefits of yoga for individuals with eating disorders. She found that the use of yoga provided a balance to traditional medication and diagnostics and allows individuals to have personal control over therapy. Gangadhar and Varambally (2011) produced a literature review of yoga as a therapy for medical and psychiatric disorders. While they found considerable research in the area with variable results, the authors call for future studies to maintain modern research standards. This research has helped to support the use of yoga as a complementary therapy and has verified the benefits of the practice that have been known since the utilization of the practice thousands of years ago. Kaley-Isley et al. (2010) studied the effects of yoga therapy on children and adolescents. The authors provide a review of literature regarding yoga as therapy for a variety of disorders such as eating disorders, irritable bowel syndrome, diabetes, and mental disorders. In general, the studies showed that yoga produced positive outcomes for the participants regardless of the disorder.

Ristuccia et al. (2011) discuss how children receiving any type of special education or rehabilitation services have a high propensity for stress and anxiety. Children obtaining these services also have difficulties with motor skills, self-regulation, learning, attention, sensory processing, daily living skills, and overall ability to adapt to

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situations (Ristuccia et al., 2011). The authors note that for these children, yoga techniques such as asana and pranayama provide an outlet for implicit learning, a necessary strategy for children in general, as well as relieving stress and anxiety. Finally, Wojciechowski (2008) discusses combining a regular yoga practice along with physical therapy in order to improve results for physical ailments. In her article, Wojciechowski provides information from several physical therapists all of whom use yoga as an adjunct to traditional physical therapy. The aforementioned research acknowledges the bolstering effect of yoga for a vast scope of disorders and stresses the prospective benefit of yoga for individuals with aphasia. According to Brookshire (2007), aphasia is a deficit in the ability to process symbolic materials existing in the auditory, visual, and tactile modalities and in the response modalities of reading, writing, and gesturing. Furthermore, the American Speech-Language-Hearing Association (ASHA) defines language as a complex and dynamic system of conventional symbols that is utilized in a variety of modalities for thought and communication (1982).

Yoga is recognized by the National Institute of Health (NIH) National Center for Complementary and Alternative Medicine (NCCAM) in the form of “mind-body” medicine (National Center for Complementary and Alternative Medicine [NCCAM], 2008). According to the National Institutes of Health, “mind-body medicine focuses on the interactions among the brain, mind, body, and behavior, and on the ways in which emotional, mental, social, spiritual, and behavioral factors can directly affect health” (2010, p. 1). Conventional medicine focuses on treating the impairment rather than the overall functionality of the individual and consequently often overlooks the stress and anxiety that can accompany an illness. Including yoga in therapy can provide a balance

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to conventional therapy that is frequently essential to the healing process (Douglass, 2011).

Yoga is a unique addition to therapy given the emphasis that yoga places on the individual (Kaley-Isley et al., 2010). Including yoga with intervention may also be based on contemporary psychological texts that are increasingly placing primacy on the body as a modality of healing or on yoga's interrelationship with other mind-body based therapies (Douglass, 2011). According to a 2007 NCCAM survey, more than 13 million Americans practiced yoga in 2006. Yoga is used by practitioners for a variety of reasons including: Overall health maintenance, reducing blood pressure, alleviating anxiety and depression, insomnia, alleviating menopausal symptoms, smoking cessation and posttraumatic stress disorder (Barnes, Bloom, & Nahin, 2008).

Pranayama

Breath control, or pranayama as it is known in Sanskrit, is a major focus of a yoga practice. Considerable research studying the effects of pranayama on the body both mentally and physically has been conducted (Jerath, Edry, Barnes, & Jerath, 2006; Kyizom, Singh, Singh, Tandon, & Kumar, 2010; Novotny & Kravitz, 2007). The study conducted by Jerath et al. (2006) explains why pranayamic breathing is an effective tool for resetting the autonomic nervous system. Jerath et al. express that pranayama generates inhibitory signals and hyperpolarizing current by mechanically stretching tissues during inhalation and retention (2006). Thus, it is likely that inhibitory impulses, in conjunction with hyperpolarization current, spurs the synchronization of neural elements in the central and peripheral nervous system. This coordination essentially causes a shift to parasympathetic nervous system dominance. Novotny and Kravitz

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(2007) review the literature that exists regarding pranayama. They explain how the shift to parasympathetic responses caused by pranayama can have positive affects on a number of disorders. Additionally, Novotny and Kravitz express the advantages of pranayama used in conjunction with more traditional fitness and wellness techniques in order to provide greater benefit to individuals. Kyizom et al. (2010) conducted a study in which individuals with diabetes mellitus type-2 were provided with either conventional medical therapy only or with both conventional medical therapy as well as yoga in the form of both a pranayama and asana practice. The researchers found statistically significant improvements in glycemic control, reductions in hyperglycemia, and stabilizations in autonomic functions for the group participating in both conventional medicine and yoga.

The main philosophy behind pranayama is “to increase awareness and understanding of the relationship between cognitive states, physical functioning, and breathing styles” (Novotny & Kravitz, 2007, p. 40). Pranayama has the ability to alter the brain’s information processing (Jerath et al., 2006) by shifting a typically involuntary process into a voluntary one. Uma, Nagendra, Nagarathna, Vaidehi, & Seethalakshmi (1989) found that pranayama has the ability to more easily treat psychological and stress disorders and increased IQ and social abilities in intellectually and developmentally disabled children. Pranayama has also been shown to positively affect immune function, hypertension, asthma, psychological and stress-related disorders, and autonomic nervous system imbalances (Jerath et al., 2006).

Emotion

If yoga conjures up images of peace-loving hippies, chanting on a mountaintop without a care in the world, that is because yoga is a proven practice for relieving stress.

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This is not just a concept accepted from yoga's ancient beginnings but has been verified in many studies (Behere et al., 2011; Buckley-Reen, 2008; Diamond, 2012; Douglass, 2011; Fan & Chen, 2011; Hager, n.d.; Novotny & Kravitz, 2007). Stress reduction is one of the most consistent findings in yoga related research (Douglass, 2011). There is now considerable evidence showing the negative health consequences of sustained stress on health and wellbeing through psychological, behavioral, and physiological effects (Chaoul & Cohen, 2010). The effects of stress can have negative impacts on the mind, and, as described by Ristuccia et al. (2011): "Low-level, continuous stress negatively impacts retention and learning since the hippocampus, the part of the brain that stores short-term memory, is not afforded the downtime necessary to convert information into long-term memory" (p. 29).

Other studies have shown mental health benefits including reduced sleep disturbances, improved self-sufficiency, and increased quality of life (Fan & Chen, 2011). In a study conducted by Behere et al. (2011), yoga as an add-on therapy improved psychopathology, emotion recognition deficits, and socio-occupational functioning in antipsychotic-stabilized patients with schizophrenia as compared with physical exercise and the control group. Further research has found improvements in other emotional aspects including a reduction in feelings of depression, increased feelings of respite, and a reduction of anxiety (Diamond, 2012; Fan & Chen, 2011; Hager, n.d.). Depression is heavily prevalent among those recovering from a stroke and can have a negative impact on motor and cognitive function (Lynton, Kligler, & Shiflett, 2007) including language ability.

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Cognition

Stress and anxiety not only impact an individual emotionally but cognitively as well. Studies have shown that stress levels interfere with memory performance and increased anxiety can affect performance on tasks requiring attention (Rocha et al., 2012). In turn, attention improvements could lead to better performance in several kinds of cognitive tasks. It has been suggested that yoga-induced improvement in cognitive tasks arises from improvement in mental concentration (Douglass, 2011; Rocha et al., 2012; Velikonja et al., 2010). Regular yoga practice emphasizes active attention and therefore has been related to increased levels of attention and improved ability to direct attention (Rocha et al., 2012). Velikonja et al. (2010) showed a significant increase in scores on a test of selective attention in a group of participants involved in yoga. They believed that the results could be due to high levels of concentration on body posture and movement.

It has also been proven that yoga reduces cortisol levels, which results in better health and clearer thinking (Douglass, 2011). Studies of healthy adults have shown yoga training to have a positive effect on cognitive functioning, especially in the areas of reaction time and strategic planning. Rocha et al. (2012) found that six months of a regular yoga practice by healthy males improved performance in recognition memory tasks and that the participants performed significantly better than the control group.

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Neurology

Conducting and repeating newly learned movements reinforces neuroplasticity (Velikonja et al., 2010). This occurs due to an increase in the production of neurotransmitters and neural growth hormones, enhancing neural connections and promoting cortical reorganization (Cozolino & Sprokay, 2006). An activation of neuroplasticity may be responsible for an improvement of cognitive function (Velikonja et al., 2010). Not only can increased neuroplasticity improve learning, but the more regions of the cortex used, the more powerful the learning experience (Zull, 2006). These two ideas can be united: Increased use of certain areas of the brain generates more neurological synapses which in turn increases neurological plasticity (Zull, 2006). Since an individual who has undergone a stroke commonly suffers damage to neurological connections, changes in neurological synapses are necessary in order for the individual to regain cortical function.

According to Stein & Cutler (2002), a holistic approach to therapy means that treatment methods utilize mind-body relationships. Therefore, language therapy that also engages the body provides a more holistic approach to therapy. “Neurobiologists now view the mind as an inseparable aspect of the body, a view that has been long held in the yogic traditions of psychology” (Douglass, 2011, p. 88). In their research regarding neuroscience and the brain, Cozolino and Sprokay (2006) found that anxiety can hinder left hemisphere function. By decreasing stress, hemispheric function can return to a relative equilibrium and can activate semantic and narrative processes that had been

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previously shut down (Cozolino & Sprokay, 2006). Therefore, a reduction in stress can be shown to directly correlate to enhanced language production.

Yoga and Language

There are several ways in which yoga therapy can be attributed to improvements in language. First, yogic exercises enhance both posture and breathing, essential foundations for speech (Ristuccia & Ristuccia, 2010). Without proper breath control and posture, communication impairment is inevitable. Along those same lines, Ristuccia & Ristuccia (2010) state that: “incorporating movement into developmental and therapeutic activities strengthens proprioceptive awareness, facilitates sensory processing, improves arousal and attention to task, and enhances language organization” (p.12). Yoga is an activity that can be adapted for any individual in any physical circumstance. This allows for anyone, including stroke victims with hemiparesis or paralysis, to participate in the practice and therefore engage in movement.

The vestibular system also contributes to the acquisition of word understanding and speech, as it plays a major role in the organization of sensation. It is closely associated neurologically with auditory processing and language pathways (Ristuccia & Ristuccia, 2010). The practice of yoga improves practitioners’ balance (Archer, 2011) presumably by engaging the vestibular system. Lynton et al. (2007) conducted a study in which stroke victims with aphasia participated in a regular yoga practice. Their results demonstrated an improvement in auditory and visual reaction time for all subjects following yoga training as well as an overall improvement in language with a reduction in aphasia as measured by post-test results on the Boston Diagnostic Aphasia Exam (Goodglass, Kaplan, & Barresi, 2000).

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As previously stated, yoga contributes to increases in emotional function and ameliorates negative emotional states. According to Cozolino and Sprokay (2006), the left hemisphere “verbal centers” shut down in times of fear and anxiety, which impairs semantic and narrative aspects of learning. Individuals who have suffered a stroke or other brain trauma are frequently subject to feelings of anxiety and stress (Hager, n.d.). Thus, a stroke victim who has suffered direct damage to the language-based left hemisphere may endure further language complications due to the effects of stress. The author hypothesizes that by using yoga to help dispel feelings of stress and anxiety, language intervention may have a greater impact. Furthermore, the utilization of multiple regions of the brain, for instance, the frontal lobe responsible for motor movement, the temporal lobe responsible for language comprehension, and the medulla oblongata in the brainstem responsible for breath control, could more readily improve language learning.

Conclusion

This review examines the current literature regarding yoga and therapy in various facets in order to explore the potential efficacy of yoga therapy to bolster language ability. Yoga has been studied significantly as a CAM therapy and is regarded as a legitimate and beneficial CAM therapy by the National Institute of Health (National Center for Complimentary and Alternative Medicine, 2008). The abilities of pranayama to reset the autonomic nervous system and provide volitional control to a generally automatic function implicate its potential healing properties (Jerath et al., 2006; Kyizom et al., 2010). Pranayama as well as an asana practice have been shown to impart emotional benefits in the form of reductions in stress, anxiety, and depression (Jerath et al., 2006). Stress can also inhibit neurological function and a decrease in stress can

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balance hemispheric function (Li & Goldsmith, 2012). Further studies demonstrate cognitive improvements among yoga practitioners with an increase in attention and concentration (Lynton et al., 2007).

In terms of language therapy, both attention and concentration are necessary skills for an individual to possess in order for therapy to be successful. Neurological findings show how utilization of the body is a key component in any learning situation as it increases neuroplasticity in the brain (Cozolino & Sprokay, 2006; Zull, 2006). An individual who is attempting to regain language must create new neurological pathways in order to circumvent damaged connections in the language center. Yoga therapy can also benefit language disorders. Yoga can provide physical benefits, which directly improve communication in such ways as improving breath control and posture and ameliorating cognitive and emotional factors such as stress, attention, and reaction time, that affect language (Diamond, 2012; Lynton et al., 2007; Ristuccia & Ristuccia, 2010). This review of literature has prompted the hypothesis that yoga therapy may provide additional benefit to traditional language therapy by alleviating feelings of stress and anxiety, providing a conscious connection between mind and body, and improve learning. Given this foundational research, the following research question arose: Can yoga therapy increase linguistic skills and improve language quality of life for an individual with aphasia resulting from a CVA?

Methods

Study Design

This case study sought to determine whether a 12-week yoga practice would lead to improvements in aphasia and quality of life for an individual who has aphasia caused by stroke. A case study design was implemented in which data were collected before and after experimental intervention. The study sought out a participant who had suffered a cerebral vascular accident (CVA) and had been formally diagnosed with aphasia. It was necessary that the participant be able to tolerate therapy for sixty (60) minutes in duration and did not require respiratory assistance. No other physical limitations were put in place. Once IRB approval was received from the Office of Research Protections at Appalachian State University, recruitment efforts were initiated to identify an appropriate individual for participation. The participant was recruited from the aphasia group led by a speech-language pathologist employed with the Appalachian Regional Healthcare System in Boone, North Carolina.

Skilled yoga therapy was the intervention of the study. Data was collected through formal assessments at baseline and upon completion of intervention procedures. Physical measurements of the participant's heart rate and oxygen saturation (SpO₂) level were collected at the beginning and end of each yoga therapy session. The participant attended eight of the twelve scheduled sessions due to adverse weather conditions, the participant's health-related problems, such as a migraine, or scheduling conflicts.

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Participant

The subject who met the research requirements, referred to here as Sally, is a 49-year old female who had two previous left hemisphere CVAs, one in December of 2005 and one in June of 2009, prior to enrolling in the study. A third, undiagnosed CVA was suspected between the ages of 10 and 12. The most recent CVA was located in the left parietal, temporal, and frontal lobes. This stroke resulted in mild numbness in the right extremities and exacerbated Sally's aphasia, which had occurred due to the previously diagnosed CVA. Sally also has concomitant disorders including depression, migraines, and thyroid disease. At the time of diagnosis four years earlier, Sally was placed on a selective serotonin reuptake inhibitor (SSRI) for depression. She is also treated pharmacologically for both the migraines and thyroid disease.

Assessment Tools

The World Health Organization Quality Of Life -BREF (WHOQOL-BREF; World Health Organization, 2004) and the Western Aphasia Battery –Revised (WAB-R; Kertesz, 2006) were used as standardized assessments to measure the participant's quality of life and linguistic and nonlinguistic skills respectively. Mean scores for the WHOQOL-BREF were taken from Hawthorne, Herrman & Murphy's article regarding how to interpret norms for the assessment (2006).

The WHOQOL-BREF is a generic, multidimensional profile for assessing quality of life covering 24 aspects of quality of life, which were internationally agreed upon (Lucas-Carrasco, Laidlaw, & Power, 2011). The assessment utilizes direct patient input

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in order to obtain the most accurate measurements. Psychometric evaluations have shown that the WHOQOL-BREF has strong internal consistency reliability and construct validity (Skevington, Lotfy, & O'Connell, 2004).

The WAB-R is a commonly used clinical assessment of language performance in aphasia (Hula, Donovan, Kendall, & Gonzalez-Rothi, 2010). The assessment is used to classify patients into aphasia types and to measure overall severity of aphasia (Hula et al., 2010). It is a norm-referenced standardized assessment that allows for comparison between individual scores and the norm population on which the test was standardized (Shewan & Kertesz, 1980). The WAB-R possesses high internal consistency measures and high test-retest reliability. Both inter- and intra-judge reliability are high, implying consistent scoring within and between scorers. Results from the WAB-R and the Neurosensory Center Comprehensive Examination for Aphasia (NCCEA; Spreen & Benton, 1977) highly correlate, which indicates good construct validity (Hula et al., 2010). The WAB-R determines aphasia severity in terms of an aphasia quotient (AQ) and supplemental language and cognitive tests that produce a language quotient (LQ) and cognitive quotient respectively. This research utilized only the AQ and LQ scores.

Formal assessments were completed at the Charles E. and Geneva S. Scott Scottish Rite Communication Disorders Clinic at Appalachian State University. The WAB-R was conducted in an individual treatment room. The initial WAB-R was given prior to intervention procedures in order to obtain baseline measurements and again post-intervention. The participant completed the WHOQOL-BREF independently both prior to and following intervention.

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Heart rate and SpO₂ levels were measured using the ChoiceM²Med OxyWatch C29, a fingertip pulse oximeter. This technique uses a tiny cuff worn around the finger that can measure pulse rate and oxygen saturation levels. Heart rate and SpO₂ assessments were measured prior to and following each yoga therapy session. Values were documented and are displayed in Figure 3 with both session baseline values and post-intervention values.

Setting

Yoga therapy sessions were also conducted at the Communication Disorders Clinic in a large conference room. Overhead lights remained off throughout the session and only natural light was used by request of the participant. Room temperature could not be controlled, but the temperature was comfortable for the participant. A central air fan did add to the ambient noise of the room. People in the clinic, who were unaware that the yoga sessions were taking place, occasionally interrupted a session by entering the room during a session.

Intervention Procedures

The subject was asked to participate in one individual yoga session per week lasting 60 minutes in duration, spanning a three-month period. As a certified yoga instructor with additional training in adaptive yoga, I taught all classes. Adaptive yoga can be defined as yoga specifically designed for individuals living with mobility disabilities. Specific postures were chosen based upon the participant's abilities.

Each yoga therapy session was broken into three components: postures (asana), breath work (pranayama), and meditation. These components are explained in further detail in Appendix A. The asana practice followed the same general sequence each

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session. Each asana was held from one breath to five minutes. Throughout the yoga classes, participant was encouraged to link her own breath with her movements and to focus on the breath while holding an asana. This is a key component to any yoga practice and is a main factor in distinguishing yoga from traditional exercise such as jogging or weight training. The asana portion of the class lasted approximately 50 minutes in duration.

Following this portion, the participant engaged in instructor-guided pranayama lasting five minutes. Pranayama occurs while the participant is in a comfortable position. While pranayama has many purposes, the intended focus of the specific techniques utilized was to calm the nervous system and incite relaxation. The final five minutes of each session consisted of an instructor-guided meditation or a self-guided meditation. Instructor-led meditations included concentration on physical sensations, visualizations, and auditory focus. Self-guided meditation allowed the participant to remain in a comfortable position, generally prone, with the eyes closed. This portion of the class was held in silence.

Results

Quantitative Results

This study sought to determine the potential affect yoga therapy may have on language abilities and quality of life for individuals with aphasia due to left hemisphere CVA. This was done by engaging the participant in 60-minute yoga therapy sessions once a week for three months totaling in eight sessions. Language abilities were assessed using the WAB-R, quality of life was assessed using the WHOQOL-BREF, and physical measurements were assessed using a pulse rate oximeter.

Sally's pretest scores on the WHOQOL-BREF were less than one standard deviation below the mean on both the physical health and psychological wellbeing domains. Her score on the environment domain was within normal limits and the score on the social relationships domain could not be calculated which will be further discussed (Hawthorne, Herrman, & Murphy, 2006). Table 1 shows how Sally's scores compare to mean scores (Hawthorne et al., 2006).

Table 1

WHOQOL Scores (0-100)

Domains	Sally	Mean (standard deviation)
Physical health	44	73.5 (18.1)
Psychological wellbeing	50	70.6 (14)
Social relationships	N/A	71.5 (18.2)
Environment	75	75.1 (13)

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Results from the initial WAB-R assessment are shown in Table 2. The baseline aphasia quotient (AQ) score of 80 classifies Sally as having a mild anomic aphasia. The language quotient (LQ) score of 86.5 further confirms that Sally's baseline aphasia is classified as mild.

Table 2

WAB-R Score Results

Sections	Sally's score/Total possible
Spontaneous Speech Total	13/20
Auditory Verbal Comprehension Total	9.7/10
Repetition Total	8.1/10
Naming and Word Finding Total	9.2/10
Aphasia Quotient	80/100
Spontaneous Speech	13/20
Auditory Verbal Comprehension	19.4/20
Repetition	8.1/10
Reading Score	19.2/20
Writing Score	17.6/20
Language Quotient	86.5/100

Table 3 shows baseline WAB-R scores in terms of the AQ and the LQ as compared to post-intervention scores. Post-test AQ score improved by 9.1 points as compared to the baseline score and post-test LQ score rose by 3.9 points as compared to baseline. These increases in AQ and LQ scores at post-test demonstrate an improvement in scores as compared to baseline.

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Table 3

WAB-R Baseline/Post-Test Score Results

Sections	Baseline	Post-Test
Spontaneous Speech Total	13	17
Auditory Verbal	9.7	9.45
Repetition Total	8.1	8.5
Naming and Word Finding	92	96
Aphasia Quotient (AQ)	80	89.1
Spontaneous Speech	13	17
Auditory Verbal	19.4	18.9
Repetition	8.1	8.5
Reading Score	19.2	19.6
Writing Score	17.6	16.8
Language Quotient (LQ)	86.5	90.4

Figure 1 displays the differences between the WAB-R AQ and LQ scores at baseline and post-test. The graph visually displays the increase of AQ and LQ scores from baseline to post-test. The AQ post-test score experienced a greater increase than the LQ post-test score as compared to baseline.

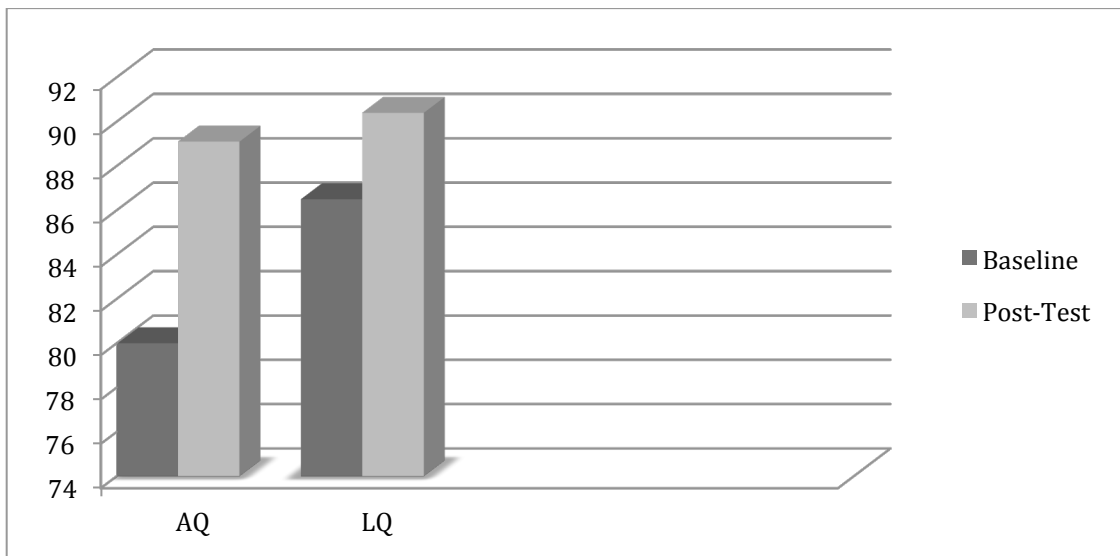


Figure 1. Baseline WAB-R Values Compared to Post-Test Values

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Table 4 displays baseline WHOQOL-BREF scores as compared to post-intervention scores. WHOQOL-BREF scoring instructions do not allow for scoring of a domain if greater than 20% of the domain is left unanswered (Skevington, Lotfy, & O'Connell, 2004). Therefore, a social relationships domain score was undeterminable due to the subject's refusal to respond to a single question in this domain. Decreases in all other domains, physical health, psychological wellbeing, and environment, demonstrate a decrease in Sally's perceived quality of life as compared to baseline scores. The value for the physical health domain dropped to two standard deviations below the mean, the psychological wellbeing value stayed within one standard deviation below the mean, and the value for the environment domain decreased to one standard deviation below the mean.

Table 4

WHOQOL-BREF Baseline/Post-Intervention Score Results (0-100)

Domains	Baseline	Post-Test
Physical Health	44	38
Psychological wellbeing	50	44
Social relationships	N/A	N/A
Environment	75	63

A chart displaying the differences between the WHOQOL-BREF scores at baseline and post-test are compared in Figure 2. For all measurable domains, post-test scores decreased as compared to baseline. This decrease potentially indicates a decrease in Sally's perceived quality of life at the time of post-test as compared to baseline.

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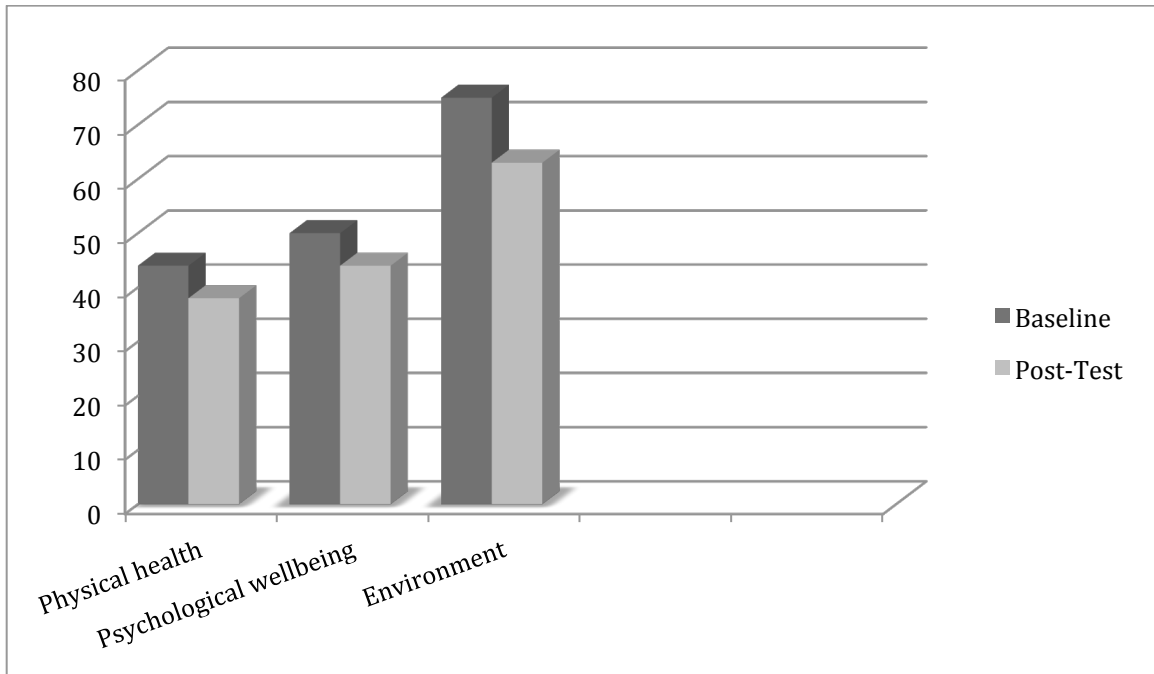


Figure 2. Baseline WHOQOL-BREF Values Compared to Post-Test Values

Baseline and post-intervention heart rate and SpO2 values were taken before and after each yoga therapy session respectively as shown in Figure 3 with the x-axis representing the date of each session with measurable data. Of the seven sessions with available data, five of the sessions showed a decrease in heart rate from baseline to post-test and four of the seven sessions showed an increase in SpO2 levels from baseline to post-test. Post-test data was not taken for the session on 3/18/13 due to an unexpected interruption during the final meditation section of the session. Consequently, the session was not completed in the same manner as all other sessions.

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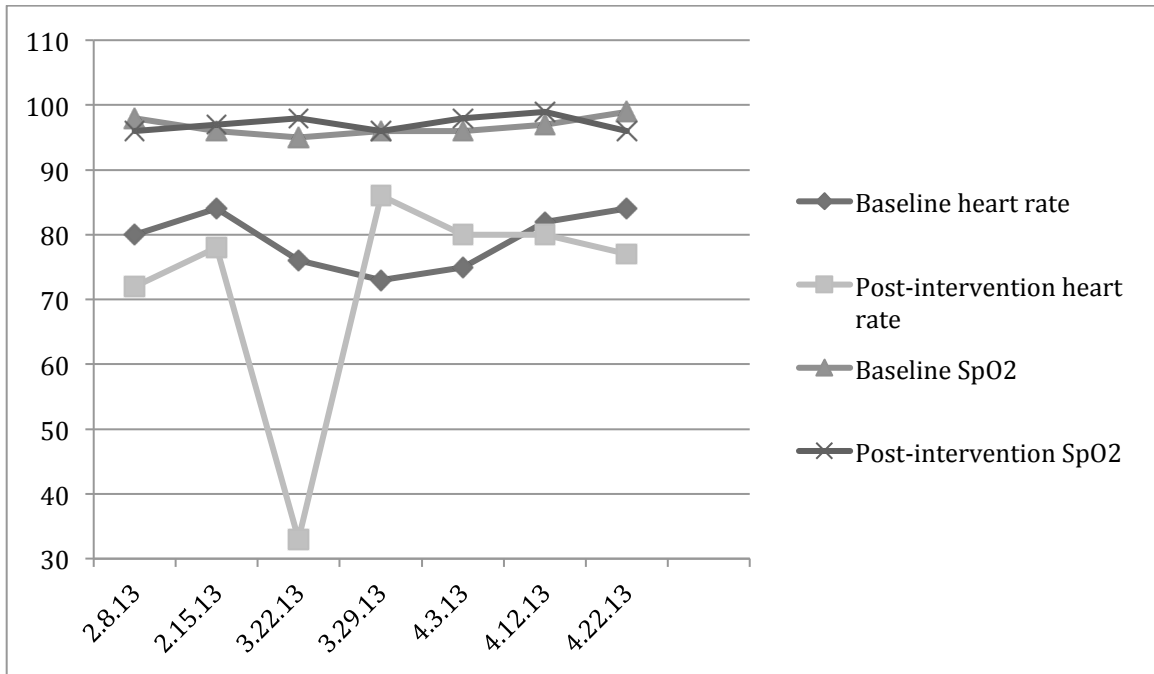


Figure 3. Baseline and Post-Intervention Heart Rate and SPO2 Values

Qualitative results

An informal interview with the participant was conducted following intervention procedures and formal assessments. This interview was used to determine Sally's overall opinion of the yoga therapy sessions and to obtain her opinion of potential changes to future yoga therapy sessions.

In general, Sally reported that she appreciated the opportunity to participate in the yoga therapy, especially with the one-on-one instruction. Following each yoga session, Sally reported feeling more relaxed and felt a mind-body connection that had not existed before the session. These feelings persisted throughout the day and generally into the evening. Sally expressed an interest in continuing yoga therapy if given the opportunity.

Regarding language comprehension during the sessions, Sally did report occasional difficulties. When asked whether the language used in the yoga sessions was clear enough to understand, she responded with "fake it til you make it," implying that

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she did not always understand the instruction being given. When asked what techniques aided in her language comprehension, Sally stated that her understanding was bolstered by repetition (of words or phrases) and personally asking for clarification of language that was not understood. Appendix B contains a full script of the interview.

Discussion

The primary goal of this research was to assess the potential influence that yoga therapy may have on language. While this effect was overtly measured through formal language assessments, previous research has shown how depression, stress, and anxiety, disorders commonly occurring following a CVA, can have negative consequences that both directly and indirectly affect language (Chaoul & Cohen, 2010; Douglass, 2011; Fan & Chen, 2011; Gangadhar & Varambally, 2011; Lynton et al., 2007). Therefore, further assessments, including quality of life, heart rate, and oxygen saturation level, and an informal interview were conducted in order to provide a comprehensive evaluation.

The participant demonstrated minor declines in her WAB-R AQ and LQ scores from baseline to post-test with changes of 9.1 points and 3.9 points respectively. Since the severity of the participant's aphasia was classified as mild at baseline, post-test values did not change the level of severity. The WAB-R was readministered following a three-month period mandated by the testing procedures; therefore, it is unlikely that retest effects influenced the score increases. Instead, possible explanations for the positive outcome are as follows.

First, yoga therapy can ameliorate complications brought on by a stroke, such as depression (Douglass, 2011). Prior to the yoga intervention, the subject's depression was only being treated pharmacologically. Despite consistent use of an SSRI for the past four years, the participant still reported feelings of depression. The yoga therapy was the first time that the depression was addressed therapeutically, albeit indirectly, since the

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participant began use of the SSRI. The participant's depression may be negatively impacting cognitive function (Lynton et al., 2007), which could in turn hamper language ability. By participating in the yoga therapy intervention, it is possible that the feelings of depression were being alleviated, thereby improving the subject's cognitive function.

Second, pranayama has been shown to alter the brain's information processing system, treat stress disorders, and increase awareness of cognitive states (Jerath et al., 2006; Novotny & Kravitz, 2007; Uma et al., 1989). It is possible that the pranayama techniques used during intervention helped to alleviate the participant's feelings of stress and depression. Third, feelings of stress and anxiety are common among individuals who have suffered a stroke, including the participant (Hager, n.d.). Feelings of fear and anxiety can cause the left hemisphere verbal centers to shut down thereby impairing language function. Improvement in the participant's AQ and LQ scores could possibly correlate with a decrease in feelings of stress and anxiety brought on by the yoga therapy. While these are all viable possibilities, the single case study approach makes it impossible to draw definitive conclusions concerning the increase in WAB-R scores.

It is difficult to account for the decrease in the subject's WHOQOL-BREF scores. Given the subject's positive comments obtained from the interview regarding yoga therapy, it is unlikely that the intervention techniques caused a decrease in the subject's quality of life. Additionally, the informal interview allowed the participant to express her attitude regarding the yoga therapy in a less constrained form than the WHOQOL-BREF provides. Sally's overall assessment of the yoga intervention was positive. The subject did express feelings of relaxation and a mind-body connection, indicative of increased cognitive function. The improvement in cognition may contribute to Sally's greater

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awareness and could potentially encourage her to make changes to address her current quality of life. This could explain Sally's positive view of yoga therapy but reduced score on the WHOLQOL-BREF.

Heart rate SpO2 levels were also variable. Ideally, heart rate values should decrease following yoga therapy while SpO2 levels should increase. It should be noted that the two instances in which heart rate increased following yoga therapy, on 3/29/13 and 4/3/13, sessions were disrupted during either the pranayama section or the final meditation section of the intervention session. Individuals entering the therapy room unaware of the intervention that was taking place caused interruptions. These disturbances altered the mental state of the participant and could explain the increase in heart rate on those dates. As a reduction in heart rate can directly correlate with a reduction in anxiety (Thurber, Bodenhamer-Davis, Johnson, Chesky, & Chandler, 2010), the decrease in the subject's heart rate post-intervention could imply a temporary decrease in feelings of anxiety. As previously mentioned, feelings of anxiety can hinder language function (Cozolino & Sprokay, 2006). It is possible then, that language function could improve during times when feelings of anxiety are diminished.

Adapting Yoga for a Person with Aphasia

Upon completion of intervention procedures, it was apparent that further insight could be gathered from this research. Namely, how to best adapt yoga instruction to accommodate a person with aphasia. The following list gives suggestions to yoga instructors who are teaching a class to individuals with aphasia. This list was created from both my experience with this study and from the participant's feedback.

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- Simplify words and sentences.
- Use the English translation for Sanskrit words.
- Repeat instructions and features of postures.
- Visually demonstrate poses whenever possible.
- Encourage questions and allow participant to express the need for clarification at any time.

Limitations of the Study

The study was constrained by several limitations. First, this single subject case study limits the generalizability of the results. Second, the setting in which the yoga therapy sessions took place was not ideal for the participant or the instructor. Particularly, a fan in the room provided a constant ambient noise that the participant found irritating. The participant reported increased sensitivity to light and noise following her CVA. This sensitivity is common among individuals who have suffered from a stroke (Carlsson, Möller, & Blomstrand, 2004), and therefore these distractions need to be reduced to provide the participant with the greatest opportunity for relaxation and concentration. Third, this study was performed under time constraints that only allowed for the research to be conducted in a three-month period. Due to availability, the yoga therapy session could only take place once a week. An intervention period with an increased duration and frequency may allow the practitioner to be better acquainted with the asana, pranayama, and meditation practice. A stronger grasp of the methods of the yoga therapy may allow the practitioner to become more mindful of the sensations instead of focusing on the techniques.

Implications for Clinical Practice and Research

Several studies have shown that stress, anxiety and depression, feelings that frequently accompany a communication disorder, can create negative effects, both physically and emotionally (Chaoul & Cohen, 2010; Douglass, 2011; Ristuccia, Ristuccia, & Gretsche, 2011; Rocha et al., 2012). As discussed, these concomitant disorders can complicate speech-language intervention, prolonging therapy and increasing the severity of the disorder. A yoga therapy practice could enhance the success of speech-language intervention by ameliorating concomitant disorders and allowing the speech language pathologist to hone in on the true communication disorder. Thus, yoga therapy could provide benefit to a variety of disorders including traumatic brain injury, apraxia of speech, Parkinson's disease, voice disorders, dementia, and many more.

Conclusions

Yoga has proven to be a successful complimentary alternative medicine for a wide variety of disorders. Previous research has demonstrated the efficacy of yoga in reducing stress, anxiety, and depression, three impairments that can have adverse health consequences. These disorders have the potential to impede the formation of new neurological connections and negatively affect cognition in general. This negative impact on cognition caused not by CVA but instead by outside factors, means that an individual with aphasia due to stroke is not only combatting neurological damage from the stroke, but additional cognitive issues related to the stress, anxiety, or depression that

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may be brought on by the life changes they experience as a result of the stroke. It is necessary to provide individuals with aphasia with the best opportunity for language recovery. This includes reducing concomitant disorders that may hinder language learning and acquisition.

While this research does not substantiate the use of yoga therapy as an enhancement to language therapy, it does justify the need for further research. The research findings do not directly suggest that yoga therapy may be related to improving language ability for a person with aphasia. This participant's positive attitudes toward the yoga therapy may indicate that the yoga therapy could provide benefit to a person with aphasia by ameliorating negative emotional disorders, thereby reducing any negative life changes that often co-occur with major health related events.

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Appendix A

Yoga Therapy Procedures

Postures (Asana): 50 minutes

Asana are based on a combination of Iyengar style and Ashtanga style yoga. While specific asana were varied throughout classes, the general format of the asana practice remained the same throughout every class. Since participants' physical abilities varied greatly, asana were adapted to accommodate the participant. Adaptations included personal assistance and props including bolsters, blocks, blankets and straps. The practice was conducted as shown in Table 5.

Table 5

Structure of Asana Practice and Examples by Category

Asana Category	Examples of Asana			
Beginning Meditative	Comfortable seat	Child's pose	Prone	
Sun Salutations	*			
Standing	Warrior 1	Warrior 2	Triangle	Extended Side Angle
Back Bend/ Heart Opening	Wide legged standing forward bend Cobra	Cat/Cow	Camel	Bridge
Twists	Half Lord of the Fishes	Revolved Side Angle (modified)	Bharadvaja's Twist	
Seated	Bound Angle Pose	Hero Pose	Wide Angle Seated Forward Bend	Head-to-Knee Forward Bend

* Traditionally sun salutations are a series of postures that allow the participant to connect each movement to an inhalation or exhalation and therefore connect their body to their breath. In addition, sun salutations are used to warm up the body.

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Breath Work (Pranayama): 5 minutes

Nadi Sodhana Pranayama, a technique used to purify the nerves (Iyengar, 1979).

Participants inhale through one nostril and out the other, consecutively alternating sides for 10 cycles.

Meditation: 5 minutes

The first portion of the meditation was instructor-guided and included meditations on physical sensations, visualizations, and auditory focus. The final portion consisted of a silent participant-guided meditation in a prone position.

For more information about specific asana and pranayama, refer to Iyengar, B.K.S. (1979). *Light on Yoga*. New York: Schocken Books, Inc.

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Appendix B

Final informal interview

Investigator: How did you feel about the yoga sessions?

Sally: Very good.

Investigator: What specifically did you like about it?

Sally: I appreciated the one-on-one. I enjoyed the alternate nostril breathing.

Investigator: How did you feel following the classes?

Sally: Good. I was more relaxed, more whole compared to-

Investigator: How long did those feelings last?

Sally: They lasted throughout the day into the evening.

Investigator: If given the opportunity, would you like to continue the yoga sessions?

Sally: Yes.

Investigator: Why?

Sally: I really enjoyed it very much.

Investigator: Were the words and language used clear enough to understand?

JU: Like we always say in Brainstormers, fake it til you make it.

Investigator: What helped facilitate your comprehension?

Sally: Asking (for clarification).

Investigator: Would it be beneficial to repeat instructions?

Sally: Yes, the more the better.

Investigator: Would you use the yoga that you learned at home?

Sally: Yes.

Investigator: Any aspect in particular?

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Sally: Breathing.

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Vita

Natalie Rivkin was born in San Luis Obispo, California to Daniel and Tina Rivkin. She graduated from Edina High School in Edina, Minnesota in June 2000. Following a brief stint at the University of Michigan in Ann Arbor, Michigan and a degree in Esthiology Science from the Aveda Institute in Minneapolis, Minnesota, she was awarded the Bachelor of Arts degree in Linguistics in May 2007 from the University of Minnesota in Minneapolis. She was accepted into the Yoga Works Teacher Training program in Pacific Palisades, California in the winter of 2011 where she received her 200-hour teaching certificate. In January of 2012, she accepted a graduate assistantship in the department of Communication Sciences and Disorders and began study toward a Master of Sciences degree. The M.S. was awarded in August of 2013.