2019

The Impact of Education on Implementation of Mirror Box Therapy Across Occupational Therapy Practice Settings

Nicole Y. LaRue
Eastern Kentucky University, Nicole.larue35@gmail.com

THE IMPACT OF EDUCATION ON IMPLEMENTATION OF MIRROR BOX THERAPY ACROSS OCCUPATIONAL THERAPY PRACTICE SETTINGS

Presented in Partial Fulfillment of the
Requirements for the Degree of
Doctor of Occupational Therapy

Eastern Kentucky University
College of Health Sciences
Department of Occupational Science and Occupational Therapy

Nicole LaRue
2019

EASTERN KENTUCKY UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

This project, written by Nicole LaRue under direction of Camille Skubik-Peplaski, Faculty Mentor, and approved by members of the project committee, has been presented and accepted in partial fulfillment of requirements for the degree of

DOCTOR OF OCCUPATIONAL THERAPY

CAPSTONE COMMITTEE

Camille Skubik-Peplaski — 5/8/2019
Faculty Mentor — Date

Dana Howell — 5/8/2019
Committee Member — Date

EASTERN KENTUCKY UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

Certification

We hereby certify that this Capstone project, submitted by Nicole LaRue conforms to acceptable standards and is fully adequate in scope and quality to fulfill the project requirement for the Doctor of Occupational Therapy degree.

Approved:

Dana Howell 5/8/2019

Dana Howell, PhD, OTD, OTR/L, FAOTA — Date
Program Coordinator, Doctor of Occupational Therapy

Colleen Schneck 5/17/19

Colleen Schneck, ScD, OTR/L, FAOTA — Date
Chair, Department of Occupational Science and Occupational Therapy

Executive Summary

Background: Mirror box therapy has been found to be effective in changing motor and sensory outcomes in patients with cerebrovascular accident (CVA). It has many benefits to use for occupational therapists such as ease of use, ease of transportation, capability to be used across practice settings, and ability to be incorporated into conventional therapy treatment. However, therapists included in this study may not have been using the intervention due to lack of knowledge or availability of the intervention equipment.
Purpose: The purpose of this capstone project was to determine the impact education would have on occupational therapists' attitudes and behaviors towards the use of mirror box therapy. It also served to determine the impact the use of mirror box therapy would have on functional outcomes such as range of motion, muscle strength, and sensation of the affected limb for individuals recovering from CVA as well at occupational performance outcomes of changes in Functional Independence Measures (FIM) of patients with CVA across occupational therapy practice settings.
Theoretical Framework. The framework that guided the development of this study was the Person, Environment, Occupation Model. The person was identified as the therapist or the patient. The environment was identified as the practice setting, the physical environment, and the support from other staff and family. The occupation was defined as use of mirror box therapy by the therapist or participation in activities of daily living by the patient.
Methods. This study utilized a mixed methods approach and was divided in to two parts. Part A utilized a two-part educational series analyzed by a quantitative pre-test/post-test assessment of learning. This was followed by a qualitative focus group with all therapists who had participated in the educational series. Part B included using mirror box therapy with patients with acute CVA to collect pre-test/post-test data on changes in range of motion, muscle strength, sensation, and Functional Independence Measure (FIM) levels. This was followed by a qualitative focus group for therapists who had implemented mirror box therapy.
Results. Part A of this study found significant changes in learning about mirror box therapy by occupational therapists. Through the educational series, they identified how they learned, what motivates them to learn, barriers to job performance due to the environment, and overall excitement to learn. Part B of this study found changes in occupational performance for all seven patients with acute CVA. Patients identified sensory changes throughout the use of the mirror box and presented with changes in motor function resulting in improvements in FIM scores. Using mirror box therapy with patients with CVA facilitated growth by the therapists in their confidence to use, motivation to use to continue to help patients, evolution of becoming leaders in their respective practice settings, and critical thinking about changes in their environment that would be needed to successfully incorporate mirror box therapy into daily practice.
Conclusions: Education that addresses preferences in learning, motivates the therapist to want to learn, and provides support for adaptation of the person, the environment, and the occupation can be successful in creating changes in occupational performance of occupational therapists. Learning to use mirror box therapy by incorporating into practice is important to increase confidence of use in occupational therapists. As confidence improved, the therapists evolved into leaders in their practice settings by

modeling the use of the mirror box and sharing an understanding of the benefits to use of the intervention with their peers. Using mirror box therapy with patients with acute CVA can lead to changes in functional outcomes and occupational performance. Utilizing mirror box therapy for short periods of time was proven effective to initiate physical changes in patients with CVA by improving motor and sensory awareness of the affected limb. The experience of using mirror box therapy is important to the relationship between therapist use and outcome changes in patients with CVA. Using the mirror box improved confidence of use by therapists that directly impacted how they treated patients with CVA which improved occupational performance for both.

Acknowledgements

First and foremost, I want to thank my husband Justin for supporting me through this endeavor. That has meant numerous evenings and weekends of me working on assignments and him being left to fend for himself. With the birth of our daughter during this time, that meant I needed his support even more. From working all day and taking over daddy duty in the evenings and keeping her occupied on the weekend while I was able to complete a few more pages of my paper, his help has been beyond compare. Thank you for all your support, never letting me talk myself out of this process, and constantly pushing me to "get it done".

Even though she is too young to remember this, thank you to my daughter Lochlyn for making me want to be the best I can be. This has been challenging to be in the middle of the program and having a baby, but I wouldn't have it any other way. She has been a blessing and I hope one day she will be able to look back and say that her mom made her proud completing such a program in the middle of life.

I also want to thank my coworkers. Thank you for being willing to participate in this journey with me. From talking through discussion boards to learning about technology, you have demonstrated interest throughout that has motivated me to keep on. And thank you for your willing participation in this capstone project for without you, this wouldn't have come to life.

Thank you to Camille for pushing me to be better. Your constant words of wisdom and sense of humor have made this process bearable. I can't say enough about the guidance you have provided while setting me up to have those "ah-ha" moments. Thank you for listening when I get on my soap box about practice settings and lack of motivation amongst other professionals. And thank you for being so accommodating throughout the entire program. You have made this look easy being involved in your work and your community and I look up to you as a leader.

And thank you to Dana. I feel as though you have been the voice of reason throughout. You have jumped right in with all the crazy parts that has been my capstone project and provided guidance throughout. You always have positive feedback that has kept me motivated throughout.

Again, I can't thank you all enough. This experience has been challenging in it has forced me to grow as a student and professional. It also has helped me to overcome all obstacles and find that balance in life to succeed. Thank you again!

EASTERN KENTUCKY UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF OCCUPATIONAL SCIENCE AND OCCUPATIONAL THERAPY

CERTIFICATION OF AUTHORSHIP

Submitted to (Faculty Mentor's Name): Camille Skubik-Peplaski
Student's Name: Nicole LaRue
Title of Submission: The impact of education on implementation of mirror box therapy across occupational therapy practice settings.

Certification of Authorship: I hereby certify that I am the author of this document and that any assistance I received in its preparation is fully acknowledged and disclosed in the document. I have also cited all sources from which I obtained data, ideas, or words that are copied directly or paraphrased in the document. Sources are properly credited according to accepted standards for professional publications. I also certify that this paper was prepared by me for this purpose.

Student's Signature: Nicole LaRue

Date of Submission: 5/7/19

Table of Contents

List of Tables

List of Figures

Section 1: Nature of Project and Problem Identification

In the United States, cerebrovascular accident (CVA) occurs in over 795,000 individuals each year (Centers for Disease Control and Prevention, 2017). Deficits caused by CVA may result in long term disability for the individual (Centers for Disease Control and Prevention, 2017). These deficits can include motor and sensory limitations of the affected side of the body. This may lead to the inability to or impairment of participation in activities of daily living (ADLs), instrumental activities of daily living (IADLs), and functional mobility (Nilsen & Geller, 2015). Occupational therapy has the unique ability to address these areas of occupation through CVA rehabilitation to increase occupational performance (Nilsen et al., 2015). The goal of occupational therapy in CVA rehabilitation is to improve quality of life by addressing all aspects of the individual (Gurbuz, Afsar, Ayas, & Cosar, 2016, p. 2503).

Occupational therapy in CVA rehabilitation addresses a variety of deficits such as decreased range of motion, strength, and increased or diminished sensation in the affected limb. When selecting an intervention to address these deficits, there needs to be an understanding of the concepts of neuroplasticity and motor learning (Boudreau, Farina, & Falla, 2010). Neuroplasticity involves the changing and adaptation of learning in the brain (Saebo, 2018). Due to injury in the brain from the CVA, there are damaged pathways which impact how information is received and processed (Boudreau et al., 2010). Treatment focuses on forming new connections to retrain the brain how to perform tasks (Saebo, 2018). Motor learning focuses on the learning of the skill, how it performed, and the feedback provided to continue to develop the skill (Gliner, 1985). Repetition of tasks is important to learn quality of movement but also how that movement can be incorporated into function (Gilmore & Spaulding, 2001).

One intervention that incorporates the concepts of neuroplasticity and motor learning is mirror box therapy. Mirror box therapy is one part of the larger concept of graded motor imagery. Graded motor imagery consists of three parts: left/right discrimination, explicit motor imagery, and mirror therapy (Neuro Orthopaedic Institute Group, n.d.) The Neuro Orthopaedic Institute Group (n.d.) defined these parts as the following: left/right discrimination is the determination what side of the body the deficit is affecting; explicit motor imagery is being able to think about movement without moving; and mirror box therapy projects the image of the unaffected limb to create new pathways in the brain. The mirror box is placed at the patient's midline with the affected arm placed inside the box. The box obstructs the view of the affected limb. The individual then moves the unaffected limb through range of motion or to complete a task. Using mirror box therapy applies the principles of neuroplasticity by activating mirror neurons in the brain through interpretation of the image in the mirror (Ayra, 2016). What the individual sees is the reflection of the unaffected limb, but the brain interprets the image as that of the affected limb. The change in interpretation of the information may also activate new pathways in the motor cortex resulting in increased motor function (Ayra, 2016). With use of mirror box therapy, the individual is reminded how to move the affected upper extremity through visual feedback (Saebo, 2018). Mirror box therapy uses the concept of motor learning through how the task is set up. The individual may complete multiple repetitions of distal upper extremity movements. From these movements, sessions may progress to task-oriented activities focused on fine motor, gross motor, or ADL tasks (Bondoc & Burkhardt, 2004; Paik, Kim, Lee, & Jeon, 2014). Learning through progression of task is important for the individual to retain the information but also have the ability to apply this new skill to their affected limb (Breslin, 1996).

Mirror box therapy was first used to address pain in those afflicted by phantom limb pain due to upper extremity amputation (Ramachandran & Rogers-Ramachandran, 1996). Individuals reported decreased pain and increased sensation after use of mirror box therapy as well as a better understanding of how to manage phantom pain (Ramachandran & Rogers-Ramachandran, 1996). Mirror box therapy works by recruiting mirrored neurons to remap the brain into believing the image the individual is seeing in the mirror is the affected limb (Guenther, 2016). Through the use of mirror box therapy, a new pathway in the brain was created. This pathway is formed based on the relationship between touch and sight. This relationship stressed that the use of sight directly influenced the sensation of touch which then led to a direct impact on motor recovery through increased awareness of the affected limb (Colomer, Noe, & Llorens, 2016; Dohle et al., 2008; Ramachandran & Rogers-Ramachandran, 1996). Enzedam, Bongers, and Jannick (2009) reported that mirror box therapy is important to CVA recovery due to the relationship between motor and sensory involvement. Addressing neuroplasticity means being able to change how the brain takes in and processes new information (Saebo, 2018). Being able to change this dynamic allows mirror box therapy to be used for a variety of diagnoses such as amputations, CVA, complex regional pain syndrome, and peripheral nerve injuries (Ramachandran & Altschuler, 2009). For individuals with CVA, the ability to adapt how the brain learns is important through all stages of recovery as the individual's ability to learn may change as their brain begins the healing process (National Institute of Neurological Disorders and Stroke, 2017).

Using mirror box therapy with the CVA population has been widely studied and found to have positive results in changing motor and sensory functions such as active range of motion (AROM), passive range of motion (PROM), strength, coordination, sensation, and pain (Dohle et

al., 2008; Kim, Lee, Kim, Lee, & Kim, 2016; Lim, Lee, Yoo, Yun, & Hwang, 2016; Mota, Meireles, Viana, & Almedia, 2016; Paik et al., 2014; Thieme et al., 2012). This intervention has two forms, simple and task-oriented. With simple mirror box therapy, activities include basic range of motion for the distal limb (Mota et al., 2016). With task-oriented, activities include fine motor coordination, activities of daily living (ADL), and instrumental activities of daily living (IADL) (Almhdawi, Mathiowetz, White, & del Mas, 2016). Task-oriented mirror box therapy focuses on changing compensatory and incorrect movements to specifically address the activity to be completed (Park, Chang, Kim, & Kim, 2015). Progressing from simple to task-oriented mirror box therapy allows the intervention to advance from preparatory to occupation-based, placing meaning behind addressing the deficits to improve quality of life (AOTA, 2017).

One of the main findings from the literature is that mirror box therapy can have a positive impact on motor and sensory recovery in CVA patients across all stages of recovery (Colomer et al., 2016; Saunders & Cassidy, 2012). With the positive changes that can be produced, no studies have attempted to replicate findings to determine a best practice protocol or if motor and sensory changes can be maintained. Further research is needed to develop a best practice protocol to support continued use (Lee, Cho, & Song, 2012; Nilsen and DiRusso, 2014; Rothgangel, Braun, Beurskens, Seitz, & Wade, 2011; Wooster et al., 2015; Zeng, Guo, Wu, Liu, & Fang, 2018).

Problem statement

The problem this Capstone project addressed was the lack of education on and limited use of mirror box therapy by occupational therapists in the upper Ohio Valley area. A needs assessment was completed in the summer of 2017 that determined that most occupational therapists were not using mirror box therapy for treatment with individuals with neurological or

orthopedic diagnoses due to not knowing about the intervention and not having access to a mirror box to incorporate into practice (See Appendix A). The occupational therapists that had used mirror box therapy were using for hand/orthopedic therapy. They reported they were using a protocol which was the larger scale graded motor imagery. There was no reported support of use of this intervention through evidence-based practice. Occupational therapists that were not using the intervention reported that if there was a protocol, they may have felt more inclined to incorporate into practice.

Purpose of the project

The purpose of this mixed methods, sequential transformative Capstone project was to enhance the learning of occupational therapists on the use of mirror box therapy in order to change their attitudes and behaviors towards the use of the intervention and to support changes in patient outcomes by promoting the use of mirror box therapy across a variety of practice settings. This study was divided into two parts: Part A was education on mirror box therapy for occupational therapists and Part B was implementation of use of mirror box therapy for patients with CVA. Table 1 presents the organization of each part of the capstone project.

Table 1. *Description of Components of Capstone Project*

Part A: Education on Mirror Box Therapy	**Part B: Implementation of Mirror Box Therapy**
Component 1 • *Session A*: Introduction, how to build, introduction to literature, discussion of simple vs. task-oriented • *Session B*: In-depth literature review, using for simple and task-oriented activities	***Component 1*** • Use of mirror box therapy with patients with CVA in 3 practice settings: acute care, inpatient rehabilitation, and skilled care

Component 2 • *Focus Group A:* What was the learning experience like for the therapists?	***Component 2*** • *Focus Group B*: What was the experience of using in practice like for the therapists?

Each part was broken into two components. *Part A: Component 1,* of this study included a two-part educational series on mirror box therapy with occupational therapists (adult volunteers) which included the following topics: the background of mirror box therapy, types of mirror box therapy, introduction of the literature on mirror box therapy with patients with CVA and building of mirror boxes for patient use in the acute, skilled, and inpatient rehabilitation settings. *Part A: Component 2,* included a focus group with the occupational therapists to determine how the educational series impacted their level of confidence to use mirror box therapy and how they intended to use in the future. *Part B,* focused on implementing the knowledge gained in *Part A. Part B: Component 1,* identified one therapist from each practice setting, acute care, inpatient rehabilitation, and skilled care to utilize mirror box therapy with patients with CVA (hospital patients) and collect data on changes in range of motion, muscle strength, sensation, and ADL function of patients. *Part B: Component 2,* included a focus group with the three therapists who utilized mirror box therapy to determine the impact of using the intervention on their learning experience.

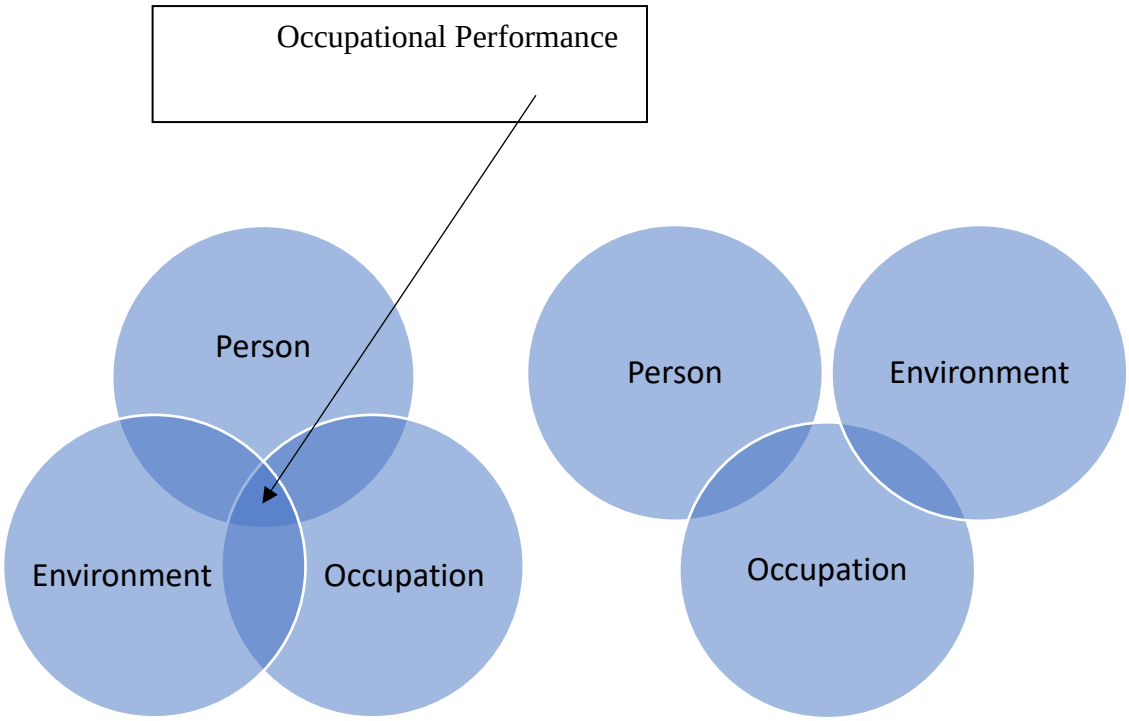
Project objectives or research questions

1. This study aimed to identify to what extent education on the use of mirror box therapy would impact the attitudes and behaviors of occupational therapists.
2. It also aimed to determine to what extent functional outcomes in clients with CVA would be impacted through the use of mirror box therapy.

Theoretical framework or scientific underpinnings

Person-environment-occupation model. The person-environment-occupation model was used as a framework to understand the impact these three areas have on occupational performance (Law et al., 1996). Strong et al. (1999) defined the person as an individual or a group. The person is made up of their interests, values, roles, and behaviors. The environment includes the physical surroundings and social groupings. Vachon, Durand, & LeBlanc (2010) stated that the environment that occupational therapists practice in can provide support or barriers. Occupations involve tasks or activities completed in everyday life. These can include self-care, leisure, and productivity (American Occupational Therapy Association, 2017). Each area has its own impact on occupational performance but with an equal balance it can optimize an individual's potential (Law et al., 1996). The person's preferences impact which occupations they participate in. The environment may impact the occupation by requiring a specific setting to occur in or may influence the person by the individuals in that selected environment. When these areas are not balanced, it can lead to difficulties with successful occupational performance. To reach optimal performance, these three areas need to be balanced or overlap equally.

Figure 1. *PEO Model, Examples of optimal and poor occupational performance by Law et al. (1996)*



Optimal occupational performance relationship *Poor occupational performance relationship*

For *Part A* of this study, the person was identified as the occupational therapists (P) in acute care, inpatient rehabilitation, and skilled care. These individuals had different levels of practice experience and different levels of motivation to seek out opportunities for further education. The occupation they were performing was providing therapy treatment for patients with CVA (O). The environments they were performing the occupation were not supportive due to time limitations from productivity demands and little support for the use of evidence-based practice (E). The occupational performance imbalance occurred due to the therapists not knowing about mirror box therapy or how to use, as well as not having access to a mirror box to utilize with patients with CVA. Therefore, occupational performance was limited by the

environment which did not support the use of evidence-based practice and the occupation of treating patients with CVA was limited due to lack of knowledge. Lack of knowledge was due to poor initiation to seek out interventions for treatment of the neurological population. Educating on the use of mirror box therapy would be beneficial to increase professional knowledge of the occupational therapists to provide the opportunity to change outcomes for their patients.

For *Part B* of this study, the PEO model guided development due to limitations patients with CVA were experiencing. The patients (P) had many roles such as family member, worker, and community member. Their occupations of ADLs, IADLs, and community mobility (O) were limited due to motor, sensory, and cognitive deficits as a result of CVA. The environment of the hospital setting (E) limited them due to not being the natural environment in which their occupations would take place. Education on mirror box therapy was needed for the patient to understand why they would want to continue use of the intervention. To achieve optimal occupational performance, how the occupations were performed would need to be adapted as well as a change in the environment to provide support and simulate the environment in which their occupations could be performed. This would create equal overlap in all three areas resulting in balanced occupational performance. Using mirror box therapy would allow the patients with CVA the opportunity to address their occupational performance deficits with an intervention that could be used across all stages of their recovery.

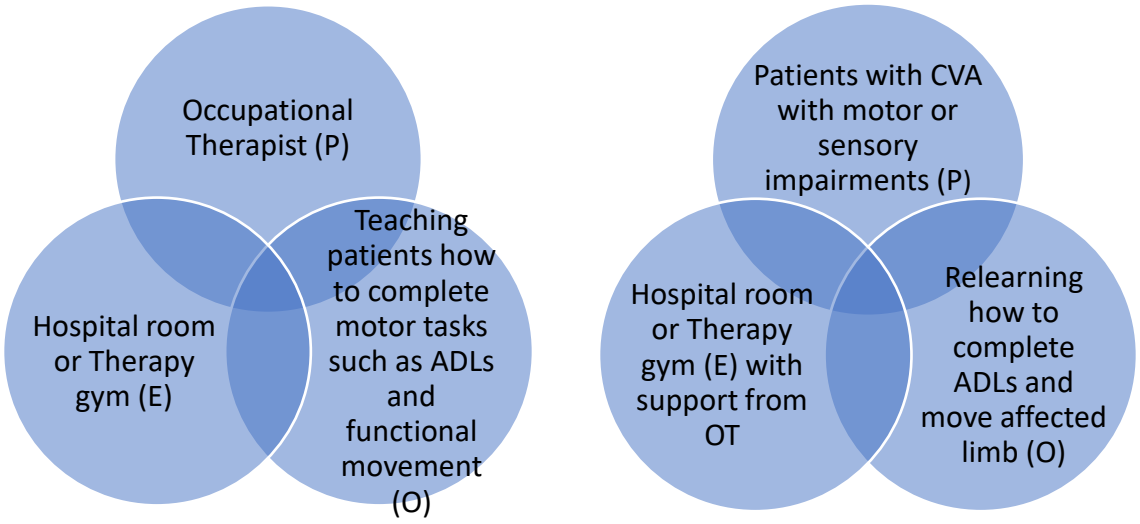
Motor learning. Breslin (1996) defined motor learning theory as a means to use practice and experience to create changes in motor function. Mirror box therapy is a means of using motor learning techniques by reeducating the brain through visual imagery. The patient is provided visual feedback using a mirror that reflects the unaffected limb, making the brain

believe that what it is seeing is the affected limb moving without difficulty. Sabari (1991) stated that motor learning theory addresses deficits experienced due to hemiplegia such as initiation, activation, and sustainability of movement of the affected limb. Breslin (1996) discussed that motor learning consisted of tasks specific to the needs of the patient. This included the approach to treatment, repetition, and cueing to provide feedback.

For *Part A*, the occupational therapists (P) had a basic understanding of motor learning with the neurological population. However, they had limited knowledge of mirror box therapy and how motor learning skills could be addressed through use of this intervention which limited the impact on occupational performance changes in their patients with CVA. They were also limited in that their settings (E) did not have a mirror box to utilize with patients with CVA. This project provided the solution of producing a mirror box for use in each practice setting and provided the education needed for occupational therapists to be able to implement into their practice.

For Part B, patients with CVA (P) presented with both motor and sensory impairments which limited their ability to perform ADLs and IADLs (O). The hospital setting (E) had the ability to provide a supportive environment to learn how to adapt tasks and regain movement of the affected limb. Occupational therapists had the ability to be a part of the environment to create occupational performance change with patients with CVA through the use of mirror box therapy. With the various activities that can be completed with mirror box therapy, the needs of the individual can be addressed through simple or task-oriented mirror box therapy and can be downgraded or advanced based on the response from the patient (Rodrigues, Farias, Gomes, & Michaelsen, 2016). Refer to Figure 2 for best fit for occupational performance.

Figure 2. *PEO Model Optimized with Motor Learning Model*

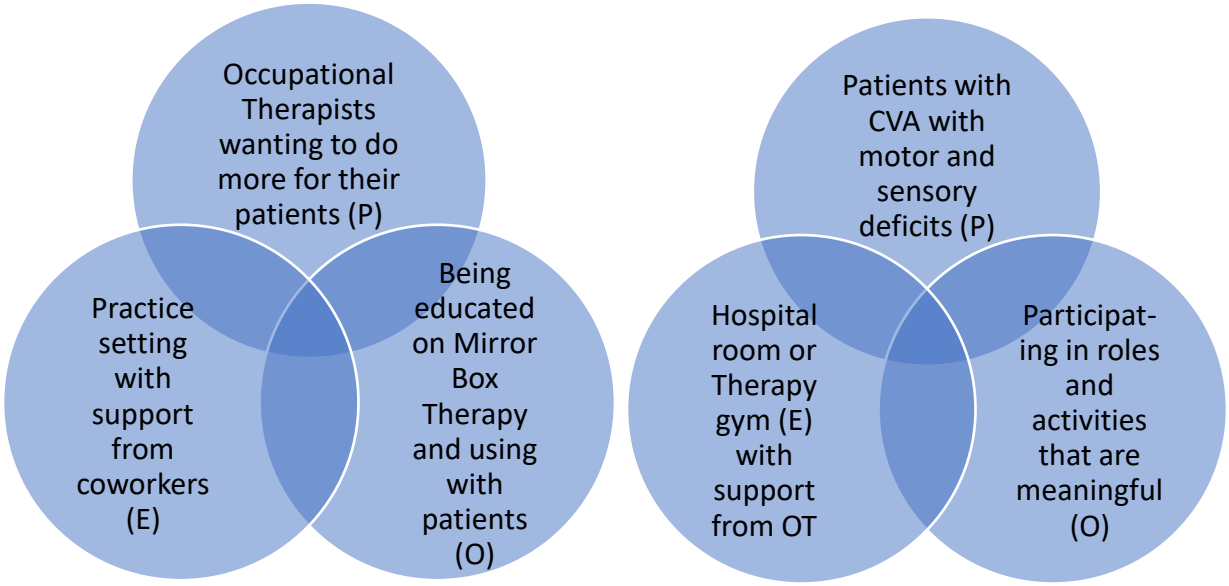


Part A *Part B*

Pragmatic worldview. Creswell (2014) emphasized that the pragmatic worldview's intention to address the what and how of research with the focus being on the end result. Vachon et al. (2010) defined this worldview as the relationship between why therapists treat the way that they do into the outside influences on practice such as insurance payments and productivity standards. For *Part A*, the educational series utilized this view by educating the therapists (P) on the purpose of mirror box therapy, how to use, and the impacts mirror box therapy could have on patients with CVA in practice settings. The intention of the educational series was to increase learning and change attitudes of occupational therapists on the use of mirror box therapy to encourage future use of this intervention for the benefit of their patients (O). The educational series provided the supportive environment (E) to increase professional knowledge. For *Part B*, the implementation of mirror box therapy, the patients with CVA (P) wanted to know how occupational therapy would help them to be able to participate in the roles and activities(O) they

did prior to injury. The hospital setting (E) provided much uncertainty about the next step in recovery. The environment also could induce feelings of anxiety and being overwhelmed due to not being in their natural home environment or surrounded with the individuals own support system. The hospital setting provided much uncertainty due to lack of communication and education on diagnoses and what to expect. The unknown could induce anxiety. Educating patients with CVA on the purpose of mirror box therapy and using to enhance occupational performance could provide the individual with the skills needed to change motor and sensory outcomes leading to increased performance in occupation.

Figure 3. *PEO Model Optimized with Pragmatic Worldview*



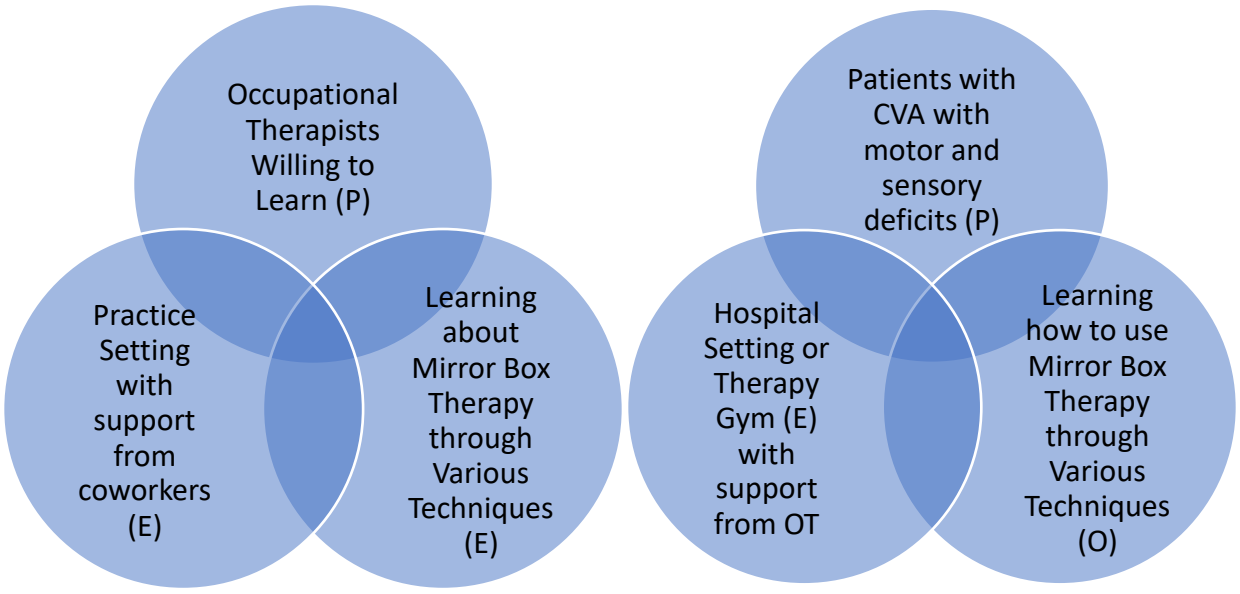
Part A *Part B*

Andragogy. Finlay (2010) discussed that it is important for adults to have a straight forward presentation of what they will learn, how they will learn it, and how it applies to them. For the adult therapist population, to encourage learning, the education must be based on

information that can be easily integrated into practice and have success (Andersen, 2001). For *Part A*, a two-part educational series was developed with the intention to educate occupational therapists (P) on the intervention of mirror box therapy, how to utilize the intervention in practice, and how to build a mirror box for use in practice and for future patient use (O). This allowed for the environment to be supportive to produce change in patient outcomes.

For *Part B*, the education provided in *Part A* provided the foundation for educating patients with CVA (P) on the benefits of use of mirror box therapy. The information needed to be presented at the patient's education level for them understand how the mirror box could be used and how it could address the deficits presented due to CVA (O). This presentation would change the environment of the hospital setting (E) to supportive by introducing a means of enabling the individual.

Figure 4: *PEO Model Optimized with Andragogy*



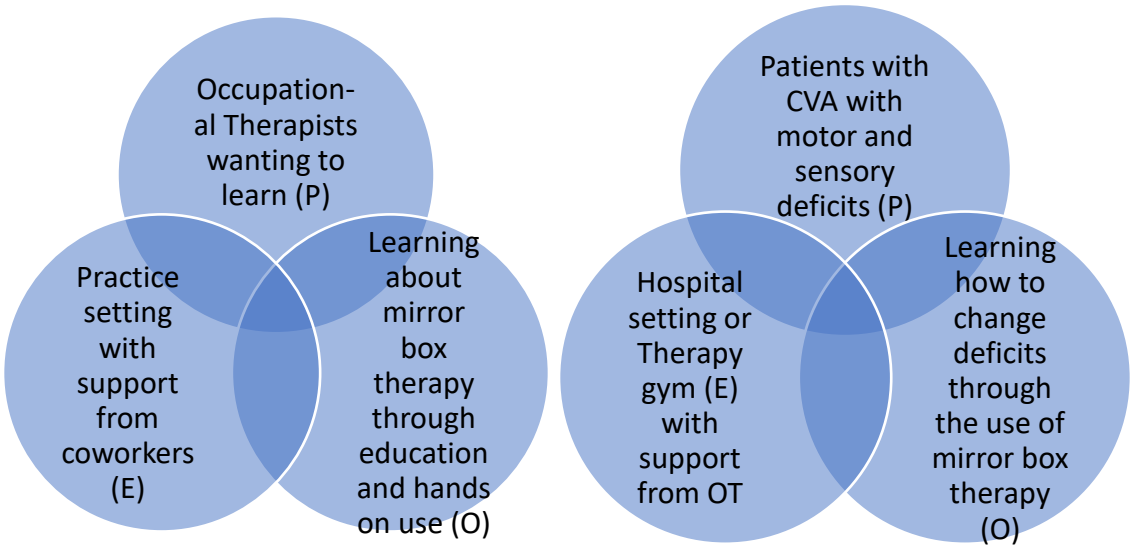
Part A *Part B*

Constructivist orientation. The focus of this orientation was to learn by doing. By utilizing this approach, experiences can evolve into beliefs and knowledge (Torre, Daley, Sebastian, & Elnicki, 2006). For Part A, this orientation guided instruction on mirror box therapy with presenting to occupational therapists (P) how to utilize with patients with CVA and then having the therapists complete hands-on learning by using the mirror box for simple and task-oriented activities to develop a better understanding of what their patients will experience (O). By demonstrating the benefit of mirror box therapy, this theory helped to evolve the intervention from a learning experience into implementation by discovery (University of California, Berkeley, 2006). Also, by presenting in this manner, it supported the environment by allowing first-hand experience how to adapt the intervention to the needs of the patient (E). Crausaz, Kelly, and Lee (2011) supported the importance of learning by doing and discussed this as an active part of learning

Further use of this orientation guided *Part B* of this study with one therapist in acute care, inpatient rehabilitation, and skilled care utilizing mirror box therapy with patients with CVA (P) and collecting data on changes in motor, sensory, and functional. Patients were educated on how the intervention worked, the benefits to them, and how it could be used as they progressed in their recovery (O). This addressed the environment by the therapist being the support the individual needed to begin working at recovery (E). The occupational therapist educating the patient on the intervention allowed for a change in knowledge while they had the hands-on experience of learning firsthand what the intervention offered by using. Having provided the change in the environment by the therapists providing the support needed could have enhanced confidence for use of the intervention for the patient. Attitudes towards use of mirror box therapy

by occupational therapists could also be influenced through learning by using the mirror box and seeing firsthand the changes in their patients.

Figure 5: *PEO Model Optimized with Constructivist Orientation*



Part A *Part B*

Overview of theories/worldviews,

The PEO model was the overarching model to guide the experience of the occupational therapist learning about mirror box therapy and utilizing in practice as well as the patient with CVA being introduced to the intervention during their occupational therapy sessions. The motor learning model guided the occupation of incorporating mirror box therapy into practice for occupational therapists and how patients with CVA would benefit from the intervention. The pragmatic worldview primarily addressed the needs of the individuals by focusing on what mirror box therapy is and how it would work for the individual. Andragogy addressed the person

and the environment by teaching the individual how to learn about mirror box therapy by utilizing learning techniques that appealed to the individual and applying that learning to the practice setting to change the support of the environment. The constructivist orientation applied to the occupation of learning by promoting understanding of the mirror box by actually using the intervention. Each model or theory helped to support and build upon the PEO model. Together, all of the models and theories focused on changing the way the person learns, how they use that learning, and how to change the environment through support to improve occupational performance.

Significance of the study

This study's intention was to improve healthcare by training occupational therapists how to use mirror box therapy to improve occupational performance outcomes of patients with CVA in all stages of recovery. These stages could include the acute stage within the first month after CVA, subacute being up to six months after CVA, and chronic being any time period after six months of experiencing a CVA. Prior to the study, therapists in this facility were not initiating learning about neurological interventions such as mirror box therapy that may be beneficial to their patients. This study provided opportunities to learn about the benefits of mirror box therapy for patients with CVA and how to implement in practice. Having therapists utilize mirror box therapy in their practice setting was intended to contribute to building of confidence with using a new intervention and firsthand experience of the changes the intervention can produce. The overall intention of *Part A* and *Part B* of the study was to provide education on mirror box therapy to change attitudes towards use of this intervention as well as build confidence through learning by doing with hopes to promote future use of mirror box therapy.

Summary

The project utilized a sequential transformative mixed methods approach in hopes of changing the attitudes of occupational therapists on the use of mirror box therapy and to determine outcome changes for the patients with CVA through the use of mirror box therapy. In *Part A*, the educational series, seventeen occupational therapists in the acute care, inpatient rehabilitation, and skilled care settings were provided with the opportunity to learn about mirror box therapy, the importance of this intervention in the treatment of patients with CVA, the differences in simple versus task-oriented approaches, the current literature supporting the use, and hands-on experience of using mirror boxes for simple and task-oriented activities to develop an understanding of how to set up patients and any difficulties that may arise with adaptations to utilize. In *Part B*, three occupational therapists utilized the intervention with their clients to track changes in motor, sensory, and ADL outcomes in the acute care, inpatient rehabilitation, and skilled care settings. Monitoring changes in these areas helped determine if findings supported the current literature. The three therapists had the opportunity to further their education on mirror box therapy through learning by applying the intervention with their patients. From their experience, the intention was for the therapists to serve as leaders in their practice settings for future use of this intervention. Gaining further knowledge allowed them to provide guidance to other staff members, transitioning these three therapists into leaders in their practice settings. This study addressed both the therapists and patients with CVA deficits in occupational performance by addressing the needs of the individual by adapting how they performed their roles and providing a supportive environment to encourage change.

Section 2: Literature Review

The needs assessment completed in the summer of 2017 identified that occupational therapists were not using mirror box therapy due to lack of knowledge of or no access to a mirror box. To guide this project, an in-depth literature review was completed to develop an understanding of the use of mirror box therapy for patients with CVA to support incorporation into practice. To encourage use in practice, an understanding of how to change behaviors in health care professionals was also needed. The literature review utilized the databases of CINAHL, EBSCOhost, ProQuest, and Google Scholar. Key terms in the search for mirror box therapy included the following: mirror box therapy, mirror therapy with adults, CVA rehabilitation interventions, mirror neurons, graded motor imagery with the neurological population, motor recovery with CVA, and sensory recovery with CVA. Key terms in the search for behavior change included the following: behavior change in healthcare professionals, attitudes towards change in adults, impressions of continuing education with adults, use of evidence-based practice with occupational therapy, and changing practice behaviors for neurological therapists. Through the literature review, a well-developed understanding of both concepts was achieved to form the basis for this capstone project.

Mirror box therapy

Mirror box therapy is a form of motor imagery that relies on the concept of neuroplasticity to promote changes in the brain to increase motor and sensory function of the affected limb (Saebo, 2018). A mirror box is constructed of reflective mirror material placed on the side of a rectangular or square box. The box has an opening at the end to place the affected limb inside. The mirror box is placed at midline of the patient with the affected upper extremity

placed inside obstructing the individual's view of the distal limb. The individual using sees a reflection of the unaffected upper extremity. Mirror box therapy works by recruiting mirror neurons to remap the brain into believing the image the individual is seeing in the mirror is the affected limb sending messages to the brain that the affected limb is moving, working without pain, and relaying the feeling of sensation of the affected limb (Guenther, 2016).

Mirror box therapy has two forms. The first type is simple mirror box therapy. Simple mirror box therapy includes basic range of motion (ROM) tasks with the unaffected upper extremity. This form focuses on the repetition of the movement to retrain the brain on formulation, initiation, and activation of movement to learn quality of movement (Mota et al., 2016). This is the simplest form of the activity and is focused only on completing the motion to address gross motor coordination deficits. This may be the most beneficial for patients with CVA that have poor sustained activity tolerance and limited active motion of the affected upper extremity (Selles et al., 2014).

The second type of mirror box therapy is task-oriented. Task-oriented mirror box therapy is occupation-based focusing on activities the patient would complete in their daily routines. Using activities that are important and practical to the individual allows for motivation to perform which can in turn positively impact occupational performance (Almhdawi et al., 2016). Task-oriented activities were also found to promote carryover by identifying activities meaningful to the individual which encouraged participation in the task (Bondoc et al., 2018; Wu et al., 2013). Paik et al. (2004) found that the use of task-oriented mirror box therapy had long term effects after completion of the study versus simple mirror box therapy. By identifying tasks that had meaning to the individual, they were more likely to continue to use the intervention of mirror box therapy to work on these tasks providing continued benefits from the intervention.

Motor Outcomes. Motor recovery from a CVA can include changes in range of motion, strength, coordination, and vision. Range of motion, strength, and coordination are the deficits most thought of when considering motor recovery (Ramachandran & Altschuler, 2009). Motor recovery includes initiation, activation, and maintenance of movement of the affected limb (Mota et al., 2016). Mirror box therapy addresses these concepts by increasing the awareness of the affected limb by relying on the reflection in the mirror. By changing the way in which the brain interprets the image it is viewing, this can create a new pathway in the brain leading it to believe the image is the unaffected arm moving. This in turn can lead to increased movement in the affected upper extremity (Mota et al., 2016). With this new movement, the concepts of gross and fine motor coordination can be addressed. Motor recovery can progress with the use of simple mirror box therapy to start the movement and progress to the use of task-oriented mirror box therapy to fine tune the movement for occupational performance (Paik et al., 2014).

Another concept of motor function is that of visuo-motor inattention. Often due to injury in the brain from stroke, an individual may suffer from neglect, hemianopsia, or decreased proprioception of the affected limb (Verstraeten, Mark, & Sitskoorn, 2016). Due to this limited awareness of the affected limb, the individual can present with decreased functional use of the limb (National Stroke Association, 2018). The mirror box utilized the reflection of the unaffected limb to address neglect by seeing a reflection of a limb that they may not have otherwise known was there or paid attention to which allowed connections in the brain to recognize that the limb existed (Guenther, 2016). The new connections formed assisted in increased awareness of the affected limb to change occupational performance in areas such as ADLs (Thieme et al., 2012). Wu et al. (2013) found that with the use of mirror box therapy, there was a greater impact of awareness of the affected limb resulting in changes in motor

function. Dohle et al. (2008) utilized the Behavioral Inattention test to assess the impact that mirror box therapy use had on attention to the affected upper extremity. They found that by focusing on the reflection of the image in the mirror that patients with stroke increased their awareness of the affected limb. Increasing motor function of the affected upper extremity can also have a direct impact on sensory recovery (Dohle et al., 2008)

Sensory Outcomes. The injury in the brain due to a stroke can result in absent or diminished sensation of touch of the affected limb. This can include light touch, deep pressure, temperature, and proprioception (Stroke Association, 2013). Sensation of the affected limb was increased by viewing the reflection of the unaffected limb. This increase in sensation was due to increased awareness through visual feedback (Lin et al., 2014; Saunders & Cassidy, 2012). With this new sensation the affected upper extremity, a new pathway was formed in the brain. This pathway was a result of the direct relationship between sight and touch (Colomer et al., 2016; Dohle et al., 2008). The use of mirror box therapy was able to positively change sensation resulting in increased awareness of the affected upper extremity (Cacchio, DeBlasis, Necozione, di Orio, & Santilli, 2009; Nilsen & DiRusso, 2014; Wu et al., 2013). Colomer et al. (2016) suggested that through visual awareness of touch that tactile perception is stimulated through functional movement. This movement can then be translated into changes in occupational performance.

Another sensory deficit that can be addressed using mirror box therapy is pain. Depending on the extent of the injury in the brain from the CVA, patients may suffer from pain in the affected limb due to changes in sensation or lack of motor function (Saebo, 2017). Mirror box therapy addressed this change in the brain by providing the image of the unaffected limb completing range of motion tasks and taking note of no pain with this activity (Cacchio et al.,

2009; Nilsen & DiRusso, 2014). The new pathway in the brain that is formed by using the mirror box had the individual believe that their affected limb can complete the tasks without discomfort.

Functional Outcomes. AOTA (2017) defined preparatory methods as a means to prepare for occupational engagement by addressing performance skills and activities as components of the occupation. Occupation-based is defined as addressing the occupation that holds meaning to the individual (AOTA, 2017). The use of mirror box can incorporate both types of these methods with either the simple or task-oriented versions being used. Mirror box therapy can address motor and sensory deficits to increase functional use of the affected upper extremity after stroke (Colomer et al., 2016). Changing the way an individual perceives how the affected arm moves and feels can promote physical changes in the affected limb such as use for occupational performance of ADLs and IADLs (Park, Chang, Kim, & Kim, 2015). DaSilva Costa, da Silveria, Clementino, de Macedo Borges, and de Melo (2016) found that increased motor function through use of mirror box therapy led to direct improvements with ADLs. Mirror box therapy emphasizes the importance of the relationship between sight and touch (Dohle, et al., 2008). This relationship is important in assisting with functional and occupational performance gains for the patient.

Benefits to the therapist and the patient. Using mirror box therapy can change motor and sensory outcomes which may result in increased occupational performance outcomes for ADLs and IADLs. Mirror box therapy can be used across all stages of CVA recovery and all practice settings while serving as a compliment to traditional occupational therapy sessions (Arya & Pandian, 2013; Brunetti et al., 2015; Gurbuz et al., 2016; Lee et al., 2012; Perez-Cruzado, Merchan-Baeza, Gonzalez-Sanchez, & Cuest-Vargas, 2017; Radajewska et al., 2013; Samuelkamaleshumar et al., 2014). Traditional therapy sessions addressed ADLs, IADLs, ROM,

strength, neuromuscular re-education, sensory re-education, and perceptual awareness to decrease deficits caused by CVA (Latham et al., 2006). Mirror box therapy can easily be incorporated into practice as a means to prepare the affected limb to participate in ADLs and IADLs and also to address these occupations directly.

Another benefit of mirror box therapy is that the tools to make a mirror box are inexpensive (Paik et al., 2014; Toh & Fong, 2012; Wooster et al, 2015). The box can be constructed out of any material as long as the view of the affected limb is impeded. Materials to make are easily accessible and can include a simple cardboard box, storage cube, or clothing hamper. The mirror material needs to be unbreakable and without sharp edges to prevent injury. It also needs to produce a clear image without distortions.

Mirror box therapy can be easy to use. The individual is set up with the mirror box placed at midline with the affected arm inside while sitting upright. The individual then moves the unaffected arm through range of motion or task-oriented activities provided by the occupational therapist specifically for that individual. The occupational therapist can initially set the individual up for the task and as recovery progresses, the individual can gain independence with learning how to set up the intervention and complete the exercises that can transition into a home exercises program (Nilsen & DiRusso, 2014).

Another factor that is of benefit to the use of mirror box therapy is that the affected limb is not required to move. This allows the intervention to be utilized across all stages of recovery from CVA and with individuals with no motor return in the affected limb at the time of use (Colomer et al., 2016). If the patient gains motor recovery, the intervention can be adapted to include the affected limb attempting the movements inside the box (Invernizzi et al., 2012).

Concerns of use. Spasticity occurs due to impairments of upper motor neurons following CVA (Franciso & McGuire, 2012). Spasticity occurs when there is an increase in tone present. When the affected joint is moved, the tone continues to increase limiting any further antagonist muscle movement (Hall & White, 2008). This can result in being unable to move the affected limb or limit gross and fine motor coordination needed to complete occupational tasks. Spasticity throughout the upper extremity may lead to impairments with ADLs, IADLs, and functional mobility (Franciso & McGuire, 2012). When using mirror box therapy, the reflection of the unaffected limb is unable to address the effects of spasticity of the affected limb. Mota et al. (2016) stated that the reflection from the mirror box is unable to impact the muscle spindles which control the movement of the affected limb. The effects of spasticity cannot be replicated in the reflection of the unaffected limb therefore that deficit is unable to be addressed with mirror box therapy (Enzendam et al., 2009; Yavuzer et al., 2008). If the client has increased spasticity following CVA, they would not be a candidate for use of mirror box therapy.

Another concern from the strength of the literature review on mirror box therapy was that no study attempted to replicate the results of prior studies. This study did not attempt to replicate another due to inconsistencies amongst intensity, frequency, and duration. Many studies selected four weeks as their duration while utilizing mirror box therapy for varied intensities of fifteen minutes to one hour per session (Arya & Pandian, 2013; Altschuler et al., 1999; Gurbuz et al., 2016; Kim et al., 2016; Lee et al., 2012; Lim et al., 2016; Park et al., 2015; Rodrigues et al., 2016; Wu et al., 2013). No reasoning was provided for the selection of dosages. These dosages were also not consistent across the stages of recovery. Comparison of dosages across stages of recovery offered a variety of dosages to utilize with no one that was identified to be optimal (DaSilva Costa et al., 2016; Rothgangel et al., 2011). While the studies support the use of mirror

box therapy, there is no way to determine the long-term effects of the intervention without replication of the studies to determine a best practice protocol for dosage, intensity, and duration as well as optimal stages of recovery and practice setting (Perez-Cruzado et al. 2017; Rothgangel et al., 2011, Thieme et al., 2012; Zeng et al., 2018). These studies were systematic reviews that contained between ten and fifteen randomized controlled trials with variations in number of patients admitted, length of study, and intensity. To determine best practice methods, further research would be needed to replicate the effectiveness of dosages throughout all stages of recovery.

Behavior change in healthcare professionals

To determine how to best utilize the literature concerning mirror box therapy to create professional change in occupational therapists, an in-depth understanding of behavior change was necessary. Behavior change can include changing of attitudes, approaches, and activity performance. Changes in functional outcomes for clients may occur if behavior changes in treatment approaches occur.

Understanding how an individual learns is important to create behavior change (Johnson & May, 2015). For healthcare professionals it is important to have educational opportunities to continue to develop professionally. Johnson and May (2015) found that education that focused on how an intervention could work in a specific setting was the most beneficial. This supported the findings of Lockyer et al. (2016) that healthcare professionals preferred teaching approaches that utilized a scaffolding approach to build upon pre-existing knowledge and preferences. Chauhan et al. (2017), Johnson and May (2015), and Stern (2001) found that healthcare professionals supported a collaborative team approach to learning. They found it beneficial to

learn in groups to be able to share and discuss ideas and concepts. To optimize behavior change through education, the learning needs to apply to the practice setting, build upon skills already learned, and promote group engagement for support (Chauhan et al., 2017; Johnson & May, 2015; Lockyer et al., 2016; Stern, 2001).

There are barriers to behavior change in healthcare professionals. These include lack of time, lack of support, and lack of awareness of how to incorporate new skills into practice. Dunleavy (2014), Johnson and May (2015), and Wellings, Gendek, and Gallagher (2017) found that common time barriers that healthcare professionals experienced were productivity standards, scheduling, and documentation standards. Wellings et al. (2017) also found that healthcare professionals felt they lacked support to make time to incorporate new skills or to seek out new opportunities to develop skills whether in clinical practice or through reading and learning from evidence-based practice. Professionals were pushed for the gains of the company but not for their own professional gains.

Holmes and Scaffa (2009) discussed that to continue to gain competence, practitioners needed to integrate evidence into practice settings. Evidence-based practice is considered a professional obligation to continue to grow as a therapist and can be considered a core competency (Bondoc & Burkhardt, 2004). Doucet (2012) found that therapists were not utilizing evidence-based practice due to not knowing where to locate information or how to use that information in practice. This led to healthcare professionals being resistive of evidence-based practice due to not having the resources or time to make use of new learning. Not having time available to begin to incorporate new skills learned into practice, lack of support, and lack of awareness of new skills resulted in healthcare professionals not professionally growing and developing.

It is important to find the right fit for learning and practice to change behaviors in healthcare professionals. Introducing new skills through practice, using evidence-based practice, and tying the two skills together is important to professionally grow but these concepts must address the needs of the professional for follow through (Bondoc & Burkhardt, 2004). With enough support, behavioral changes can be made with healthcare professionals. These changes could lead to enhanced treatments in their practice settings, which may lead to increased outcomes for patients. Doucet (2012) discussed the importance of optimizing outcomes for patients by using all tools available to the profession of occupational therapy. Encouraging the use of evidence-based practice is very important to continue to grow the profession (Dubouloz, Egan, Vallerand, & von Zweck, 1999).

Summary,

Mirror box therapy can improve motor and sensory deficits in individuals with CVA (Saunders & Cassidy, 2012). There is a direct relationship between the senses of sight and touch which can lead to improvements with active movement and sensation of the affected limb. Ramachandran and Althschuler (2009) stated that "restoring congruence between vision and motor output can lead to an unlearning of learned paralysis in stroke patients" (p. 1702). Bolognini, Russo, and Edwards (2016) determined that motor recovery was directly impacted by sensory impairments. Improvements in motor and sensory deficits can lead to improvements in occupational performance such as changes in ADLs or IADLs (Park et al., 2015). Mirror box therapy can also decrease pain with activity, resulting in increased ability to participate in functional tasks (Cacchio et al., 2009). Mirror box therapy has no impact on changing spasticity in the affected upper extremity due to the mirror box being unable to address the muscle spindles (Mota et al., 2016). The literature has demonstrated the need for further research to develop a

protocol to determine optimal dosages and long-term impacts of use of mirror box therapy on the affected upper extremity of patients recovering from stroke (Thieme, Mehrholz, Pohl, Behrens, & Dohle, 2013).

Behavior change in healthcare professionals is an important concept to understand. Healthcare professionals prefer education that relates specifically to their practice, learning in groups, and education that continues to build on established skills. They feel limited by lack of time, support, and understanding of how to implement new skills into practice. (Johnson & May, 2015). With mirror box therapy, behavior change in therapists would mean developing their understanding of mirror box therapy with patients with CVA, supporting the use of the intervention in all practice settings, and assisting with future incorporation into practice by other occupational therapists. Changing behavior in healthcare professionals could lead to increased use of mirror box therapy to promote motor and sensory outcome changes to encourage increased functional outcomes.

To provide the opportunity for change to occur in both occupational therapists and patients with CVA, first the values and interests of the individual must be taken into consideration. From this, an activity analysis is needed to understand where deficits may occur and how to address. The environment needs to be supportive to guide change. To address all the areas of person, environment, and occupation can lead to behavior changes in use of mirror box therapy as well as occupational performance changes for patients with CVA in the areas of ADLs and IADLs (Law et al., 1996; Strong et al., 1999; Vachon et al., 2010).

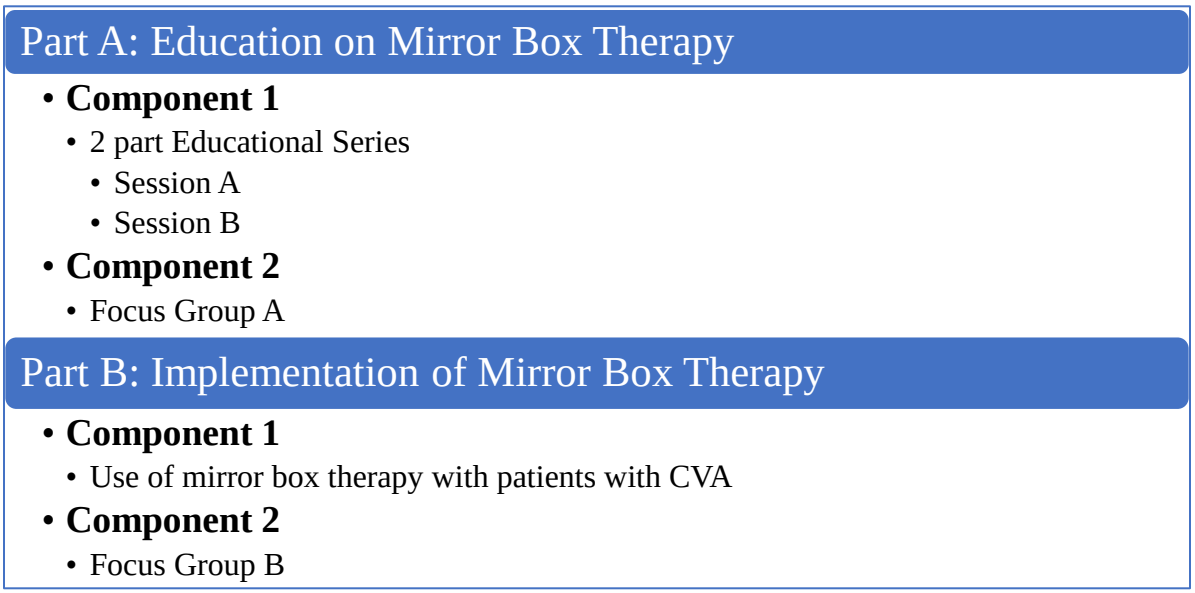
Section 3: Methods

Project design

This project developed from a needs assessment completed in June 2017 (Appendix A). The needs assessment consisted of a survey with questions concerning the use of mirror box therapy, why therapists were using or not using, and if they were using a protocol. From the needs assessment, it was determined that some occupational therapists were not using mirror box therapy due to not knowing about the intervention or not having access to a mirror box. If therapists were using, they were not using for the stroke population and instead using for pain management in patients with complex regional pain syndrome.

This study utilized a mixed methods sequential transformative design to determine the impact of education on mirror box therapy on occupational therapists' attitudes and behaviors towards use and their clients' occupational performance outcomes following use. Hospital and university Institutional Review Board (IRB) approval from obtained (See Appendix B). The study was divided into two parts. *Part A* of this study was to determine if education on mirror box therapy could change the attitudes towards the use of the intervention and evidence-based practice amongst occupational therapists. *Part B* of this study was to determine if the use of mirror box therapy could impact occupational performance outcomes of patients with CVA and the attitudes toward use of mirror box therapy of the therapists implementing the intervention. Figure 6 demonstrates organization of *Parts A* and *B* of this study.

Figure 6. *Organization of Capstone Project*



Setting

The study was completed at two suburban southeast facilities. These hospitals provided the opportunity to work in the acute care, inpatient rehabilitation, and skilled nursing settings. Having a variety of practice settings available allowed for a diverse collection of therapists and clients to partake in the study. Seventeen occupational therapists with varying levels of practice experience, averaging over fourteen years, were recruited to participate in the educational series. This included eight acute care therapists, four inpatient rehabilitation therapists, and five skilled nursing therapists. The acute care setting offered two hundred and forty beds, inpatient rehabilitation offered fourteen beds, and skilled care offered twenty-four short term beds.

Inclusion/exclusion criteria

The occupational therapists in the study were selected from a convenience sample of those working in the hospital systems. Therapist choice was based on those that would have

access to treating patients with CVA in their assigned setting. From the twenty-six therapists working for the corporation, ten therapists were excluded from this study. Of those ten occupational therapists, eight therapists specialized in hand therapy and did not work directly with patients with CVA. One therapist worked only in the pediatric setting and therefore did not have access to adult patients with CVA. One therapist worked exclusively with the neurological population and had used mirror box therapy in treatment, possibly presenting a biased attitude towards the intervention, therefore that therapist was excluded from the study.

Recruitment of patients with CVA was also based off a convenience sample. Adult patients that were currently admitted onto the acute care, skilled care, or inpatient rehabilitation units of the two hospitals were available for inclusion in this study. Inclusion criteria for these patients included: diagnosis of CVA with current evidence of hemiparesis or hemiplegia and/or evidence of sensory deficits. Exclusion criteria included clients with CVA but not medically stable, no motor or sensory deficits, and those with impaired cognition resulting in being unable to follow directions to participate in the intervention as determined upon the occupational therapist's evaluation.

Project Methods

Part A. *Part A: Component 1* of this study began with a two-part educational series for seventeen occupational therapists in the acute care, inpatient rehabilitation, and skilled care settings (See Appendix C). Each session lasted approximately seventy-five minutes each. The first session began with gaining consent from the occupational therapists followed by a quantitative pretest to determine their knowledge of mirror box therapy (See Appendix D). Questions reviewed what deficits and diagnoses could be treated with mirror box therapy as well

as benefits of use to the occupational therapist and the patient with CVA. Their first session included education on what mirror box therapy is, what diagnoses could be treated with this intervention, the deficits that can be addressed by this intervention, the difference between simple and task-oriented mirror box therapy, and the importance of this intervention's use with the stroke population. The session ended with a discussion of how to build a mirror box, materials that could be used, and the importance of teaching our patients how to build and use for follow through upon discharge to home. The second session began with a brief review of the first session followed by each department using the mirror box to complete both simple and task-oriented activities amongst therapists to gain an understanding of what their patients may experience. This session also included a review of the current evidence supporting the use of mirror box therapy with patients with stroke broken down by acute, subacute, and chronic stages of recovery. The discussion was followed by a brief overview of the *Part B: Component 1* of the study involving data collection on the use of mirror box therapy with patients with CVA. A quantitative post-test was given, and all questions and answers were reviewed in group discussion following completion of post-test. *Part A: Component 2* involved completion of a qualitative survey and 25-minute focus groups to discuss expectations of the learning, intentions of future use of mirror box therapy, and intentions of future use of evidence-based practice (See Appendix E). Peer debriefing was completed at the end of all focus groups.

Part B. *Part B: Component 1* of this study included having one occupational therapist from acute, inpatient rehabilitation, and skilled care, three occupational therapists total, incorporating mirror box therapy into practice for a period of four weeks. Patients with CVA were included in the study at any time during the four-week period. Patients were recruited by the therapists after occupational therapy orders had been received and it was determined the

individual had motor or sensory deficits of the affected upper extremity. Participant consent was obtained for participation in the study by the assigned occupational therapist. Duration of mirror box therapy use was dependent upon the patient's length of stay, with treatment being no longer than the four-week period. Mirror box therapy treatment was provided three to five times per week for ten to fifteen-minute sessions. Therapists were required to complete simple mirror box therapy for the allotted time period and may transition to task-oriented if the patient would benefit at that time. Simple mirror box therapy consisted of the unaffected limb completing supination, pronation, wrist flexion, wrist extension, ulnar deviation, radial deviation, digit flexion, digit extension, and digit opposition. Traditional occupational therapy was also provided, and length was dependent upon practice setting and admission stay. See Appendix F for data collection sheet. At the end of data collection, *Part B: Component 2* involved the three therapists that implemented the intervention in their practice setting participating in a 30 minute focus group to answer qualitative questions based on how using the mirror box has changed their confidence, their plans for use in the future, how their opinion on evidence-based practice has changed from educational series, and how they felt this experience of learning and using has impacted and will continue to impact their respective departments (See Appendix G). Peer debriefing was completed through the process of implementation and the focus groups.

Part A Data Collection

Part A: Component 1 data collection began with collection of the number of correct answers from the pre-test that occurred during educational session 1. These results were entered into a table in Microsoft Excel (2013). A post-test was provided at the end of *educational session 2*. These results were also entered into a table in Microsoft Excel to compare to pre-test number of correct answers.

Part A: Component 2 data collection occurred through four informal focus group at the end of the second educational session. Seventeen total occupational therapists participated. Seven structured questions were presented with probing questions throughout. Seven open-ended questions were provided to identify optimal learning techniques for therapists, their impression of evidence-based practice, their impression of mirror box therapy, how they plan to use in the future, and how their confidence to use the intervention has been impacted. Each focus group was transcribed, but not audio recorded due to technical difficulties. Participant pseudonyms were implemented to separate therapists from their responses. See table 2 below.

Table 2. *Pseudonyms for Therapists Participating in Part A and Part B*

Pseudonyms for Occupational Therapists Participating in Study			
Therapist	***Setting***	***Years Experience***	***Gender***
A1	Acute Care	12	F
A2	Acute Care	22	F
A3	Acute Care	3	M
A4	Acute Care	25	M
A5 *	Acute Care	23	F
A6	Acute Care	20	F
A7	Acute Care	5	F
A8	Acute Care	20	F
R1	Inpatient Rehabilitation	14	F
R2 *	Inpatient Rehabilitation	16	F
R3	Inpatient Rehabilitation	11	F
R4	Inpatient Rehabilitation	11	F
S1	Skilled Nursing	22	M
S2	Skilled Nursing	15	F
S3	Skilled Nursing	9	M
S4 *	Skilled Nursing	17	F
S5	Skilled Nursing	6	F

- * signified therapist also participated in Part B

Part B Data Collection

Part 2: Component 1 involved the three investigating therapists gathering information on time since onset of CVA, length of stay, and number of mirror box therapy sessions. These therapists also collected data in a pre-test, post-test manner for changes in range of motion (ROM), muscle strength, sensation, and Functional Independence Measure (FIM) score (See Appendix F). FIM scores on ADL levels were based on initial assessment of the patient and post use of the intervention for level of independence using a one to seven scale with one being dependent level of assistance and seven being complete level of independence (Keith, Granger, Hamilton, & Sherwin, 1987).

These areas were assessed as part of each patient's evaluation upon receiving occupational therapy orders increasing the reliability and validity of the assessment. Therapists were trained to utilize these assessments following standardization of procedures to ensure replication abilities in range or motion and manual muscle testing as well as the FIM. All three therapists that completed implementation of mirror box therapy were FIM certified.

Patients' expectations of treatment and their opinion of the treatment after completion was also collected at the end of each session. All areas of data were collected after each session. All data was entered into table in Microsoft Excel for comparison. Specifics of assessment for each area listed in Table 3 below.

Table 3. ***Outcome Measures for Patients with CVA Data Collection***

Outcome Measures Part B Component 1	
Range of motion	Shoulder flexion, shoulder extension, elbow flexion, elbow extension, supination, pronation, wrist flexion, wrist extension

Muscle Strength	Shoulder flexion, shoulder extension, elbow flexion, elbow extension, supination, pronation, wrist flexion, wrist extension
Sensation	Intact, hypersensitive, diminished, absent
FIM	Eating, grooming, bathing, upper extremity dressing, lower extremity dressing

Part B: Component 2 utilized a focus group with the three investigating therapists at the end of the four-week data collection period. Seven open-ended questions were posed including how using mirror box therapy has changed their confidence levels for future use, how their impression of evidence-based practice has changed, how their impression of mirror box therapy has changed, how they felt this study has changed attitudes towards the intervention in their departments, and how they intend to use evidence-based practice and the intervention in the future. Two therapists, the acute care and inpatient rehabilitation therapist, attended the focus group which was recorded using Samsung voice. The skilled care therapist was unable to attend, and a phone interview was conducted. This interview was not recorded, but comprehensive notes were taken throughout. Both the focus group and phone interview were transcribed by hand.

Data Analysis

Quantitative Data. *Part A: Component 1* was assessed by collecting data on the percentage of correct answers at the pre-test versus the number correct at post-test and what questions had the greatest amount of change. Sample t tests were used to compare pre and posttest correct scores (Taylor, 2017). This determined the impact of the educational series in changing knowledge through incorporating all forms of learning: auditory, visual, and kinesthetic learning.

Part B: Component 1 implemented use of mirror box therapy to collect data on changes in range of motion, muscle strength, pain, and FIM levels. Range of motion measures were compared through the degrees of change. Manual muscle strength was recorded in fractions. Due to incorporation of positive and minuses in documentation of these levels, the fractions were converted to a nominal scale to compare data (Table 4). Sensation was assessed using a verbal feedback scale. These responses were also converted to a nominal rating scale for analysis (Table 5). FIM levels were also based on nominal scale with word association for levels of assistance (Table 6). Data for each patient and each area of assessment was compared. Paired t-tests were run to determine if changes were significant.

Table 4. *Nominal Scale for Manual Muscle Strength*

Manual Muscle Strength Scoring	
Rating	***Nominal Scale Association***
5/5	10
4/5	9
4-/5	8
3+/5	7
3/5	6
3-/5	5
2+/5	4
2+/5	4
2/5	3
2-/5	2
1/5	1
0/5	0

Table 5. *Nominal Scale for Sensation (Wordpress, n.d.)*

Sensation Scoring	
Sensation	***Nominal Scale Association***
Absent	0
Hypersensitive or Diminished	1
Intact	2

Table 6. *Nominal Scale for FIM Changes (Keith et al., 1987)*

Functional Independence Measure (FIM) Scoring	
FIM Word Association	***FIM Nominal Scale Association***
Independent	7
Modified Independent	6
Supervision	5
Min A	4
Mod A	3
Max A	2
Dep A	1

Qualitative data. Focus groups were completed post educational series in *Part A: Component 2* and post use of mirror box therapy with patients with CVA in *Part B: Component 2*. This data was combined for analysis to determine the full extent of the experience of learning about mirror box therapy and utilizing in practice while developing a deeper understanding of why and how a change in attitude toward use occurred. Following transcription of all sessions, Braun and Clarke (2006)'s six phase process of thematic analysis was used. After transcription and familiarization with the information, data was initially coded. All data was reviewed, and initial codes were generated. From this, identification of broader themes were found to organize information. Upon review of themes, information was reorganized or discarded to be checked in

relation to initial codes and overall data. The next step was refinement of emerging themes, labeling of these themes, and development of discussion of the therapists' experiences.

To strengthen the validity of the *Part A* of the study triangulation was used through the combination of a quantitative pre-test/post-test and qualitative focus group. This allowed for two strategies to interpret information on learning (Lysack, Luborsky, & Dillaway, 2017). The changes demonstrated from the quantitative pre-test post-test questionnaire would be further expanded upon in the qualitative focus group to develop a better understanding of the learning experience in this sequential transformative design

Ethical considerations

One of the ethical considerations was that participation by occupational therapists and patients with CVA was voluntary. Occupational therapists and patients signed consents prior to participation in *Part A* and *Part B* of the study. Therapists implementing mirror box therapy in practice settings were trained and approved to gather consents from patients with focus on educating the patient on the purpose of the study, expectations, and risks involved.

Creswell (2014) discussed an important ethical consideration of not disrupting the site. This held true in all settings as there needed to be little to no interference with other staff or patients so the focus would be on the use of mirror box therapy. The hospital setting has its own dynamic with multiple disciplines requiring time and space to interact with patients. For *Part B: Component 1*, the setting was a hospital room or therapy gym. This was not the natural home setting for the patient but was considered their temporary normal. If the participants in this study altered the environment that the intervention took place in through changing the setup of the treatment room, providing distractions from other disciplines, or completing the intervention

outside of scheduled treatment time, they would be disrupting the temporary setting for the intervention to take place in which may have negative implications for the ability to use mirror box therapy. Distractions could be present taking away from the impact of the intervention.

The intervention of mirror box therapy may or may not be successful in changing patient outcomes in each setting, but the intent of the project was to determine if results of this study could be supported with current evidence. Creswell (2014) stressed the importance of not only providing positive results but providing negative responses as well to define the experience. For reporting results of perception of therapists towards learning, therapists needed to be prompted to be honest and forthright with their opinions (Taylor, 2017).

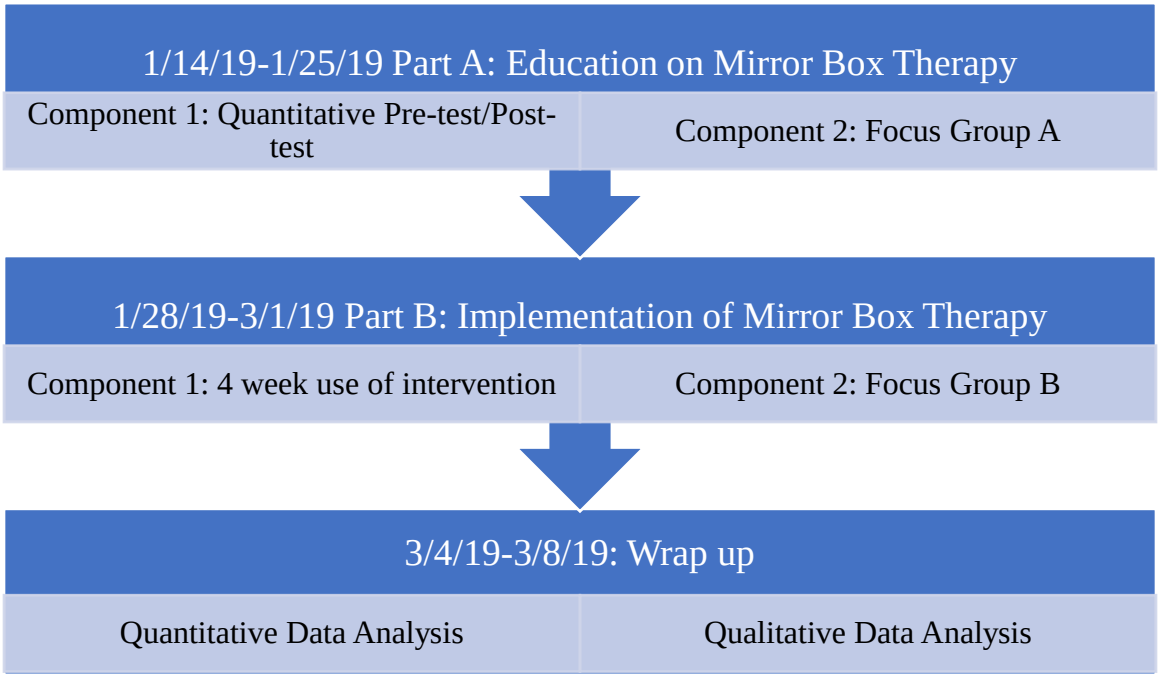
The final ethical consideration was concept of nonmalificence. AOTA (2015) defined this as "personnel shall refrain from actions that cause harm" (p. 3). Through the educational series, therapists learned what criteria patients needed to meet to benefit from mirror box therapy. When implemented, it was assumed that therapists would follow these guidelines and not place patients at undue risk for harm. This was reinforced through signing of consents for the therapists participating in part one of the study and the patients participating in part two of the study. The Institutional Review Board Approval was received from the healthcare facilities and also Eastern Kentucky University.

Timeline of project procedures

After IRB approval, the *Part A* educational series began on January 14th, 2019 and ran for two weeks between both Wheeling Hospital and Belmont Community Hospital. Part B, implementation of mirror box therapy, ran for four weeks from January 28th, 2019 through February 22nd, 2019 in the acute care, inpatient rehabilitation, and skilled nursing settings.

Treatment was provided three to five times per week for ten to fifteen minutes per session. Data was analyzed for both *Parts A* and *B* of the study and results were shared with occupational therapists that participated in all parts of the project. Total time for this study was seven weeks. Timeline for entire project in Figure 7.

Figure 7. *Timeline of implementation*



Section 4: Results and Discussion

Data was collected in two parts, *Part A* and *Part B*. *Part A* was a two-part educational series on mirror box therapy with occupational therapists. Data was collected in quantitative form through a pre-test post-test (*Component 1*) and qualitative form through an end of series focus group (*Component 2*). *Part B* involved the use of mirror box therapy with patients with CVA. Data was collected in quantitative form on changes in ROM, muscle strength, sensation, and FIM scores (*Component 1*). Qualitative data was collected from an end of experience focus group with the three occupational therapists that had utilized mirror box therapy with patients with CVA (*Component 2*).

Quantitative results: Part A Component 1

Seventeen occupational therapists participated in an educational series that was two sessions. Eight therapists were from the acute care setting, four from the inpatient rehabilitation setting, and five from the skilled care setting. These therapists had an average of 14.7 years work experience with years of experience ranging from three years to twenty-five years. No therapists participating in the educational series had previously used mirror box therapy.

Figure 8. *Overview of Therapists Participating*

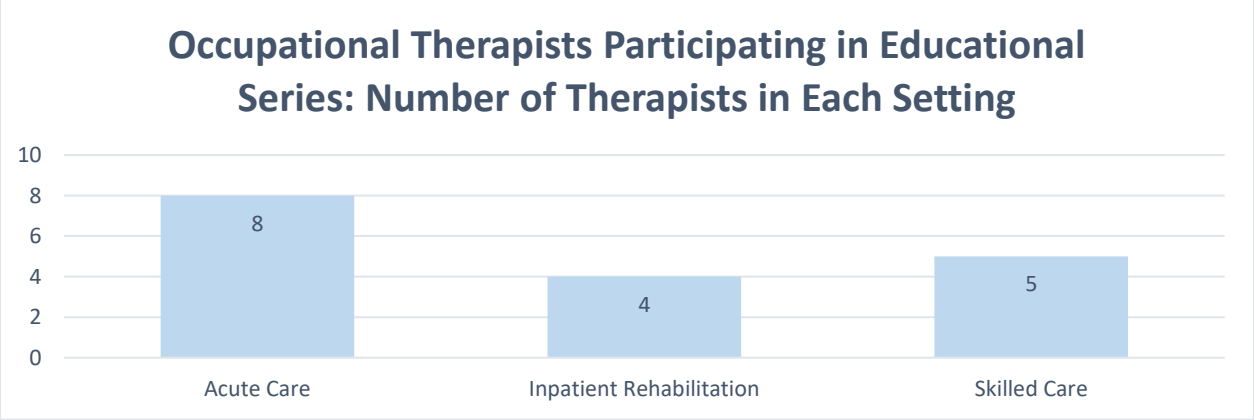
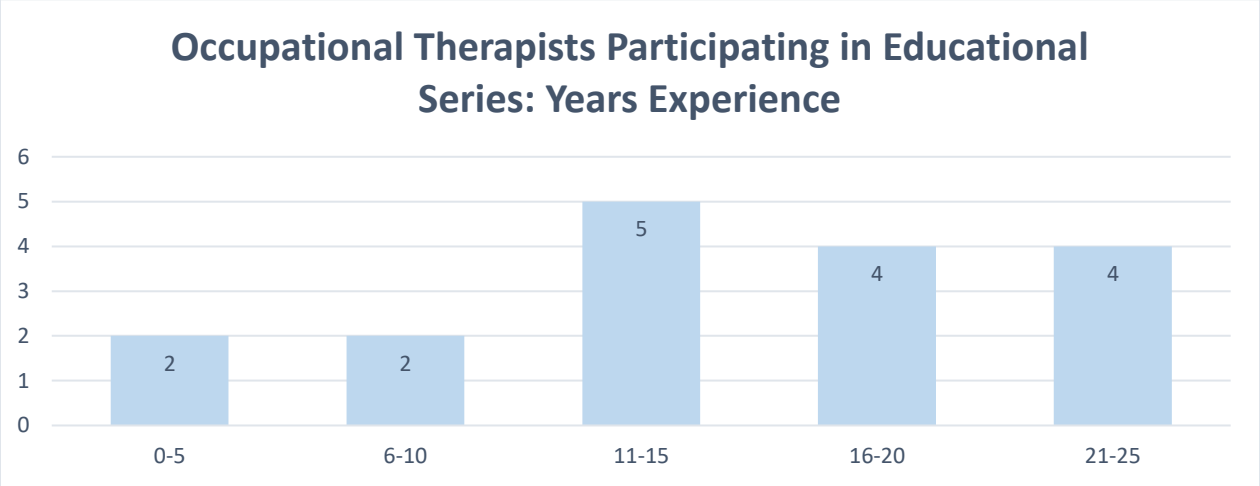
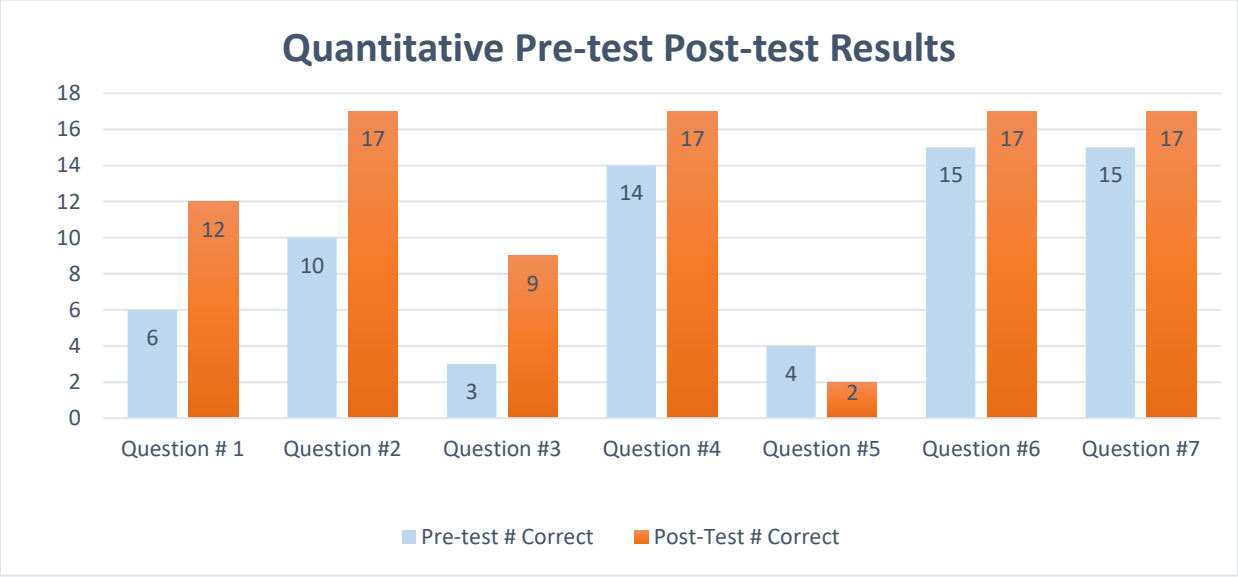


Figure 9. *Overview of Years Experience*



Prior to completion of the educational series, therapists were provided a seven-question multiple choice questionnaire to determine level of knowledge of mirror box therapy (See Appendix D). At completion of the series, therapists were given the same questionnaire to determine change in learning. Results of the questionnaire are in Figure 10. Questionnaires were reviewed with therapists upon completion of the post-test to reinforce information learned.

Figure 10. *Overview of Quantitative Questionnaire Results from Educational Series*



Six out of seven questions produced a positive change in results. Questions 1,2, and 3 had the greatest amount of change. Four out of seven questions had all seventeen therapists answer correctly at post-test. Questions 6 & 7, involving benefits for the therapist and the patient, presented the most consistency with correct responses on pre and post-test. For a comparison of all test scores, a paired t-test was completed with a two tailed p value of .034. Upon discussion of the answers to all questions, therapists reported not fully reading questions prior to answering or reading too much in to the question. Other therapists reported that they often overlooked the phrasing of select all and chose the first option they recognized. Question 5 referred to the differences in simple and task-oriented mirror box therapy. Many therapists stated they selected ROM as task-oriented because they felt that had to complete ROM to be able to complete task-oriented activities.

Quantitative results: Part A Component 2

Three occupational therapists participated in utilizing mirror box therapy with patients with CVA. Ten patients total were admitted to the study. Six patients were on acute care, three were on the inpatient rehabilitation unit, and one patient was admitted to skilled care. Three of the ten patients were lost due to attrition. Two patients on the acute care unit did not receive three sessions of mirror box therapy due to discharge or refusal of therapy. One patient was lost from skilled care due to a change in medical status. Seven patients total received over three sessions of mirror box therapy during their admissions. Due to inconsistencies in the number of patients in each setting, the inpatient rehabilitation and skilled care therapist had the opportunity to cover on the acute care unit during the length of the capstone project to increase their exposure to use of mirror box therapy. Figures 11 and 12 represent the number of patients each therapist treated. Figure 13 represents the number of mirror box therapy sessions per patient. Tables 7 and

8 represent patients with CVA demographics and total minutes for mirror box therapy and traditional occupational therapy. For clearer organization of data, patients were arranged by setting with patients 1-4 being in acute care and 5-7 in inpatient rehabilitation.

Figure 11. *Patients with CVA Treated with Mirror Box Therapy Per Occupational Therapist*

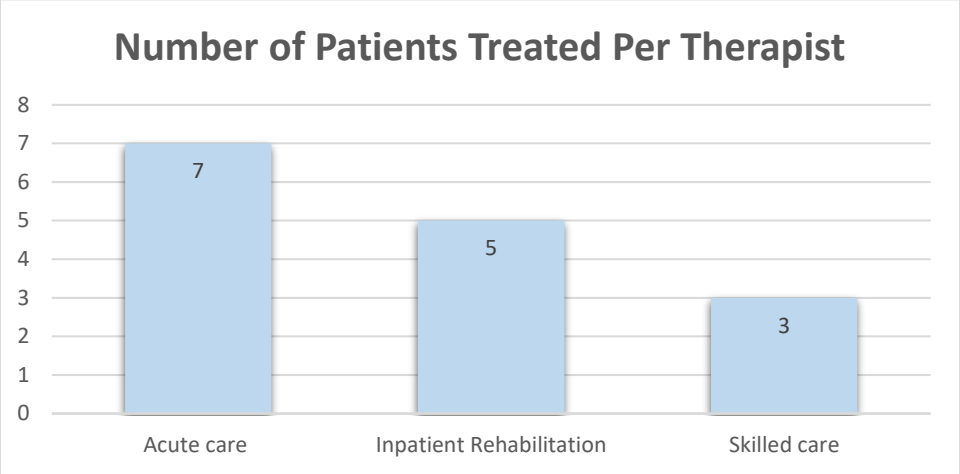


Table 7. *Patients with CVA Demographics*

Patient Demographics					
Patient	**Age**	**Sex**	**Days from onset of CVA**	**Practice Setting**	**R or L hemiparesis**
Patient 1	67	F	1	Acute care	L
Patient 2	62	F	7	Acute care	R
Patient 3	60	M	2	Acute care	L
Patient 4	80	F	1	Acute care	R
Patient 5	56	M	5	Inpatient rehabilitation	L
Patient 6	50	M	10	Inpatient rehabilitation	L
Patient 7	55	M	7	Inpatient rehabilitation	L

Figure 12. *Patients per Setting Treated by Each Therapist*

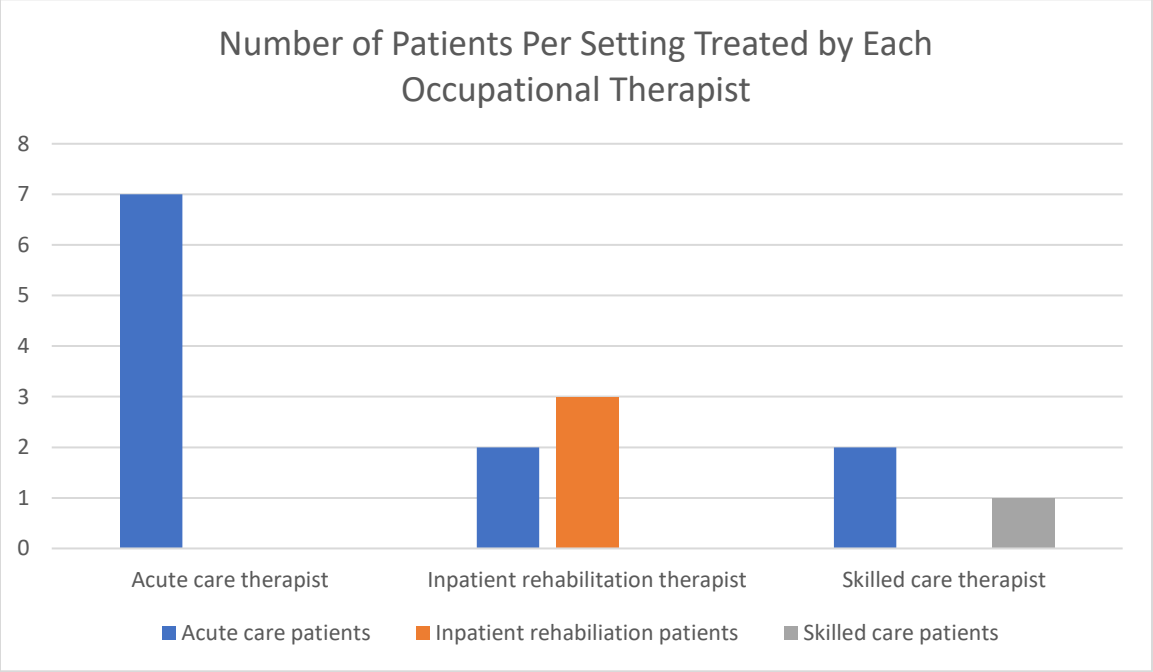


Figure 13. *Number of Mirror Box Therapy Sessions Received Per Patient with CVA*

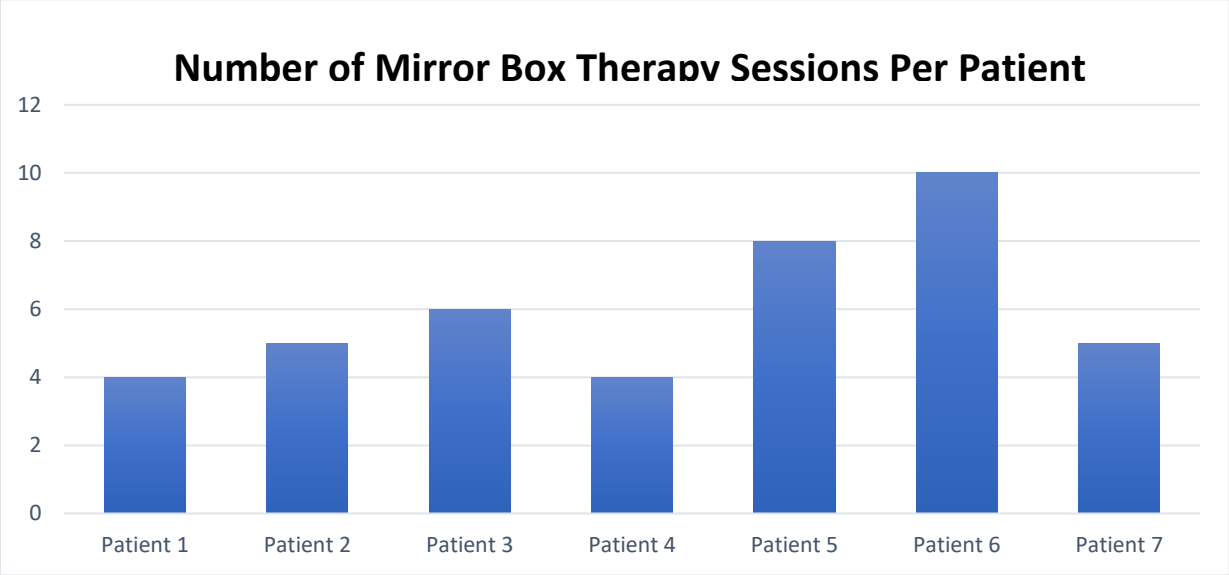


Table 8. *Patients with CVA Mirror Box Therapy and Conventional Occupational Therapy Times*

Overview of Patient Experience				
Patient	**Setting**	**Number of Mirror Box Therapy Sessions**	**Mirror Box Total Therapy Time**	**Additional Total Occupational Therapy Time**
Patient 1	Acute care	4	60 minutes	46 minutes
Patient 2	Acute care	5	75 minutes	120 minutes
Patient 3	Acute care	6	90 minutes	106 minutes
Patient 4	Acute care	4	60 minutes	40 minutes
Patient 5	Inpatient rehabilitation	8	120 minutes	587 minutes
Patient 6	Inpatient rehabilitation	10	150 minutes	1000 minutes
Patient 7	Inpatient rehabilitation	5	75 minutes	585 minutes

Patient 1. Patient 1 received four sessions of mirror box therapy. She did not demonstrate changes in ROM, muscle strength, or sensation. She demonstrated changes in FIM scores for upper body dressing from minimal assistance to supervision upon discharge. Patient did report inconsistent differences in sensation and proprioception after use (Table 9). Refer to Appendix H for patient results.

Table 9. *Patient 1 Responses to Mirror Box Therapy*

Patient 1 Responses to Use of Mirror Box Therapy
"Weird. It feels like my hand in the box is doing exactly what the R one is doing."
"Feels the exact same thing with the left hand in the box."
"I don't know. I had a bad night."
"Sensation of touching the box makes me feel nauseous."
"It's no different. I think the right one is worse."

Patient 2. Patient 2 received five sessions of mirror box therapy. She demonstrated changes in all areas of assessment. For ROM, she demonstrated changes in shoulder flexion and extension. For muscle strength, she demonstrated changes in wrist flexion and extension. For sensation she demonstrated change from diminished to normal for shoulder, elbow, wrist, and hand. She also demonstrated changes in eating on the FIM scale. Patient 2 reported one episode of sensation change with use of mirror box therapy (Table 10). Refer to Appendix I for patient results.

Table 10. *Patient 2 Responses to Mirror Box Therapy*

Patient 2 Responses to Use of Mirror Box Therapy
"Feels like right side isn't there."
"Still feels like right arm isn't there."
"Can feel my arm."
"Doesn't feel any different."
"No change."

Patient 3. Patient 3 received eight sessions of mirror box therapy. He did not demonstrate changes in ROM, muscle strength, or sensation. He demonstrated changes in FIM scores for eating from dependent assistance to maximal assistance. Patient 3 presented with expressive aphasia and was unable to report any changes in sensation with use (Table 11). Refer to Appendix J for patient results.

Table 11. *Patient 3 Responses to Mirror Box Therapy*

Patient 3 Responses to Use of Mirror Box Therapy
Pt offered no opinion throughout and had difficulty with expressive communication.

Patient 4. Patient 4 received four sessions of mirror box therapy. She did not demonstrate changes in ROM, muscle strength, or sensation. She did demonstrate changes in FIM scores for eating from maximal assistance to moderate assistance. Patient 4 reported awareness of sensation of the affected arm but did not elaborate on what she was feeling. Refer to Appendix K for patient results.

Table 12. *Patient 4 Responses to Mirror Box Therapy*

Patient 4 Responses to Use of Mirror Box Therapy
"It feels ok."
"It's good."
"It doesn't feel any different."

Patient 5. Patient 5 received eight sessions of mirror box therapy. He did not demonstrate changes in ROM or sensation. He did demonstrate changes in muscle strength for elbow flexion, elbow extension, supination, pronation, wrist flexion, and wrist extension. He also demonstrated changes in FIM scores for grooming, bathing, and upper extremity dressing from supervision to modified independent. Lower extremity dressing changed from minimal assistance to modified independent upon discharge. Patient 5 reported changes in sensation and provided detailed feedback of what he was experiencing while using the mirror box. Refer to Appendix L for patient results.

Table 13. *Patient 5 Responses to Mirror Box Therapy*

Patient 5 Responses to Use of Mirror Box Therapy
"Nothing feels different."
"Feels like left hand is levitating." "Tingling sensation feels diminished."
"Tingling and numbness has decreased to just my knuckles when it used to be the whole hand."
"I feel like I'm going crazy. It's confusing me. The numbness is relieved from the last session."

“Numbness moved from my whole hand to only my ring and pinky fingers.”
“Tingling in fingers is less.”
“Intensity of numbness is not what is used to be.”

Patient 6. Patient 6 received nine sessions of mirror box therapy. He did not demonstrate changes in sensation. He demonstrated changes in ROM for shoulder flexion, shoulder extension, and elbow flexion. He also demonstrated changes in muscle strength for shoulder flexion, shoulder extension, elbow flexion, supination, pronation, wrist flexion, and wrist extension. Patient 6 reported sensation changes throughout and described this through activities and movements he felt he could complete. Refer to Appendix M for patient results.

Table 14. *Patient 6 Responses to Mirror Box Therapy*

Patient 6 Responses to Use of Mirror Box Therapy
“Can feel left shoulder wanting to try to move.”
“Nothing feels different.”
“I feel like my coordination is improving.”
“Feels like I should be able to move my left arm.”
“I feel my hand wanting to start to move.”

Patient 7. Patient 7 received five sessions of mirror box therapy. He demonstrated no changes in sensation throughout. He did demonstrate changes in ROM for wrist flexion. For muscle strength, he demonstrated changes in shoulder flexion, shoulder extension, elbow flexion, elbow extension, supination, pronation, wrist flexion, and wrist extension. For FIM scores, he demonstrated changes in eating and grooming from modified independent to independent, bathing from supervision to modified independent, upper extremity dressing from supervision to independent, and lower extremity from minimal assistance to supervision. Patient 7 reported

sensation changes throughout and described through his ability to concentrate and activities he could complete after completion of use. Refer to Appendix N for patient results.

Table 15. *Patient 7 Responses to Mirror Box Therapy*

Patient 7 Responses to Use of Mirror Box Therapy
"The more you concentrate on the mirror and block things out, you can get the left hand to go. I felt that it was my left hand moving when I looked in the mirror."
"Easier to concentrate on mirror when performing exercises. Too hard to concentrate on the mirror when asked to complete more involved tasks."
"Twitching in left elbow and this is a new feeling. If I concentrate, I can feel my left arm moving."
"Treatment is alright."
"Treatment was cool. I can feel my left arm and it is almost normal."

Overview of Part B Quantitative Data. Changes in all assessment areas occurred during the study. Four out of seven patients demonstrated ROM changes. Four out of seven patients also demonstrated changes in muscle strength. One patient out of seven demonstrated changes in sensation, however five out of seven patients reported sensation changes following use of the mirror box. All seven patients demonstrated changes in FIM scores. Data contained in Tables 16-19. Significance was assessed through the use of paired t-tests.

Table 16. *Significance of changes in ROM*

ROM Changes for Patients with CVA	
Patient #	***Significant or Not Significant***
Patient 2	Not significant, p=.22
Patient 4	Not significant, p=.35
Patient 6	Not significant, p=.14
Patient 7	Not significant, p=.35

Table 17. *Significance of changes in Muscle Strength*

Muscle Strength Changes for Patients with CVA	
Patient #	***Significant or Not Significant***
Patient 2	Not significant, p=.17
Patient 5	Significant, p=.009
Patient 6	Significant, p=.005
Patient 7	Significant, p=.0001

Table 18. *Significance of changes in Sensation*

Sensation Changes for Patients with CVA	
Patient #	**Significant or Not Significant**
Patient 2	Not significant, p=0

Table 19. *Significance of changes in FIM Scores*

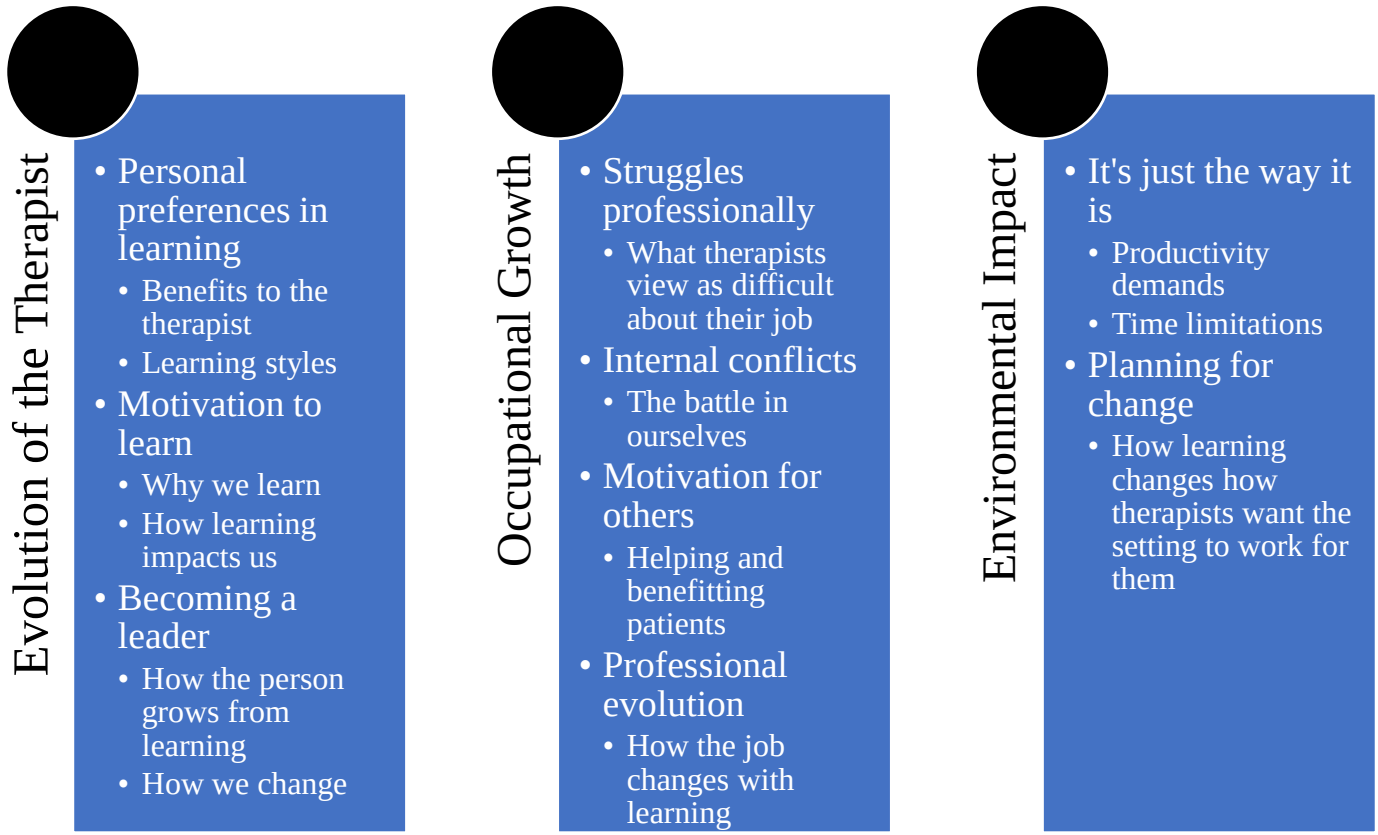
FIM Changes for Patients with CVA	
Patient #	***Significant or Not Significant***
Patient 1	Not significant, p=.37
Patient 2	Not significant, p=.37
Patient 3	Not significant, p=.37
Patient 4	Not significant, p=.37
Patient 5	Significant, p=.034
Patient 6	Not significant, p=.18
Patient 7	Significant, p=.003

No significance in change was noted for ROM and sensation. Strength changes were significant for three out of four patients. FIM score changes were significant for two out of seven patients.

Qualitative results: Part A Component 2 & Part B Component 2

Following completion of the Part A's educational series, four qualitative focus groups were completed (group 1= 6, group 2= 4, group 3= 4, group 4= 3), including seventeen occupational therapists total. Upon completion of Part B's data collection, two of the three investigating therapists participated in a focus group with the final investigating therapist completing a phone interview. Data from all focus groups was combined to enhance the understanding of the experience of learning about mirror box therapy. Themes were shaped by the Person, Environment, Occupation Model and are included in Figure 13.

Figure 14. *Emerging Qualitative Themes from Focus Groups A & B*



Themes that emerged from the focus groups represented the person (the occupational therapist), the environment (the practice settings treatment occurred in), and the occupation of treating patients with CVA. The discussion of the person included preferences in learning about mirror box therapy, what motivated the therapists to learn, and how learning impacts the individual's roles in their practice setting. The discussion of the occupation included professional struggles that therapists face when completing job duties, their drive to help their patients, and how they grow professionally with education. The discussion of the environment included barriers to growth due to standards of practice settings and what therapists felt needed to change to improve use of interventions to treat their patients. Throughout discussion of the results, therapists are referred to by their pseudonyms, identifying practice setting and years of experience (Table 2).

Theme 1: Evolution of the Therapist. Throughout the learning experience, responses were directed back to how the occupational therapists learned and what this learning meant to them. Finding a topic that was of interest to the therapists increased their motivation to learn and utilize this learning to change how they performed their job. Therapists reported personal growth and change initiated through learning. A1, A5, R1, R2, R3, S1, and S2 discussed the internal drive to learn to better themselves which further evolved into changing themselves for the betterment of their department (environment) and their patients (the occupation). The therapists wanted to do what was best for their patients while also feeling as though they were being the best versions of themselves as practitioners. Through educating therapists using a variety of learning techniques to appeal to all preferences, therapists were able to grow through increased knowledge and move into differing roles such as staff therapists, learner, educator, and leader throughout their departments.

Personal preferences in learning. Therapists emphasized addressing the needs of how they learn as an important part for them to process and retain information. Visual learning was a preference noted by A1, A2, A3, A7, R1, R2, R3, R4, S1, S2, and S4. Therapists that appreciated the visual PowerPoints during the education sessions reported that the colors drew them in to the information. They also felt that they could visualize the information in their mind later if they had an image to refer back to.

Therapists that participated in Part B also referenced being visual learners and how that assisted their experience. Both the A5 and S4 therapist appreciated having handouts from the education series to utilize as references. Having information they could refer back to gave them the support they needed to feel confident using the mirror box. This provided visual reinforcement.

Hands on learning was also a preference identified by most therapists participating. Learning by doing encouraged excitement to use mirror box therapy in the future. A1, A3, A4, A6, A7, R2, R4, S2, and S4 found that practicing with the mirror box to complete simple and task-oriented approaches was the most beneficial aspect of their learning. A3 “felt more comfortable using after seeing first hand where treatment could go wrong and how to correct”. They felt that using the mirror box pulled together what they received lecture on and gave it meaning. When prompted to what therapists would have changed about the learning experience, many reported alterations on hands on learning techniques. A5 discussed that they would have liked a better set up for hands on practice. They felt that being at their desk did not simulate the environment they would be using the intervention in. They also reported that they did not feel that in the learning process, they would need to manipulate their environment.

A6, R1, S4, and S5 suggested they would have preferred using an active patient for practice. These therapists felt this would have allowed the patient to give feedback which could have guided their treatment. They also felt this would have allowed them to make prior to completing with patients and being monitored. Multiple therapists in each setting felt that they could have used their coworkers to practice with to advance the experience from using with themselves to using with others to develop a better understanding of what to expect with future usage.

The final suggestion was to build a mirror box. Therapists reported they would have felt a sense of accomplishment to build the intervention. R3 reported it was interesting to see the variety of mirror boxes and the supplies to build but would have improved their confidence to build. R2 and R4 felt this would have improved their confidence to explain the process to future patients.

A3, A7, A8, R3, S2, S3, S4, and S5 also stated that they preferred learning with guidance throughout to enhance their learning. Therapists in all settings reported they felt they had a good basic understanding of mirror box therapy at completion of the educational series. They appreciated having someone present (investigating therapist) that can answer questions if they arise and when they would attempt to use in the future. They appreciated this learning more than attending an out of facility continuing education course where they felt they leave with handouts and no follow up to discuss. Therapists felt the group collaborative effort was beneficial to them.

Having resources provided to them increased levels of comfort to incorporate into practice. S5 reported “give me all the guidance you have. Any information you give now will make this easier for me to use later when I have information to look back on”. R2 felt having

resources that all therapists would have would make it easier to ask questions or bounce ideas off of each other to guide future use.

Motivation. Motivation is key. Many therapists reported feeling motivated by the educational series to do more for their patients. They enjoyed learning about an intervention that benefitted them professionally as well as an intervention that could change how they cared for patients with CVA. They emphasized the importance of when learning that the topic had to be of interest to them to keep their attention and motivate them to continue to use. If they aren't interested in the topic or the presentation, they felt that they were less likely to pay attention and implement the skills being presented in the future.

The importance of relating the learning back to the practice setting was also important in motivating to use the knowledge gained. Therapists felt they were more inclined to use interventions if they developed an understanding of how to use where they practice. Reigniting the passion for learning is important to motivate therapists to do more for themselves and their patients.

Therapists were also motivated by how the intervention could help others due to internally wanting to be the change for others. S4 reported that "video cases were beneficial to see varying levels of recovery and use of the mirror box". To see how the intervention worked changed the way of thinking from just opening the mirror box and letting the patient go to realizing the reasoning behind the movements and how to set up the patient. "Hearing what the patients in the videos had to say about their experience made me want to learn more about the intervention and how to use in my setting" was stated by S2.

When discussing how the educational series benefitted them and how this excited them for future use of mirror box therapy, therapists reported that even though the presentation was geared towards patients with CVA, that it was beneficial to know that it can be used with a variety of diagnoses that may be admitted in their respective practice settings. A1 reported "I feel I will use it more knowing that it can be used for more than the neurological population to address so many deficits. I don't feel pigeon-holed into using for only one thing". Other therapists supported this idea and suggested that since it can be used for multiple deficits, they would be more inclined to utilize.

Through the use of mirror box therapy, confidence was changed which in turn increased their motivation to use the intervention in the future. After using mirror box therapy with patients with CVA, A5 felt that the patients she worked with were challenging due to medical instability but that seeing that the intervention could still be used in that situation was useful to develop her problem-solving skills. Therapist S4 agreed with A5's feelings on this concept. This therapist felt she had limited experience with using the mirror box but the experience she did have was beneficial to learn how to approach, set up, and run mirror box therapy with low level patients.

Becoming a leader. All three therapists that completed the study using mirror box therapy with patients with CVA felt that learning by doing was the most beneficial. R2 reported that seeing the process and learning how to problem solve on the spot improved her learning experience. To see the benefits to the patient and how they improved in a short period of time was key to understanding the dynamics of use and reinforced what she had learned from the literature. It was important to have both the educational series to talk through and about the intervention while also learning by doing to bring all the factors of learning together to optimize performance.

R2 also reported that “it was beneficial to see sensory and motor return after using the mirror box to be sold on using it after the project”. To see the intervention work helped to support what she had learned from the presentation of current evidence available. The experience became more than just hearing about an intervention but seeing what it had to offer. Essentially, the process of learning by doing brought the experience of learning full circle to move beyond just learning about a new skill but also how to use it while understanding the benefits of mirror box therapy. It also helped to open the lines of communication amongst therapists by discussing the progress that was made with the patient as well as the development of a new skill set by the occupational therapist.

S4 identified that confidence had improved in her knowledge of mirror box therapy and she would be able to guide others to identify what patients would be appropriate. R2 reported excitement in her experience by stating “it made me believe in mirror box therapy in that it was effective and that it worked for CVA clients. It makes me want to attempt again and encourage others to use it too”. The therapists felt they would be able to demonstrate how to use, how to build, and how to implement into their specific practice setting.

Theme 2: Occupational growth. Throughout the learning experience, therapists identified how they intended to perform their job differently after being educated on and using mirror box therapy. Therapists identified areas in which they struggled to perform their job better and what motivated them to perform the job to the best of their ability. Struggles included professional responsibilities to use evidence-based practice and their motivation to do so. Throughout this discussion, therapists identified how the learning allowed them to grow which in turned changed how they intended to perform their job duties, including future incorporation of mirror box therapy.

Struggles professionally. Initially, therapists reported struggling with the general use of evidence-based practice due to feeling it wasn't practical due to lack of time and resources available to them. A2, A4, A5, A8, R4, S1, and S3 reported that if patients had questions or wanted more information, they would feel more inclined to use. Patient input could directly impact therapist's motivation for use of mirror box therapy. Therapists also felt that if they were to use evidence-based practice, they should have time when at work to complete tasks and did not want to complete what they considered work duties on personal time. Work duties were perceived as any tasks that were performed during scheduled paid hours. Therapists did not feel that seeking out evidence-based practice was a requirement for their job performance. Many identified that it was not addressed as a yearly goal for them by upper management, so they often did not consider it.

Many therapists also reported that evidence-based practice was pushed in school but when they were on fieldwork, instructors weren't using. They felt this experience carried over into their own practice behaviors. A2, A6, and S1 reported that they didn't have evidence-based practice emphasized in school therefore it was a newer concept to them. They reported they really weren't sure where to begin or how.

When discussing how mirror box therapy was supported by the evidence, therapists reported that they liked the presentation of sources to use mirror box therapy but didn't feel that evidence would enhance their presentation on ADLs or strengthening activities. However, more than half of the therapists stated they could use evidence-based practice to support mirror box therapy. When prompted to how they would use, A1, A3, A8, R1, and S2 stated they would use what was provided in the presentations. Further discussion led to the realization that there was a lack of knowledge of where to begin search to use evidence-based practice.

Internal conflict. Many therapists felt an internal conflict when discussing whether a protocol would be appropriate to use with mirror box therapy. A1, A2, A4, A5, R2, R3, S2, and S4 felt that a protocol for use of mirror box therapy would provide a "fool-proof" guide for them to follow. They felt this would increase comfort of when to start and how to progress treatment. Essentially this would teach them how to provide the intervention and would require less adaptation to complete. Some felt it would be easier to document progress if they had standards to follow. They reported this would increase their comfort level if they had something to refer back to in order to support their use of the intervention.

Continued discussion of a protocol for mirror box therapy use identified that many therapists felt conflicted as to what they wanted to do, what was best for the patient, but also do what was in the best interest of themselves professionally. "Hate to feel like what's in it for me but have to do what is best for me to be able to appropriately treat the patient" stated A2. While a protocol would be what they considered "practical" for orthopedic diagnoses, they felt that mirror box therapy would have to be standardized to have a protocol for the neurological population. Therapists felt their comfort level would improve with guidelines to assist with documentation and problem solving. Internally, therapists were torn on the need for a protocol due to knowing how it would benefit them but also what would be in the best interest of the patient.

Motivation to do better. Many therapists stated they saw themselves using mirror box therapy with patients with CVA. They felt they would not have considered mirror box therapy an option because of how involved the patients with CVA can be. A3, A7, and A20 described that they sometimes feel overwhelmed with all the deficits these patients present with and feel they can include this intervention beyond just ROM tasks and introduce ADLs tasks. When prompted

to what they were excited about, many therapists brought up improving outcomes or regaining movements for their patients with CVA. Part of the motivation of these therapists were to use the intervention for the betterment of their patients.

A5, R2, and S4 felt that learning about mirror box therapy's primary purpose was to benefit the patient through changes in occupational performance. One way in which they felt the intervention benefitted the patient was through introducing the evidence that supported the process. S4 reported that "explaining what I had learned about evidence made it easier for the patient to understand the benefits of participation". A5 reported similar findings in that explaining what the evidence found induced excitement in the patient.

Seeing how the intervention produced short term changes in the individuals also emphasized the importance of using the intervention with patients. A5, R2, and S4 felt that seeing the change was as important to them as it was to the patient in motivating for long term change. If the patient was able to see or feel the change with use, the therapists felt that the patient would be more inclined to continue to want to use. A5 also felt that if there was more time available that changes in occupational performance would have continued to improve. Seeing the evolution of the patient through their eyes and the therapist's eyes was important to emphasize the importance of the intervention of mirror box therapy to address deficits resulting from CVA. This experience was also important in the process of motivating the therapist to push themselves to do more for themselves and their patients.

Professional evolution. Using mirror box therapy with patients with CVA had a direct impact on the professional evolution of the three participating therapists. Each therapist identified a drive to use evidence-based practice in the future. R2 identified "it shows me that

other occupational therapists are out there being effective and seeing positive results with their patients. This is also doable for me and that it may not be as hard as I believed". A5 and S4 agreed with this statement acknowledging that using the mirror box, being a part of the research process, and seeing the changes that can occur has emphasized the importance of trying to incorporate evidence-based practice into their settings. Also having the literature provided the support to what they were doing changed their opinion on the importance of incorporating evidence-based practice into their clinical practice.

Theme 3: Environmental Impact. A common theme that emerged from all the focus groups was the impact the environment had on practice. Therapists felt that each setting had negatives that held them back professionally. They often felt that things such as productivity and availability were out of their control. Initially, therapists did not offer strategies to change their current situations. After the educational series and learning by doing, the investigating therapists were able to identify barriers of the environment to their success and how to overcome.

***It's just the way it is*.** A1, A2, A3, A4, A5, and A6 reported they often felt stuck in routines that were controlled by productivity standards. These standards offered them little time for documentation that needed to be the focus, not searching for research. A5 reported the pressure to see fifteen patients in one day often left her feeling overwhelmed. "I'm required to document while I am with the patient and that already takes time away from the experience. I literally take my cart and computer door to door all day and have limited time for much more. I don't want to feel that I am taking away more from my time with other patients". Therapists felt they moved from one patient to the next and would have to offer different resources to each patient due to the variety of diagnoses. A2 "that's just the way it is. This is how the daily routine goes. Limited by time and limited by staff size".

Therapists also felt that productivity standards wouldn't allow for large amounts of time for one intervention. R3, R4, S3, and S5 felt that they had to prioritize ADLs first and then consider other interventions due to time requirements and insurance updates. A1, A5, and A8 felt they ideally focused on an ADL session to get in a treatment note for the social worker and they felt they would need more time to introduce mirror box therapy. They did not feel that thirty minutes or more would be appropriate but were open to short sessions of ten to fifteen minutes if time was available. A1, A2, A5, A8, R4, and S5 felt they would like to use mirror box therapy, but they would have to prioritize the intervention over ADL functional tasks if they wanted to use long enough to see functional changes. They felt the educational series provided a support to their hectic environments but weren't sure how to make the change necessary to have carryover.

How to make the change. A5, R2, and S4 completed using the mirror box with patients with CVA had varying experiences. They were able to identify challenges to their experiences. These varied from the external influences on the practice setting and physical set up. A5 reported that she "would hang a sign on the door of the patient's room to keep others from coming in and out and interrupting the session and the patient's attention". R2 reported she felt she had more success setting individuals up for mirror box therapy in the gym instead of in their room. The barrier to the gym was the noise and she would need to adapt this by pulling a curtain or scheduling during downtimes. She also reported the difficulty with setup for lower level patients in bed and the extra work involved for positioning. She recommended incorporating physical therapy in the session to help with positioning before initiating task. S4 reported she hoped to designate time to use mirror box therapy and felt middle management would be more inclined to include in the schedule once they saw the physical changes after use of mirror box therapy.

Summary of qualitative results

The therapists in both *Part A* and *Part B* of this study experienced a change in their level of knowledge and how they intended to perform their job while identifying barriers to their environment that impacted how they performed their job and their motivation for use. Therapists identified how they learned best and how this motivated them to continue to learn. They also noted the motivation behind why and how they performed their job. And finally, they noted the barriers that their practice environment presents. Throughout the process, therapists identified how they evolved and how they plan to overcome barriers by demonstrating motivation to improve themselves with support of the primary investigating therapist. Learning about mirror box therapy and utilizing in practice helped to initiate the process of making changes in occupational performance.

Discussion

Part A. Results of the quantitative pre-test/post-test demonstrated a change in the level of understanding of mirror box therapy by occupational therapists. This supported the findings of Part A Component 2's Focus Group A, that occupational therapists are motivated to learn. These therapists felt that mirror box therapy could be beneficial to them and to their patients. Many felt they learned because the information presented addressed the needs of their practice setting (Johnson & May, 2015). Relating the information presented back to the practice setting through discussion on how to incorporate, how it could be utilized with patients, and adaptations that may be necessary addressed all areas of concern that therapists may have had. This stressed the importance of the learning addressing how the therapists preferred to learn.

The last two questions from the quantitative pre-test/post-test referred to how the mirror box benefitted the therapist and the patients. These topics also presented themselves in Focus Group A. Therapists identified their support for use in that it benefitted them by being easy to use, easy to transport, and able to be incorporated into conventional treatment sessions. The therapists based the benefits to the patients on what deficits could be addressed during treatment sessions. The key term of benefits stood out to the therapists, resulting in increased consistency of correct responses on pre and post-test.

Six out of seven questions on the post-test had positive changes from the pre-test. Question 5 was the only question with negative change. This question prompted what activities would be considered task-oriented. ROM, which is simple mirror box therapy, was also a selection that ten out of seventeen therapists chose. An explanation for the decrease in the number of therapists who answered the question correctly could be that most therapists had identified themselves as visual learners. Session 1 of the educational series provided a PowerPoint slide referencing the difference between simple and task-oriented. Session 2 of the educational series provided the opportunity to complete both simple and task-oriented activities with the mirror box but there was no visual PowerPoint to demonstrate differences. Instead there was auditory conversation of differences between the two types. The negative change in results of this question could be the result of not addressing this topic with therapists' learning preference of visual technique resulting in not receiving the full impact of the topic. Wording of the question to select all choices may also have not been read correctly or overlooked. With the variety of years of experience of therapists, those with more years of experience may have settled into less routine of using occupation in practice therefore not focusing in on the different meanings between the two types (Grice, 2015).

Learning was enhanced in this study which produced a change in attitudes towards the use of mirror box therapy. Therapists were excited for a new treatment intervention and all of the benefits of this intervention to them. However, barriers to long term behavioral change were impacted by the environment not being supportive (Wellings et al., 2017). Therapists felt that productivity standards dictated how they could treat their patients. These standards led to decreased time available for treatment. They also felt that they were not supported by those in charge to change these standards to better suit the needs of the therapist and the patient.

Clinical reasoning skills used by the therapist were tested with group discussion of mirror box therapy and hands on learning. Occupational therapists were provided the tools to set up for the use of mirror box therapy and had to problem solve how to set it up for themselves to complete both simple and task-oriented activities. Guidance was provided, but not until therapists had begun the activity. During the focus group, the investigating therapist asked probing questions to develop a full understanding of the learning experience. This included how to use mirror box therapy and adapt to each of the three practice settings. Barriers to continued progression and evolution of these reasoning skills were evident in therapists not using evidence-based practice and not having a desire to seek out opportunities to do so. With no motivation to change their behavior (P), how therapists would treat patients with CVA may also not change (O) (Bondoc & Burkhardt, 2004).

Part B. For this study, all patients were in the acute phase of recovery. All seven patients demonstrated improvements in occupational performance through changed FIM scores, whether the change was significant or not. Increased number of sessions with mirror box therapy did not provide consistent changes. However, practice setting did impact outcomes. The three patients in inpatient rehabilitation were provided a significant amount of additional occupational therapy

services in addition to mirror box therapy which may have impacted the extent of changes in occupational performance.

Motor changes were more frequent than sensory changes. However, patients' responses to what they thought of mirror box therapy demonstrated more awareness of sensory changes occurring. This may have related to the constructivist orientation in learning by doing. Torre et al., (2006) emphasized the importance enhancing the experience by learning while performing a task. The findings also may demonstrate a connection between physical recovery and sensory recovery. Ramchandran and Altschuler (2009) emphasized the importance of the relationship between vision and touch in restoring function of the affected arm. This was supported by the results of this study as those patients that reported changes in sensory input of the affected arm also demonstrated changes in motor function of the affected arm. Having change in one area can directly impact the other area, which may in turn produce on overall change in occupational performance tasks. Overall, the patients with CVA demonstrated hope and positivity with changes created in motor and sensory performance.

Seeing is believing was important for therapists utilizing mirror box therapy with patients with CVA. The constructivist orientation of learning by doing was important for the therapists to see the changes the patients were experiencing while also taking in and processing the patients' responses to treatment. Having this experience provided the opportunity to increase occupational therapists' confidence which in turn impacted how they performed their occupation and how they changed their environment to incorporate use of the intervention. Having this experience reignited their desire to help others. Using mirror box therapy helped to further develop their critical thinking skills, motivating them to want to continue to use mirror box therapy and evidence-based practice in the future. This also provided the opportunity to problem solve how

they would need to change their environment to support continued use of the intervention in the future.

Objective 1. Objective 1 of this study was to determine the impact education on the use of mirror box therapy would have on attitudes and behaviors of occupational therapists. Occupational therapists were in tune with how they learned best but struggled with differences between what they distinguished professional requirements of being an occupational therapist and work requirements of their facility. Initially, the majority of therapists felt that the environment did not support the use of new interventions due to limited time, staffing, and productivity standards. The *Part A Educational Series* provided the opportunity to change knowledge on use of mirror box therapy by appealing to the learning preferences of the therapist. This change in knowledge was demonstrated by the significance in change from *Part A Component 1* quantitative pre-test/post-test. Johnson and May (2015) reported that education that focused on how an intervention could work in a specific practice setting is the most beneficial to healthcare professionals. This study capitalized on this fact. Providing education on problem solving with set up of the intervention and organization of how to use in practice set the wheels in motion on how to adapt and utilize the intervention. However, even with this presentation, therapists were not ready to give up their impressions of limitations of their practice environments.

Part B of this study changed how therapists performed their occupation of treating patients with CVA by incorporating the new intervention of mirror box therapy. The pragmatic worldview guided this process as the therapists were provided with the what benefit they could provide to their patients with how and why they would utilize this intervention. Incorporating this worldview into the presentation allowed the primary investigator to provide motivation

which is important to impact learning (Bircan & Slugar, 2016). Without motivation to utilize this intervention, there would be no change in attitudes towards use or behaviors to use in the future. The environment was changed by building a support system with each of the three other investigating therapists. From the experience of using, the three occupational therapists were able to evolve personally by gaining confidence in their skill set while being motivated to become leaders in their respective settings. Attitudes towards use changed with the development of critical thinking skills involving how to change the environment to optimize performance of the patient with CVA and the ability for the therapist to incorporate into practice amongst productivity requirements. Wellings et al., (2017) found that therapists lacked support to make time to incorporate new skills or seek out opportunities to develop skills whether in clinical practice or evidence-based practice. Metzler and Metz (2010) reported that therapists perform in environments that are not supportive but when therapists are able to self-reflect on experiences, they can bring about a change. This current study was successful in changing therapists' attitudes towards the use of mirror box therapy by modifying behaviors of use of the intervention. By providing a supportive environment, therapists were able to reflect on how using the intervention could benefit themselves and patients with CVA. This reflection and seeing the changes first-hand helped to evolve the three investigating therapists into leaders in their practice settings.

Objective 2. The second objective of this study was to determine the impact the use of mirror box therapy would have on patient with CVA outcomes. All of the patients with CVA in this study saw changes in occupational performance through FIM assessments, whether significant or not. Park et al., (2015) stated that improvements in motor and sensory deficits can lead to improvements in occupational performance. Five out of seven patients reported sensory changes but only one of those patients demonstrated assessed changes. Four of the seven patients

demonstrated muscle strength changes. These changes impacted how the patients were able to perform their ADLs. All patients received various amounts of traditional occupational therapy in addition to mirror box therapy which limited the ability to distinguish if changes were due to mirror box therapy or other interventions. Brunetti et al., (2015) also had difficulty distinguishing between the impact of mirror box therapy and traditional therapy interventions. The patients with the greatest amount of change overall were those on the inpatient rehabilitation unit. Those in acute care received less sessions of mirror box therapy and were less medically stable. This may have led to changes not being significant. Yeldan et al. (2015) had similar findings in acute patients demonstrating limited functional improvements due to medical instability.

Length of use of mirror box therapy may also have limited the intervention from providing its full impact. Sessions were also short at only fifteen minutes of use. However, these short periods were enough to demonstrate physical changes. Perez-Cruzado et al., (2017) noted that mirror box therapy for shorter sessions were more effective than longer sessions as patients would become bored with repetition.

Overall, patients with CVA outcomes were changed. How patients performed ADLs were changed as evident by FIM score changes. The environment was changed by providing the support of a knowledgeable therapist using mirror box therapy. When patients reported sensation changes, this motivated them to continue to want to use the intervention. With shorter duration and limited sessions, mirror box therapy was able to change patient with acute CVA outcomes.

The experience of learning about mirror box therapy and utilizing in practice supported occupational therapists evolvement as professionals. Throughout the study, therapists

demonstrated a desire to learn and help their patients. By addressing their learning styles with education, that learning was able to translate into wanting to change the way they performed treatment with patients with CVA. The primary investigating therapist changed the environment for all therapists by providing education on the use of mirror box therapy in their practice settings while providing the support needed to foster learning. The three investigating therapists that utilized in practice were able to change the environment by presenting skills from their learning along with the findings from evidence-based practice to their patients to make the environment supportive for functional changes. This helped to evolve their roles in their practice settings to leaders to be able to help not only the patients but also their coworkers to utilize the intervention in the future. Overall, occupational performance was changed for all therapists.

The experience of using mirror box therapy for patients was also focused on learning about the intervention and the benefits to them. Patients were generally eager to gain recovery and demonstrated excitement to use the intervention. They appreciated the education on the topic from the occupational therapists and the support provided for use. Addressing the needs of the patient while providing them support with use of the intervention changed the dynamics of the hospital environment. By addressing the person, the occupation, and the environment, all seven patients were able to demonstrate changes in occupational performance with FIM score changes for ADLs.

Limitations

One of the limitations of the study was that the primary investigating therapist was an active member of the therapy department. This may have provided a better understanding of the practice experiences of the occupational therapists having experienced each practice setting

firsthand. Having the primary investigating therapist there may have biased how therapists responded. Creswell (2014) discussed that another limitation of focus groups is that no individuals come with the same practice experiences which may limit their understanding of the information provided therefore skewing their responses. This was apparent amongst practice settings. Each group was provided the same presentations with teaching and questions based on responses from prior groups. Each group responded differently which may have been reflective of their levels of experience treating the neurological population and their exposure to evidence-based practice. The smaller groups appeared more at ease than the larger groups. In the larger groups, the primary investigating therapists had to present information differently to increase overall participation. The larger group may have been intimidating for newer therapists due to the variety of levels of experience. The smaller group provided less opportunity to let others talk over and was structured more as group interviews where everyone had an opportunity to respond.

Another limitation was the time available for educational series due to productivity standards of each practice setting. The series was limited to two sessions of approximately seventy-five minutes each. This meant that a large amount of information had to be provided in a short period of time. Being completed over a period of two weeks also limited the time therapists had to take in the information and process prior to the next session. This may have allowed for increased retention but also limited time to develop a full understanding of the experience of using a mirror box.

The initial focus groups were not recorded due to technical difficulties. This limited the amount of information that could be collected and transcribed by the primary investigating therapist. Yet, extensive field notes were completed during each session and peer debfriefing

occurred after the completion of each focus group. In addition, the primary investigating therapist completed reflexive journaling of the sessions to create supplemental notes that thoroughly represented the session. Unfortunately, this may have limited the impact of the information presented during the interpretation of data.

Another limitation of the study was the there was no equal distribution of patients amongst settings leading to therapists not having the same opportunities for experience, with a variety of patients with CVA at varying levels of recovery. This may have impacted the level of learning of each therapist therefore impacting their impression of the learning experience. This may also impact their future role as a leader in using mirror box therapy in their practice setting as they did not have the experience they expected. However, each therapist had the opportunity to cover the acute care setting providing them the experience to use the intervention with patients with CVA in the beginning stages of recovery which may have proved more challenging than patients further into recovery who are gaining independence.

Due to the low numbers of admissions and shorter admission stays, many patients included in the study were from the acute care setting, limiting the amount of sessions the patient was able to participate in, prior to discharge. With shorter durations, this may not have allowed mirror box therapy to have its full impact on changing deficits and function. Patients may have also been limited due to medical instability in the acute care setting. The number of admissions during the four-week period was also low which resulted in a small sample size. This limited having a wide variety of patients with CVA in all stages of recovery to compare and contrast. Having a small sample size limited the ability to generalize results to a larger picture.

Also, during this time period, the skilled care practice setting was limited in admissions due to a nursing shortage. This changed the availability of thirty beds to eighteen limiting availability of a bed for a CVA patient during the four-week period. In the middle of the four-week period, the hospital corporation announced the closing of the hospital housing the inpatient rehabilitation unit to be completed one month after the completion of the project. This limited admissions as well due to concern of transfer of services to another facility upon closer. Therefore, the environment of the hospital corporation limited the study throughout.

The amount of additional occupational therapy received by the inpatient rehabilitation patients was also a limitation. The amounts were much larger than the acute care group, limiting comparisons between groups. This also made it more difficult to determine if results were directly impacted by use of the mirror box or traditional occupational therapy services.

Future research

Many options and questions have arisen from this project. To determine the full extent of change in therapists' attitudes and behaviors towards the use of mirror box therapy, a study would need completed to track the percentage of use of mirror box therapy by all occupational therapists in each department over a longer period. This would determine if the change in knowledge could produce long-term impacts to changes in attitude and behavior. To determine if further changes to patient outcomes could occur, another study that would be beneficial to complete is the use of mirror box therapy with patients with CVA for a longer period to determine if longer duration of use would impact occupational performance outcomes. Another study that may be beneficial to complete is using mirror box therapy with longer intensities of sessions to compare if fifteen-minute sessions versus thirty minutes had any impact on the

functional changes in patients and if impacted the behaviors of the therapists on their impression of the treatment. The final recommendation would be to reproduce a previous study to determine if results could be replicated to support the need or non-need for a practice protocol. It would be beneficial to determine if this practice would impact occupational therapists' impression of evidence-based practice.

Summary

Occupational therapists demonstrated that learning can be impacted through education. Education needs to address the learning preferences of the therapists to promote willingness to learn. To change attitudes towards the use of mirror box therapy, the education focused on motivating the therapists so they would want to use it in the future. Learning by doing allowed the therapists the experience to use in a supportive environment to shape how they utilized the intervention. Changing the environment allowed for changes in how the patient performed their occupation. Seeing the changes in the patient improved the confidence of the therapists. The entire experience of learning and using helped the therapist to evolve into leaders in their departments.

Mirror box therapy, used for short duration and intensity, in conjunction with conventional occupational therapy services was able to produce physical changes in occupational performance of patients with CVA. By educating therapists on how to utilize the intervention and changing the environment to promote use, the occupation of performing ADLs was able to be changed for the better. Also, the patients with CVA being able to express the changes in sensation or seeing the physical changes occurring were motivating for the therapists to want to continue treatment with mirror box therapy and to continue in their recovery process.

The entire process of educating therapists on the use of mirror box therapy and implementing in practice was beneficial to both the therapists and the patients with CVA. Therapists were able to grow and evolve as leaders. Patients were able to be assisted in their recovery. Pulling these two experiences together successfully for both and emphasizing the importance of education for occupational therapists while providing the supportive environment to allow change to occur provided the opportunity for enhancement of the professional experience for the occupational therapist and improvement of functional outcomes for patients with CVA.

References

Almhdawi, K., Mathiowetz, V., White, M., & del Mas, R. (2016). Efficacy of occupational therapy task-oriented approach in upper extremity post-stroke rehabilitation. *Occupational Therapy International, 23*, 444-456. Doi:10.1002/oti.1447

Altschuler, E., Wisdom, S., Stone, L., Foster, C., Galasko, D., Llewellyn, D., & Ramachandran, V. (1999). Rehabilitation of hemiparesis after stroke with a mirror. *The Lancet, 353*, 2035-2036. Retrieved from https://www.ncbi.nlm.nih.gov/pubmed/10376620

Andersen, L. (2001). Occupational therapy practitioners' perceptions of the impact of continuing education activities on continuing competency. *American Journal of Occupational Therapy, 55*, 449-454. Doi:10.5014/ajot.55.4.449

American Occupational Therapy Association. (2015). Occupational therapy code of ethics (2015). *American Journal of Occupational Therapy, 69*(Suppl. 3), 6913410030. http://dx.doi.org/10.5014/ajot.2015.696S03

American Occupational Therapy Association. (2017). Occupational therapy practice framework: Domain and process (3rd ed.). *American Journal of Occupational Therapy, 68*, S1-S48. Doi:10.5014/ajot.2014.682006

Ayra, K. (2016). Underlying neural mechanisms of mirror therapy: Implications for motor rehabilitation in stroke. *Neurology India, 64*, 38-44. Doi:10.4103/0028-3886.173622

Arya, K., & Pandian, S. (2013). Effect of task-based mirror therapy on motor recovery of the upper extremity in chronic stroke patients: A pilot study. *Topics in Stroke Rehabilitation, 20*(3), 210-217. Doi:10.1310/tsr2003-210

Bircan, H., & Sungur, S. (2016). The role of motivation and cognitive engagement in science and achievement. *Science Education International, 27*(4), 509-529. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,sso&db=eue&AN=121323051&site=eds-live&scope=site&custid=s8356098

Bolognini, N., Russo, C., & Edwards, D. (2016). The sensory side of post-stroke motor rehabilitation. *Restorative Neurology and Neuroscience, 34*, 571-586. Doi:10.3233/RNN-150606

Bondoc, S., Booth, J., Budde, G, Caruso, K., DeSousa, M., Earl, B., Hammerton, K, & Humphreys, J. (2018). Mirror therapy and task-oriented training for people with a paretic upper extremity. *American Journal of Occupational Therapy, 72*, 7202205080. Doi:10.5014/ajot.2018.025064

Bondoc, S., Burkhardt, A. (2004). Evidence-based practice and outcomes management in occupational therapy. *OT Practice, 9*(20), CE-1-CE-8.

Boudreau, S., Farina, D., & Falla, D. (2010). The role of motor learning and neuroplasticity in designing rehabilitation approaches for musculoskeletal pain disorders. *Manual Therapy, 15*, 410-414. Doi:10.1016/j.math.2010.05.008

Braun, V., & Clarke, V. (2006). Six simple steps to conduct a thematic analysis. *Qualitative Research in Psychology, 3*, 77-101. Doi:10.1191/1478088706qp063oa

Breslin, D. (1996). Motor-learning theory and the neurodevelopmental treatment approach: A comparative analysis. *Occupational Therapy in Health Care, 10*(1), 25- 40. Doi:10.1080/J003v10n01_03

Bruntetti, M., Morkisch, N., Fritzsch, C., Mehnert, J., Steinbrink, J., Niedeggen, M., & Dohle, C. (2015). Potential determinants of efficacy of mirror therapy in stroke patients: A pilot study. *Restorative Neurology and Neuroscience, 33*, 421-434. Doi:10.3233/RNN-140421

Cacchio, A., DeBlasis, E., Necozione, S., di Orio, F., & Santilli, V. (2009). Mirror therapy for chronic complex regional pain syndrome type 1 and stroke. *New England Journal of Medicine, 361*, 634-636. Doi:10.1056/NEJMc0902799

Centers for Disease Control and Prevention. (2017). *Stroke facts*. Retrieved from https://www.cdc.gov/stroke/facts.htm

Chauhan, B., Jeyaraman, M., Mann, A., Lys, J., Skidmore, B., Sibley, K., …, Zarychanski, R. (2017). Behavior change interventions and policies influencing primary healthcare professionals' practice: An overview of reviews. *Implementation Science, 12*(3), 1-16. Doi:10.1186/s13012-016-0538-8

Colomer, C., Noe, E., & Llorens, R. (2016). Mirror therapy in chronic stroke survivors with severely impaired upper limb function: A randomized controlled trial. *European Journal of Physical and Rehabilitation Medicine, 52*(3), 271-280. Retrieved from https://www.researchgate.net/publication/292990761_Mirror_therapy_in_chronic_stroke_survivors_with_severely_impaired_upper_limb_function_A_randomized_controlled_trial

Crausaz, J., Kelly, M., & Lee, S. (2011). Three educational approaches to enhance the evidence-based practice behavior of Irish occupational therapists. *WFOT Bulletin, 64*, 11-17. Doi:10.1179/otb.2011.64.1.005

Creswell, J. W. (2014). Quantitative methods. In J. W. Creswell, *Research design: Qualitative, quantitative, and mixed methods approach* (pp. 155-181). Thousand Oaks, CA: SAGE Publications, Inc.

Da Silva Costa, V., da Silveira, J., Clementino, T., de Macedo Borges, L., & de Melo, L. (2016). Effects of mirror therapy on the motor and functional recovery of post-stroke paretic upper limbs: A systematic review. *Fisioter Pequi, 23*(4), 431-438. Doi:10.1590/1809-2950/15809523042016

Dohle, C., Pullen, J., Nakaten, A., Kust, J., Rietz, C., & Karbe, H. (2008). Mirror therapy promotes recovery from severe hemiparesis: A randomized controlled trial. Neurorehabilitation and neural repair. *The American Society of Neurorehabilitation, 10*(5), 1-9. Doi:10.1177/1545968308324786

Doucet, B. (2012). Neurorehabilitation: Are we doing all that we can? *American Journal of Occupational Therapy, 66*(4), 488-493. Doi:10/5014/ajot.2012.002790

Dubouloz, C., Egan, M., Vallerand, J., & von Zweck. (1999). Occupational therapists' perceptions of evidence-based practice. *American Journal of Occupational Therapy, 53,* 445-453. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,sso&db=ccm&AN=107224055&site=eds-live&scope=site&custid=s8356098

Dunleavy, L. (2014). Evaluation of a continuing education course for occupational therapy practitioners on the use of applied behavior analysis. *Occupational Therapy in Health Care*, 1-15. Doi:10.3109/07380577.2014.950784

Ezendam, D., Bongers, R., & Jannick, M. (2009). Systematic review of the effectiveness of mirror therapy in upper extremity function. *Disability and Rehabilitation, 31*(26), 2135-2149. Doi:10.3109/09638280902887768

Finlay, J. (2010). *Andragogy (adult learning)* [Video file]. Retrieved from http://www.youtube.com/watch?v=vLoPiHUZbE

Francisco, G., & McGuire, J. (2012). Poststroke spasticity management. *Stroke, 43*, 3132-3136. Doi:10.1161/STROKEAHA.111.639831

Gilmore, P, & Spaulding, S. (2001). Motor control and motor learning: Implications for treatment of individuals post stroke. *Physical & Occupational Therapy in Geriatrics, 20*(1), 1-15. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,sso&db=ccm&AN=106802928&site=eds-live&scope=site&custid=s8356098

Gliner, J. (1985). Purposeful activity in motor learning theory: An event approach to motor skill acquisition. *American Journal of Occupational Therapy, 39*(1), 28-34. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,sso&db=ccm&AN=107989483&site=eds-live&scope=site&custid=s8356098

Grice, K. (2015). Scientific/clinical article. The use of occupation-based assessments and intervention in the hand therapy setting: A survey. *Journal of Hand Therapy, 28*, 300-306. Doi:10.1016/j.jht.2015.01.005.

Guenther, K. (2016). 'It's all done with mirrors': V.S. Ramachandran and the material culture of phathom limb research. *Medical History, 60*(3), 342-58. Doi:10.1017/mdh.2016/27

Gurbuz, N, Afsar, S., Ayas, S., & Cosar, S. (2016). Effect of mirror therapy on upper extremity motor function in stroke patients: A randomized controlled trial. *Journal of Physical Therapy Science, 28*, 2501-2506. Retrieved from b http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,sso&db=ccm&AN=118464940&site=eds-live&scope=site&custid=s8356098

Hall, W., & White, L. (2008). Upper motor neuron control of the brainstem and spinal cord. In D. Purves, G. Augustine, D. Fitzpatrick, W. Hall, A. LaMantia, J. McNamara, & L. White (Eds)., *Neuroscience, 4th edition*, (pp.423-451). Sunderland, MA: Sinaver Associates, Inc.

Holmes, W., & Scaffa, M. (2009). An exploratory study of competencies for emerging practice in occupational therapy. *Journal of Allied Health, 38*(2), 81-90.

Invernizzi, M., Negrini, S., Carda, S., Lanzotti, L., Cisari, C., & Baricich, A. (2012). The value of adding mirror therapy for upper limb motor recovery of subacute stroke patients: A randomized controlled trial. *European Journal of Physical and Rehabilitation Medicine, 48*, 1-7. Retrieved from https://www.researchgate.net/publication/236019326_The_value_of_adding_mirror_therapy_for_upper_limb_motor_recovery_of_subacute_stroke_patients_A_randomized_controlled_trial

Johnson, M., & May, C. (2015). Promoting professional behavior change in healthcare: What interventions work, and why? A theory-led overview of systematic reviews. *BMJ Open, 5*, 1-13. Doi:10.1136/bmjopen-2015-008592

Keith, R., Granger, C., Hamilton, B., & Sherwin, F. (1987). The functional independence measure: A new tool for rehabilitation. *Advanced Clinical Rehabilitation, 1*, 6-18.

Kim, K., Lee, S., Kim, D., Lee, K., & Kim, Y. (2016). Effects or mirror therapy combined with motor tasks on upper extremity function and activities of daily living of stroke patients. *Journal of Physical Therapy Science, 28*(2), 483-487. Doi:10.1589/jpts.28.483

Latham, N., Jette, D., Coster, W., Richards, L., Smout, R., James, R., …, Horn, S. (2006). Occupational therapy activities and intervention techniques for clients with stroke in six rehabilitation hospitals. *American Journal of Occupational Therapy*, *60*, 369-378. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=ccm&AN=106218370&site=eds-live&scope=site&authtype=shib&custid=s8356098

Law, M., Cooper, B., Strong, S., Stewart, D., Rigby, P. & Letts, L. 1996. The person-environment-occupation model: A transactive approach to occupational performance. Canadian Journal of Occupational Therapy, 63(1):9-23. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,sso&db=eric&AN=EJ53

Lee, M., Cho, H, & Song, C. (2012). The mirror therapy program enhances upper-limb motor recovery and motor function in acute stroke patients. *American Journal of Physical and Medical Rehabilitation, 91*(8), 689-696. Doi:10.1097/PMH.0b013e31824fa86d

Lim, K.B., Lee, H.J., Yoo, J., Yun, H.J., & Hwang, H.J. (2016). Efficacy of mirror therapy containing functional tasks in poststroke patients. *Annals of Rehabilitation Medicine, 40*(4), 629-636. Doi:10.5535/arm.2016.40.4.629

Lin, K., Chen, Y., Huang, P., Wu, C., Huang, W., Yang, H., Lai, H., & Lu, H. (2014). Effect of mirror therapy combined with somatosensory stimulation on motor recovery and daily function in stroke patients: A pilot study. *Journal of Formos Medical Association, 113*(7), 422-428. Doi:10.1016/j.jfma.2012.08.008.

Lockyer, J., Hodgson, C., Lee, T., Faremo, S., Fisher, B., Dafoe, W., … & Violato, C. (2016). Clinical teaching as part of continuing professional development: Does teaching enhance clinical performance? *Medical Teacher, 38,* 815-822. Doi:10.3109/0142159X.2015.1112895

Lysack, C., Luborsky, M. R., & Dillaway, H. (2017). Gathering qualitative data. In R. R. Taylor (Ed.), *Research in occupational therapy: Methods of inquiry for enhancing practice* (pp. 196-213). Philadelphia, PA: F. A. Davis Company.

Metzler, M., & Metz., G. (2010). Analyzing the barriers and supports of knowledge translation using the PEO model. *Canadian Journal of Occupational Therapy, 77,* 151-158. Doi:10.2182/cjot.2010.77.3.4

Mota, D., Meireles, A., Viana, M, & Almedia, R. (2016). Mirror therapy for upper limb rehabilitation in chronic patients after stroke. *Physical Therapy in Movement, 29*(2), 287-293. Doi:10.1590/0103-5150.029.002.AO07

National Institute of Neurological Disorders & Stroke. (2017). *Post-stroke rehabilitation fact sheet.* Retrieved from https://www.ninds.nih.gov/Disorders/Patient-Caregiver-Education/Fact-Sheets/Post-Stroke-Rehabilitation-Fact-Sheet

National Stroke Association. (2018). *We can help*. Retrieved from http://www.stroke.org/we-can-help/survivors/stroke-recovery/post-stroke-conditions/physical

Neuro Orthopaedic Institute Group. (n.d.). Graded motor imagery. Retrieved from http://www.gradedmotorimagery.com/

Nilsen, D., & DiRusso, T. (2014). Using mirror therapy in the home environment: A case report. *American Journal of Occupational Therapy, 68*(3), e84-e89. Doi:10.5014/ajot.2014.010389

Nilsen, D., & Geller, D. (2015). *Fact sheet: The role of occupational therapy in stroke rehabilitation.* Retrieved from https://www.aota.org/About-Occupational-Therapy/Professionals/RDP/stroke.aspx

Nilsen, D., Gillen, G., Geller, D., Hreha, K., Osei, E., & Saleem, G. (2015). Effectiveness of interventions to improve occupational performance of people with motor impairments after stroke: an evidence-based review. *American Journal of Occupational Therapy, 69*(1), 6901180030p1-9. Doi:10.5014/ajot.2015.011965

Paik, Y., Kim, S., Lee, J., & Jeon, B. (2014). Simple and task-oriented mirror therapy for upper extremity function in stroke patients: A pilot study. *Hong Kong Journal of Occupational Therapy, 24,* 6-12. Doi:10.1016/j.hkjot.2014.01.002

Park, J., Chang, M., Kim, K., & Kim, H. (2015). The effect of mirror therapy on upper extremity function and activities of daily living in stroke patients. *Journal of Physical Therapy Science, 27,* 1681-1683. Doi:10.1589/jpts.27.1681

Perez-Cruzado, D., Merchan-Baeza, J., Gonzalez-Sanchez, M., & Cuest-Vargas, A. (2017). Systematic review of mirror therapy compared with conventional rehabilitation in upper extremity function in stroke survivors. *Australian Occupational Therapy Journal, 64,* 91-112. Doi:10.1111/1440-1630.12342

Radajewska, A., Opara, J., Kucio, C., Blaszczyszyn, M., Mehlich, K, & Szczygiel, J. (2013). The effects of mirror therapy on arm and hand function in subacute stroke patients. *International Journal of Rehabilitation Research, 36*(3), 268-274. Doi:10.1097/MRR.0b013e3283606218

Ramachandran, V., & Altschuler, E. (2009). The use of visual feedback, in particular mirror visual feedback, in restoring brain function. *Brain, 132*, 1693-1710. Doi:10.1093/brain/awp135

Ramachandran, V., & Rogers-Ramachandran, D. (1996). Synaesthesia in phantom limbs induced with mirrors. *Proceedings; Biological Sciences, 263,* 377-386. Doi:10.1098/rspb.1996.0058

Rodrigues, L., Farias, N., Gomes, R., & Michaelsen, S. (2016). Feasibility and effectiveness of adding object-related bilateral symmetrical training to mirror therapy in chronic stroke: A randomized controlled pilot study. *Physiotherapy Theory and Practice, 32*(2), 83-91. Doi:10.3109/09593985.2015.1091872

Rothgangel, A., Braun, S., Beurskens, A., Seitz, R., & Wade, D. (2011). The clinical aspects of mirror therapy in rehabilitation: A systematic review of the literature. *International Journal of Rehabilitation Research, 34*, 1-13. Doi:10.1097/MRR.0b013e3283441e98

Sabari, J. (1991). Motor learning concepts applied to activity-based interventions with adults with hemiplegia. *American Journal of Occupational Therapy, 45*(6), 523-530. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,sso&db=ccm&AN=107958120&site=eds-live&scope=site&custid=s8356098

Saebo. (2017). *Pain after stroke: Symptoms to watch out for*. Retrieved from https://www.saebo.com/pain-stroke-symptoms-watch/

Saebo. (2018). *Guide to mirror therapy and benefits of neuroplasticity*. Retrieved from http://www.saebo.com/guide-mirror-therapy-benefits-neuroplasticity

Samuelkamaleshumar, S., Reethajanetsureka, S., Pauljebaraj, P., Benshamir, B., Padankatti, S., David, J. (2014). Mirror therapy enhances motor performance in the paretic upper limb after stroke: A pilot randomized controlled trial. *Archives of Physical Medicine and Rehabilitation, 95*, 2000-2005. Doi:10.1016/j.apmr.2014.06.020

Saunders, K., & Cassidy, E. (2012). Mirror box therapy for the treatment of the severely paretic upper limb in acute stroke patients: An exploratory single subject experimental design. *International Journal of Stroke, 7*(2), 21-21. Retrieved from https://www.researchgate.net/publication/293810442_Mirror_box_therapy_for_the_treatment_of_the_severely_paretic_upper_limb_in_acute_stroke_patients_-_an_exploratory_single_subject_experimental_design

Selles, R., Michielsen, M., Bussman, J., Stam, H., Hurkmans, H., Heijnen, I., DeGroot, D., & Ribbers, G. (2014). Effects of a mirror-induced visual illusion on a reaching task in stroke patients: Implications for mirror therapy training. *Neurorehabilitation and Neural Repair, 28*(7), 652-659. Doi:10.1177/1545968314521005

Strong, S., Rigby, P., Stewart, D., Law, M., Letts, L., & Cooper, B. (1999). Application of the person-environment-occupation model: A practical tool. *Canadian Journal of Occupational Therapy, 66*(3), 122-133. Doi:10.1177/000841749906600304

Stroke Association. (2013). *Physical effects of stroke.* Reviewed from https://www.stroke.org.uk/sites/default/files/physical_effects_of_stroke.pdf

Stern, P. (2001). Occupational therapists and research: Lessons learned from a qualitative research course. *American Journal of Occupational Therapy, 55(*1), 102-105. Doi:10.5014/ajot.55.1.102

Taylor, R. R. (2017). Deciding on an approach to data analysis. In R. R. Taylor (Ed.), *Research in occupational therapy: Methods of inquiry for enhancing practice* (pp. 330-341). Philadelphia, PA: F. A. Davis Company.

Thieme, H., Bayn, M., Wurg, M., Zange, C., Pohl, M., & Behrens, J. (2012). Mirror therapy for patients with severe arm paresis after stroke: A randomized controlled trial. *Clinical Rehabilitation, 27*(4), 314-324. Doi:10.1177/0269215512455651

Thieme, H., Mehrholz, J., Pohl, M., Behrens, J., & Dohle, C. (2013). Mirror therapy for improving motor function after stroke. *Stroke, 44*, 1-2. Doi:10.1161/STROKEAHA.112.673087

Toh, S., & Fong, K. (2012). Systematic review of the effectiveness of mirror therapy in training upper limb hemiparesis after stroke. *Hong Kong Journal of Occupational Therapy, 22*, 84-95. Doi:10.1016/j.hkjot.2012.12.009

Torre, D., Daley, B., Sebastian, J., & Elnicki, D. (2006). Overview of current learning theories for medical educators. *American Journal of Medicine, 119* (10), 903-907. Retrieved from http://www.amjmed.com/article/S0002-9343%2806%2900837-0/pdf

University of California, Berkeley. (2016). Learning: Theory and research. In *UC Berkeley's Teaching guide for graduate student instructors*. Retrieved from http://gsi.berkeley.edu/teachingguide/theories/learning-chapter.pdf

Vachon, B., Durand, M., & LeBlanc, J. (2010). Empowering occupational therapists to become evidence-based work rehabilitation practitioners. *Work, 37*, 119-134. Doi:10.3233/WOR-2010-1063

Verstraeten, S., Mark, R., & Sitskoorn, M. (2016). Motor and cognitive impairment after stroke: A common bond or a simultaneous deficit? *Stroke Research and Therapy, 1*(1), 1-10. Retrieved from http://stroke.imedpub.com/motor-and-cognitive-impairment-after-strokea-common-bond-or-a-simultaneous-deficit.php?aid=9074

Wellings, C., Gendek, M., & Gallagher. (2017). Evaluating continuing nursing education: A qualitative study of intention to change practice and perceived barriers to knowledge translation. *Journal for Nurses in Professional Development, 33*(6), 281-286. Doi:10.1097/NND.0000000000000395

Wooster, D., Woodward, A., Brown, L., Cunha, A, Maria, D., Frank, E., Meghan, M., & Maegan, R. (2015). Effectiveness of mirror therapy on function for chronic stroke patients. *American Journal of Occupational Therapy, 69*. Doi:10.5014/ajot.2015.69S1-PO1104

Wordpress. (n.d.). Sensation testing. Retrieved from https://weloveadls.wordpress.com/sensation-testing/

Wu, C., Huang, P., Chen, Y., Lin, K., & Yang, H. (2013). Effects of mirror therapy on motor and sensory recovery in chronic stroke: A randomized controlled trial. *Archives of Physical Medicine and Rehabilitation, 94*, 1023-1030. Doi:10.1016/j.apmr.2013.02.007

Yavuzer, G., Selles, R., Sezer, N., Sutbeyaz, S., Bussman, J., Koseoglu, F, Atay, M, & Stam, H. (2008). Mirror therapy improves hand function in subacute stroke: A randomized controlled trial. *Archives of Physical Medicine Rehabilitation, 89*, 393-398. Doi:10.1016/j.apmr.2007.08.162

Zeng, W., Guo, Y., Wu, G, Liu, X, & Fang, Q. (2018). Mirror therapy for motor function of the upper extremity in patients with stroke: A meta-analysis. *Journal of Rehabilitation Medicine, 49*, 1-8. Doi:10.2340/16501977-2287

Appendix A

Needs Assessment

The following survey addresses the topic of mirror therapy. Mirror box therapy is an intervention using in the treatment of neurological patients. A mirror box is placed at the patient's midline. The affected arm is positioned inside the box. The patient then boxes the unaffected arm through a variety of motions and completes purposeful activity to retrain the brain into thinking that it is viewing the affected limb completing the movements.

1. What setting to do you primarily work in? (more than one may be selected)

- inpatient rehabilitation
- outpatient
- home health
- pediatrics
- acute care
- hand therapy
- behavioral medicine
- skilled nursing facility
- community-based
- other _____

2. Have you use mirror therapy prior to receiving this survey?

- Yes (1)
- No (2)

3. Do you currently use mirror therapy in your practice setting?

- Yes, please proceed to question 5 (1)
- No, please proceed to question 4 (2)

4. If not using mirror therapy, why? After answering, please proceed to question 13.

- [ ] Not available (1)
- [ ] Did not know about (2)
- [ ] Did not feel it benefited the patients (3)
- [ ] Not interested in using (4)
- [ ] Other _____(5)

5. What population are you using mirror therapy with?

- ○ Neurological (CVA, TBI, etc.) (1)
- ○ Hand diagnoses (2)
- ○ Amputations (3)
- ○ Other _____ (4)

6. If using mirror therapy, are you using as your main treatment technique or in conjunction with other treatments? (i.e. electrical stimulation or task-oriented skills)

- ○ Main treatment, please proceed to question 8 (1)
- ○ In conjunction with, please proceed to question 7 (2)
- ○ Other (3)

7. If using mirror therapy in conjunction with other treatments, what are those treatments?

- ○ Biofeedback (1)
- ○ Electrical stimulation (2)
- ○ Task-oriented activities (3)
- ○ Other _____ (4)

8. Are you using a protocol (set number of days, set time after injury, length of time for each treatment, overall time)?

- Yes , please proceed to question 9 (1)
- No, please proceed to question 10 (2)
- Other _____ (3)

9. What protocol are you using?

- _____

10. How long post injury or event are you starting your patients with mirror therapy?

- 0-3 months (1)
- 3-6 months (2)
- 6 months- 1 year (3)
- 1 year + (4)
- Other _____ (5)

11. Have you found there to be improvements in the individual with use of mirror therapy? If yes, please elaborate on how.

- Yes _____ (1)
- No (2)
- Other _____ (3)

12. Would you find a set protocol beneficial for mirror therapy replication amongst neurological patients? (i.e. length of time after stroke, duration of treatment, treatment time)

- Yes (1)
- No (2)
- Other _____ (3)

13. Would you be interested in local opportunities for education on neurological rehabilitation with interventions such as mirror therapy?

- Yes (1)
- No (2)
- Other _____ (3)

Appendix B

Institutional Review Board Authorization

Institutional Review Board (IRB) Authorization Agreement

Name of Institution or Organization Providing IRB Review (Institution/Organization A):
Wheeling Hospital

IRB Registration #: IRB00003700 Federalwide Assurance (FWA) #: FWA00005576

Name of Institution Relying on the Designated IRB (Institution B):
Eastern Kentucky University

IRB Registration #: IRB00002836 Federalwide Assurance (FWA) #: FWA00003332

The Officials signing below agree that Eastern Kentucky University may rely on the designated IRB for review and continuing oversight of its human subjects' research described below: (*check one*)

(___) This agreement applies to all human subjects' research covered by Institution B's FWA.

(x) This agreement is limited to the following specific protocol(s):

Name of Research Project: The impact of education on and the implementation of the use of mirror box therapy across occupational therapy practice settings: A mixed methods approach
Name of Principal Investigator: Nicole LaRue
Protocol Number: 18-12-01

(___) Other (*describe*):_____

The review performed by the designated IRB will meet the human subject protection requirements of Institution B's OHRP-approved FWA. The IRB at Institution/Organization A will follow written procedures for reporting its findings and actions to appropriate officials at Institution B. Relevant minutes of IRB meetings will be made available to Institution B upon request. Institution B remains responsible for ensuring compliance with the IRB's determinations and with the Terms of its OHRP-approved FWA. This document must be kept on file by both parties and provided to OHRP upon request.

Signature of Signatory Official (Institution/Organization A):
Dennis R Niess MD Date: 1/15/19
Full Name: Dennis Niess, M.D. Institutional Title: Chief Medical Information Officer

Signature of Signatory Official (Institution B):
Date: 1/22/19
Full Name: Dr. Gerald J. Pogatshnik Institutional Title: Associate Vice President for Research

JAN 15 2019

Appendix C

Part A: Component 1

Educational Series: Parts 1 & 2

<table>
<tr><th colspan="4">Educational Series Timeline</th></tr>
<tr><td>Session 1
75 minutes</td><td>Dates & Settings Completed</td><td>Session 2
75 minutes</td><td>Dates and Settings Completed</td></tr>
<tr><td>Consent form
10 minutes</td><td rowspan="8">Acute care- Monday January 14th
Skilled care- Monday January 14th
Rehab- Thursday January 17th
Catch all make up date- Friday January 18th</td><td>Indepth review of the literature
15 minutes</td><td rowspan="8">Skilled care- Friday January 18th
Catch all make up date- Friday January 18th
Acute care- Monday January 21st
Rehab- Monday January 21st</td></tr>
<tr><td>Quantitative pre-test
10 minutes</td><td>Used mirror box therapy to review simple and task-oriented types
15 minutes</td></tr>
<tr><td>Introduction and overview of mirror box therapy
25 minutes</td><td>Reviewed what research assistants will be completing
5 minutes</td></tr>
<tr><td>How to build a mirror box
15 minutes</td><td>Question & answer
5 minutes</td></tr>
<tr><td>Brief introduction to the literature
5 minutes</td><td>Quantitative post-test
10 minutes</td></tr>
<tr><td>Reviewed differences between simple and task-oriented mirror box therapy
10 minutes</td><td>Qualitative focus group
25 minutes</td></tr>
</table>

Appendix D

Part A: Component 1

Quantitative Pre-test/Post-test Survey

1. What diagnoses can be treated with mirror box therapy? Circle all that apply.
    a. Joint replacement
    b. Stroke
    c. Complex regional pain syndrome
    d. Arthritis
    e. Amputations
2. What deficits can be treated with mirror box therapy? Circle all that apply.
    a. Proprioception
    b. Pain
    c. Sensation
    d. Range of motion
    e. Coordination
3. When would it not be appropriate to use mirror box therapy? Circle all that apply.
    a. Patient unable to attend to task
    b. Pt unable to maintain sitting posture
    c. Pt in extreme pain
    d. Pt with expressive or receptive aphasia limiting direction understanding and following
    e. Pt with extreme spasticity of the affected limb
4. The mirror box should block the view of the affected limb.
    a. True b. False

5. Task-oriented mirror box therapy could include which of the following activities? Circle all that apply.
    a. Holding or moving a coffee mug.
    b. Range of motion
    c. Turning a key
    d. Pouring water from one cup to another
    e. Buttoning a shirt
6. Mirror box therapy benefits *occupational therapists* in what way(s)?
    a. Easy to use
    b. Easy to transport
    c. Can be used in a variety of settings
    d. Can serve as an adjunct to conventional occupational therapy
    e. All of the above
    f. None of the above
7. Mirror box therapy benefits the *patient* in what way(s)?
    a. Easy to transition into home exercise program
    b. Simple and easy to use
    c. Can provide a sense of independence with the patient controlling the activities
    d. Can address deficits that impact functional use of the affected limb
    e. All of the above
    f. None of the above

Appendix E

Part A: Component 2

Qualitative Focus Group A

1. What has been the most beneficial part of your learning experience regarding mirror box therapy? How so? Why?
2. What were your expectations for the learning experience? Why? Were they met/not met and why?
3. What would you have changed to enhance your learning? Why? How would you change the experience?
4. How would a set protocol impact your future use of mirror box therapy? Why?
5. How do you see yourself using mirror box therapy in the future? Any limitations or benefits?
6. How do you see yourself using evidence-based practice in the future? Any limitations or benefits?
7. How has the learning experience impacted your confidence level to use mirror box therapy? In what ways? Why?

Appendix F

Part B: Component 1

Data Collection Sheet

*Therapist's name*_____ *Date*_____

Pt identifier _____ *Time since stroke for pt*_____

*Pain pre/post*_____ *UE affected* _____*R or L*_____

Affected UE	**AROM or PROM (A or P)**	**ROM measurement**	**MMT**
Shoulder flexion (0-180)			
Shoulder extension (0-60)			
Elbow flexion (0-145)			
Elbow extension(0)			
Supination (0-80)			
Pronation (0-80)			
Wrist flexion (0-80)			
Wrist extension (0-70)			

Sensation Affected UE	**Absent**	**Diminished or Hypersensitive**	**Normal**
Shoulder			
Elbow			
Wrist			
Hand			

Self care area	**FIM score (circle one)**						
Eating	I	Mod I	Supervision	Min A	Mod A	Max A	Dep A
Grooming	I	Mod I	Supervision	Min A	Mod A	Max A	Dep A
Bathing	I	Mod I	Supervision	Min A	Mod A	Max A	Dep A
UE dressing	I	Mod I	Supervision	Min A	Mod A	Max A	Dep A
LE dressing	I	Mod I	Supervision	Min A	Mod A	Max A	Dep A

Patient's opinion of the treatment _____

Appendix G

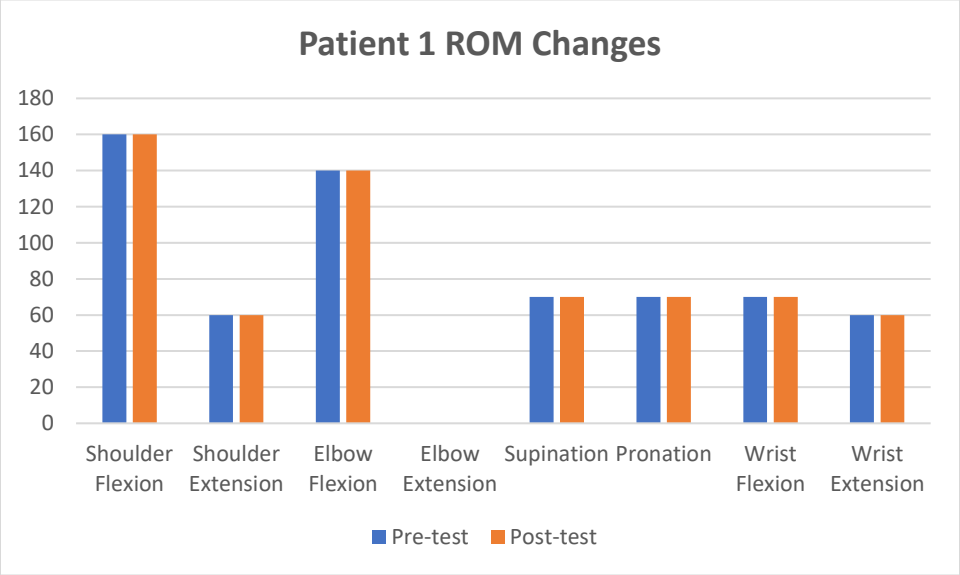
Part B: Component 2

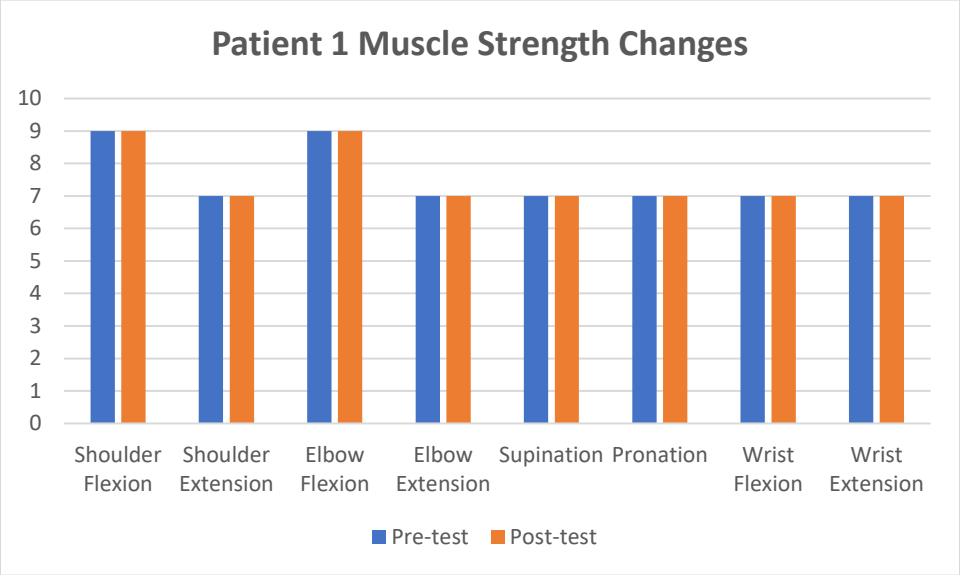
Qualitative Focus Group B

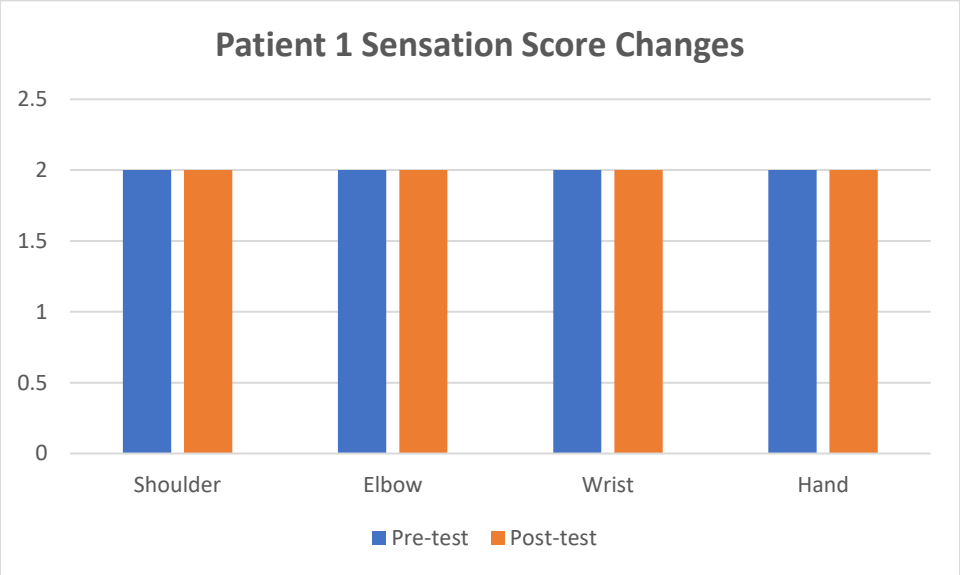
1. What has been the most beneficial part of your learning experience regarding mirror box therapy? How so? Why?
2. What was your experience like being a part of this study?
3. What would you have changed to enhance your learning? Why? How would you change the experience?
4. What did it mean to you to use mirror box therapy?
5. How do you see yourself using mirror box therapy in the future? Any limitations or benefits?
6. How do you see yourself using evidence-based practice in the future? Any limitations or benefits?
7. How has the learning experience impacted your confidence level to use mirror box therapy? In what ways? Why?

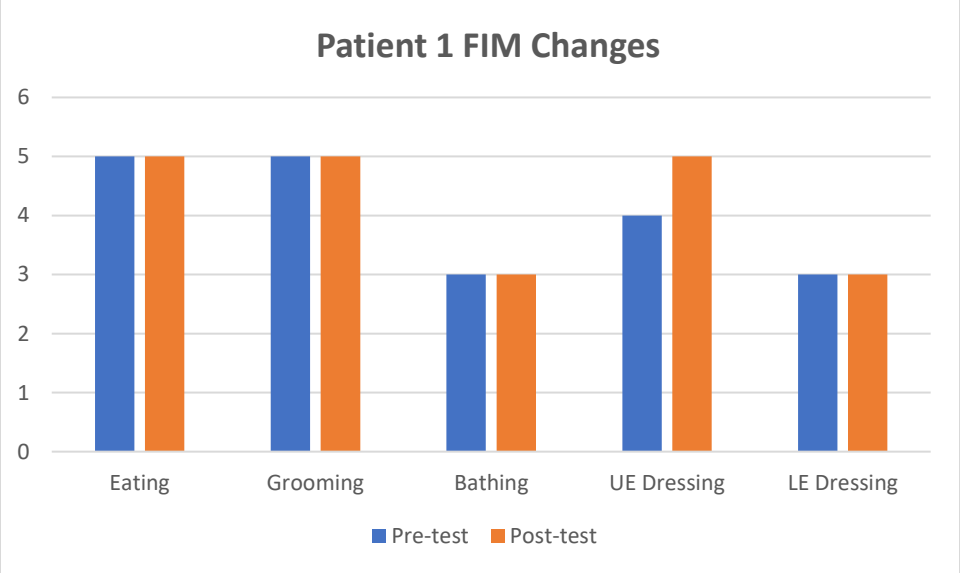
Appendix H

Patient 1 Pre/Post Test Results and Responses to Mirror Box Therapy



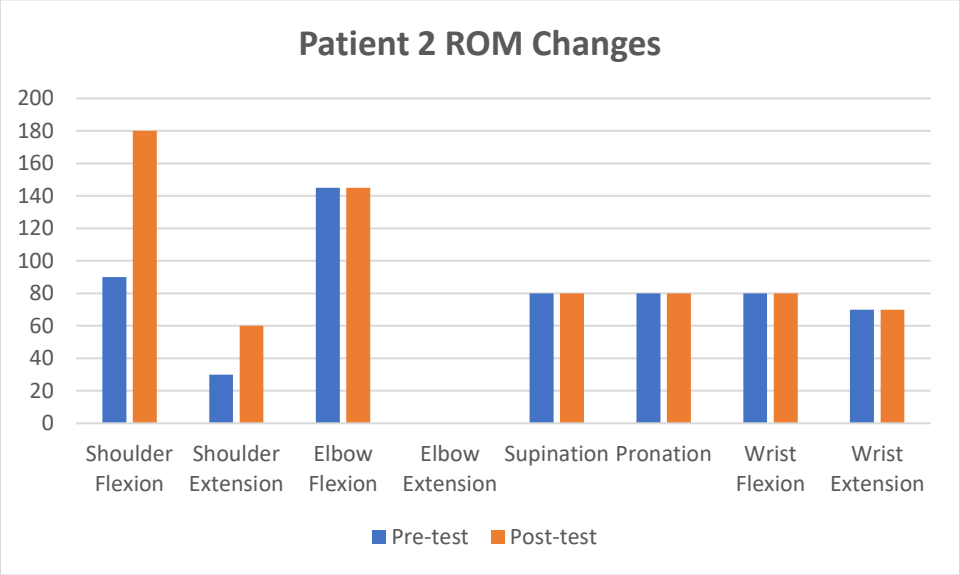


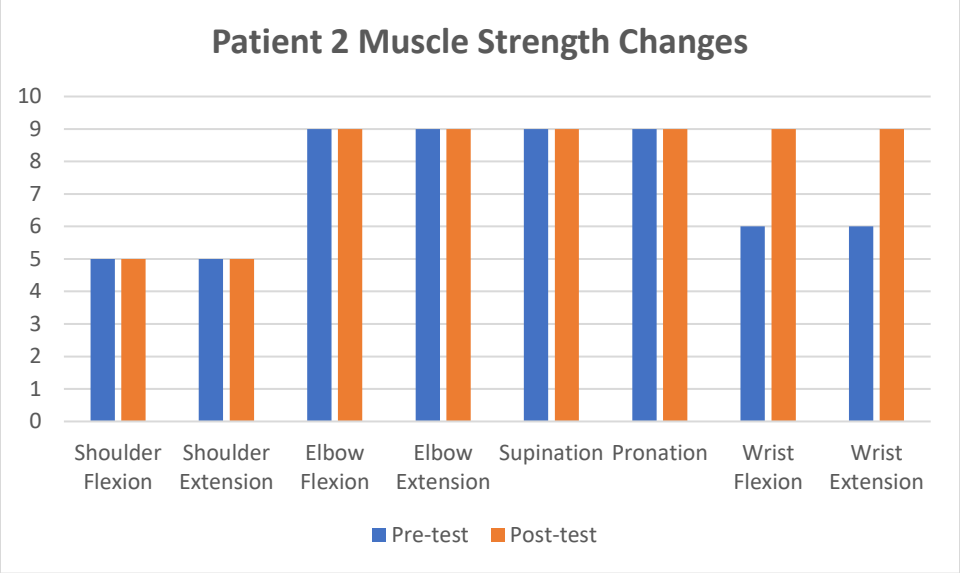

Patient 1 Sensation Score Changes
2.5
2
1.5
1
0.5
0
Shoulder
Elbow
Wrist
Hand
Pre-test
Post-test

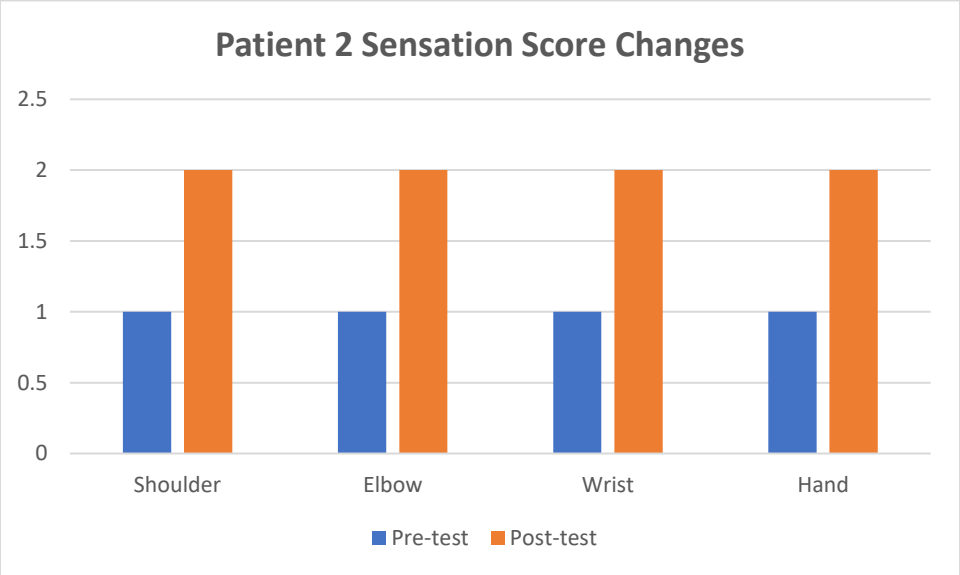

Patient 1 FIM Changes
6
5
4
3
2
1
0
Eating
Grooming
Bathing
UE Dressing
LE Dressing
Pre-test
Post-test

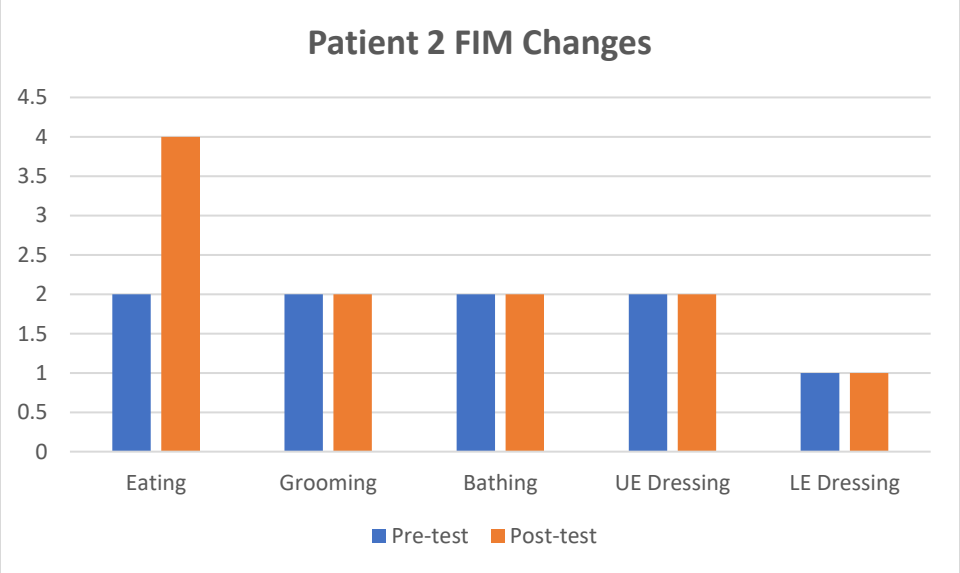
Appendix I

Patient 2 Pre/Post Test Results and Responses to Mirror Box Therapy



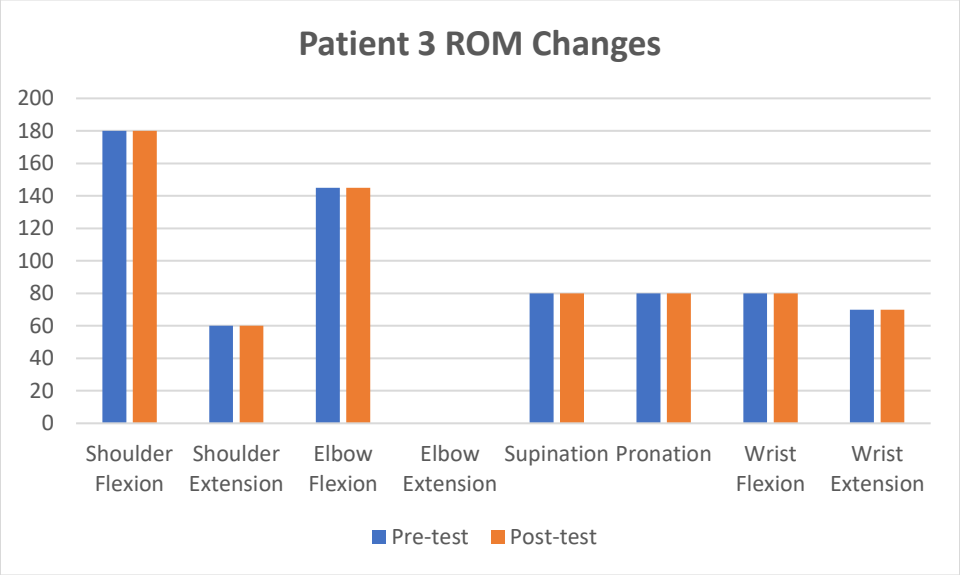


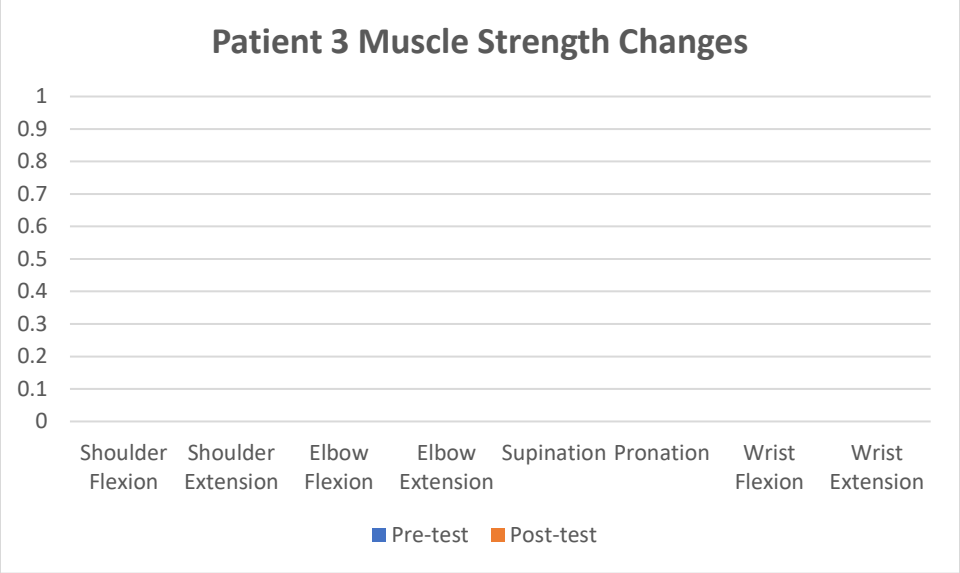

Patient 2 Sensation Score Changes
2.5
2
1.5
1
0.5
0
Shoulder
Elbow
Wrist
Hand
Pre-test
Post-test

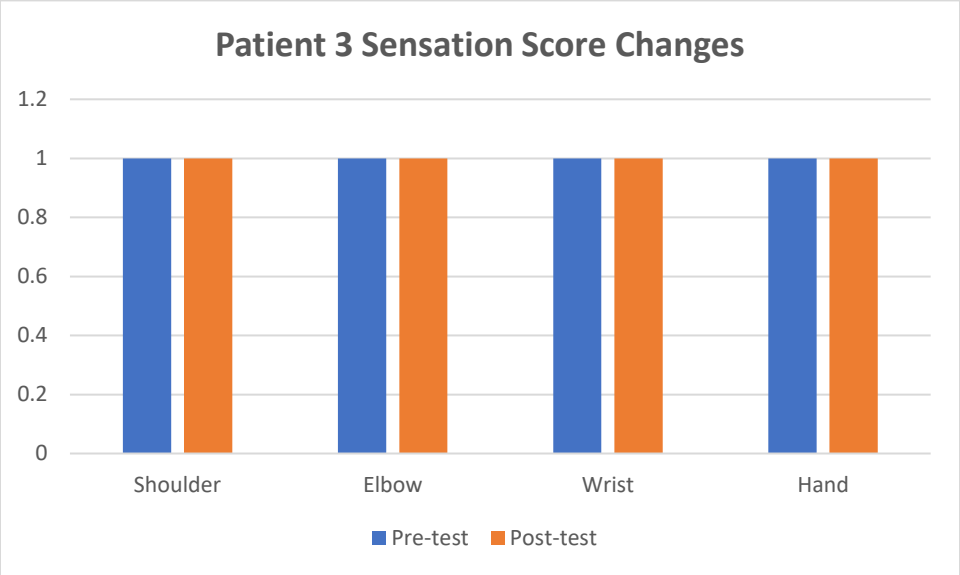

Patient 2 FIM Changes
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Eating
Grooming
Bathing
UE Dressing
LE Dressing
Pre-test
Post-test

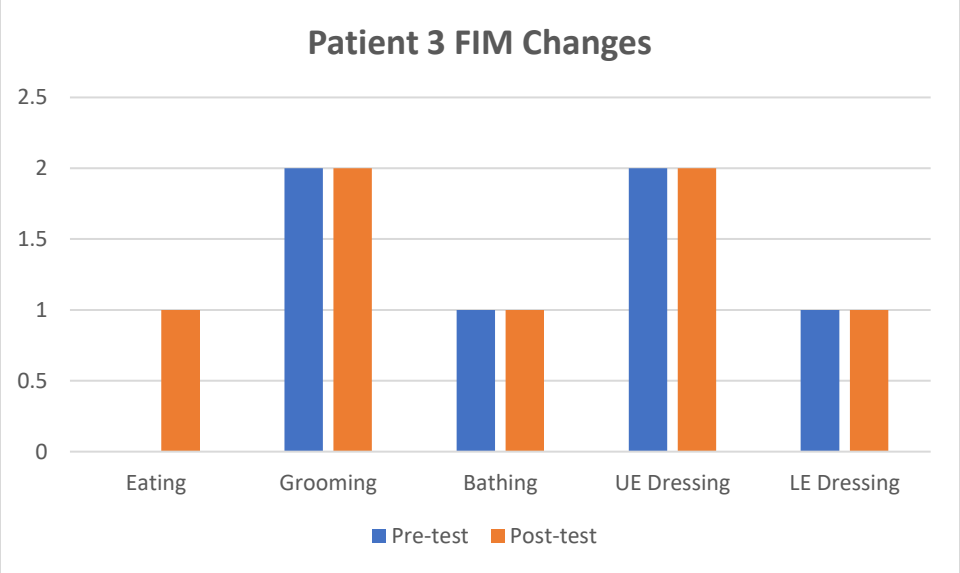
Appendix J

Patient 3 Pre/Post Test Results and Responses to Mirror Box Therapy



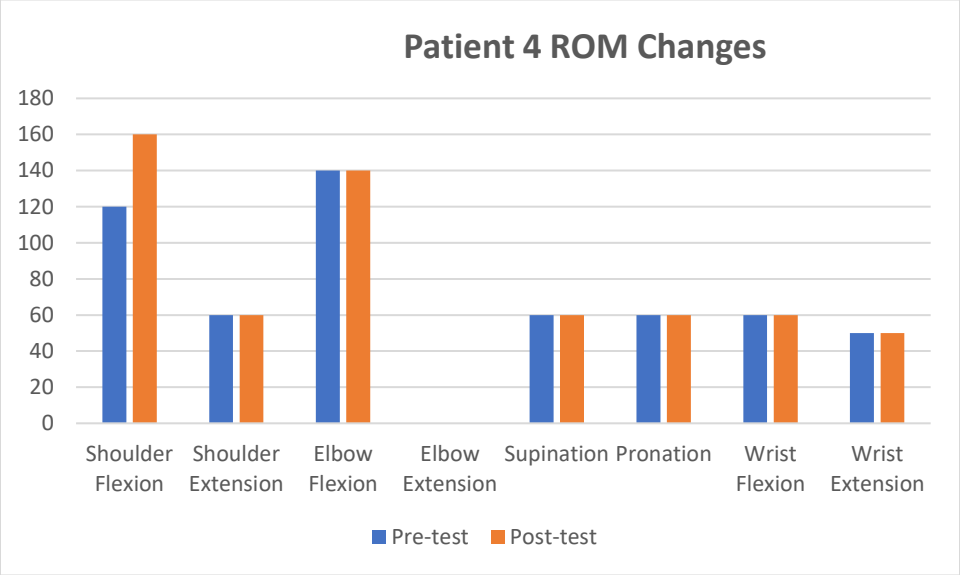


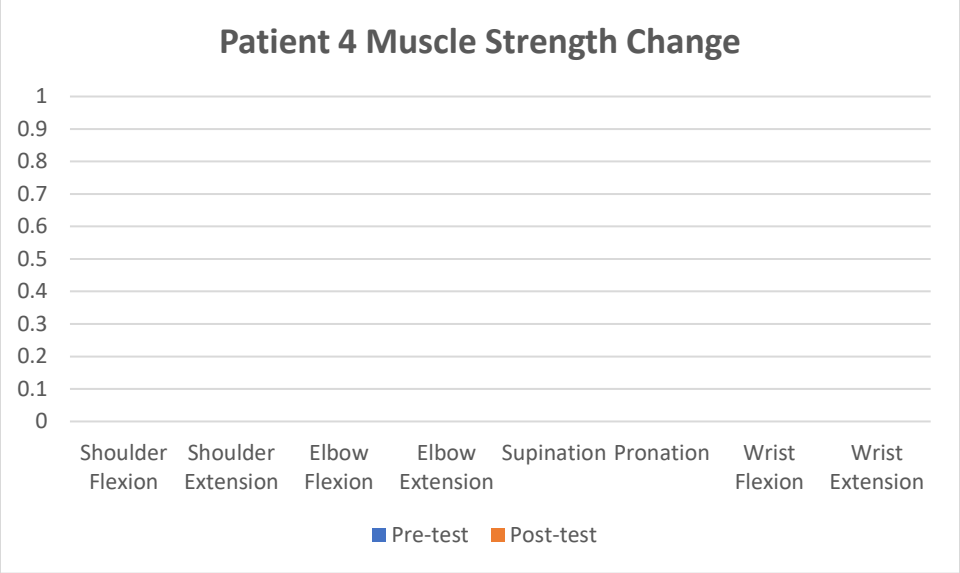

Patient 3 Sensation Score Changes
1.2
1
0.8
0.6
0.4
0.2
0
Shoulder
Elbow
Wrist
Hand
Pre-test
Post-test

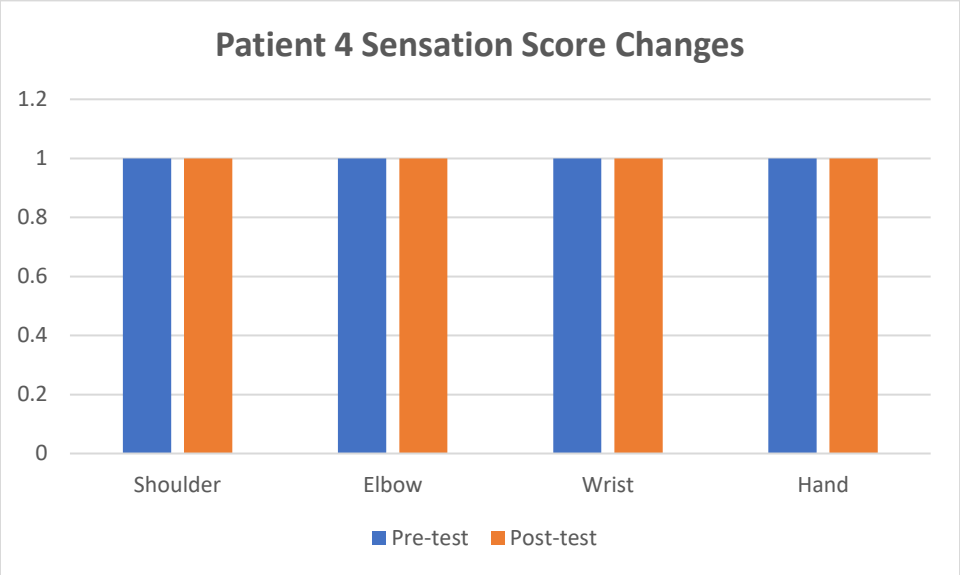

Patient 3 FIM Changes
2.5
2
1.5
1
0.5
0
Eating
Grooming
Bathing
UE Dressing
LE Dressing
Pre-test
Post-test

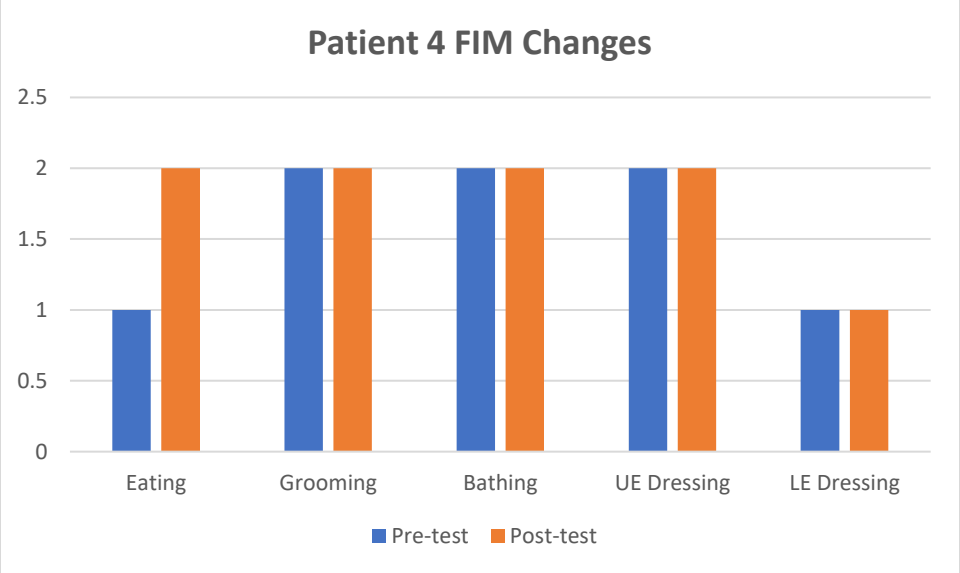
Appendix K

Patient 4 Pre/Post Test Results and Responses to Mirror Box Therapy



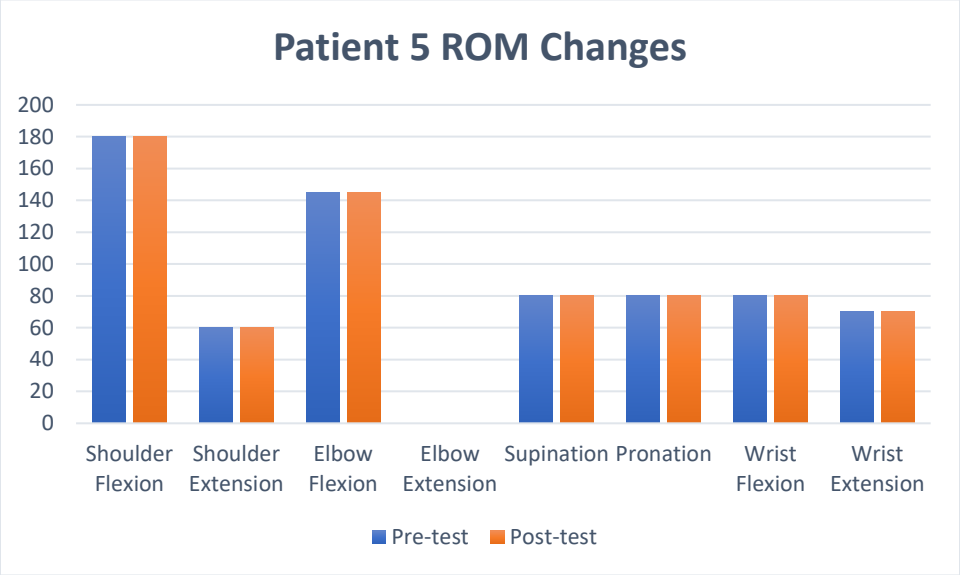


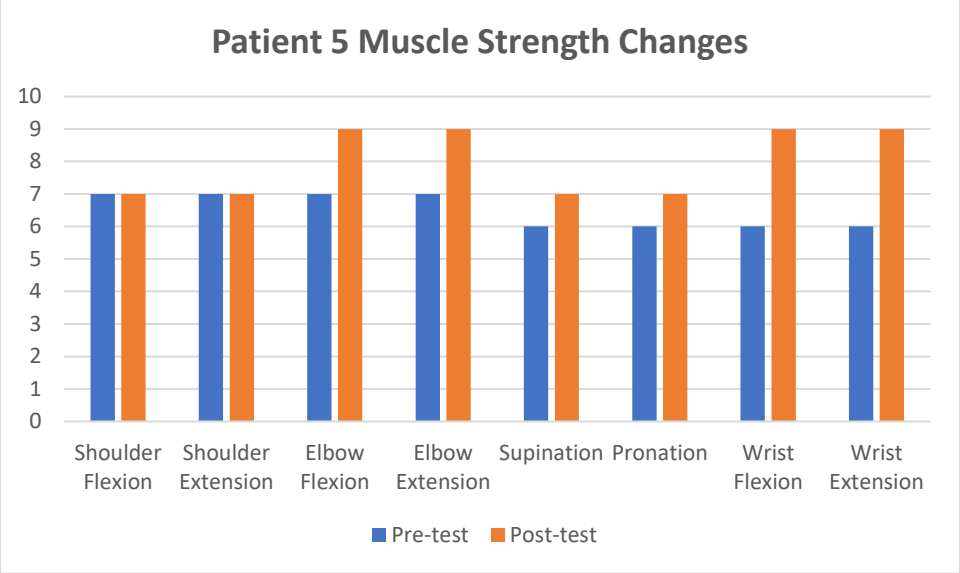

Patient 4 Sensation Score Changes
1.2
1
0.8
0.6
0.4
0.2
0
Shoulder
Elbow
Wrist
Hand
Pre-test
Post-test

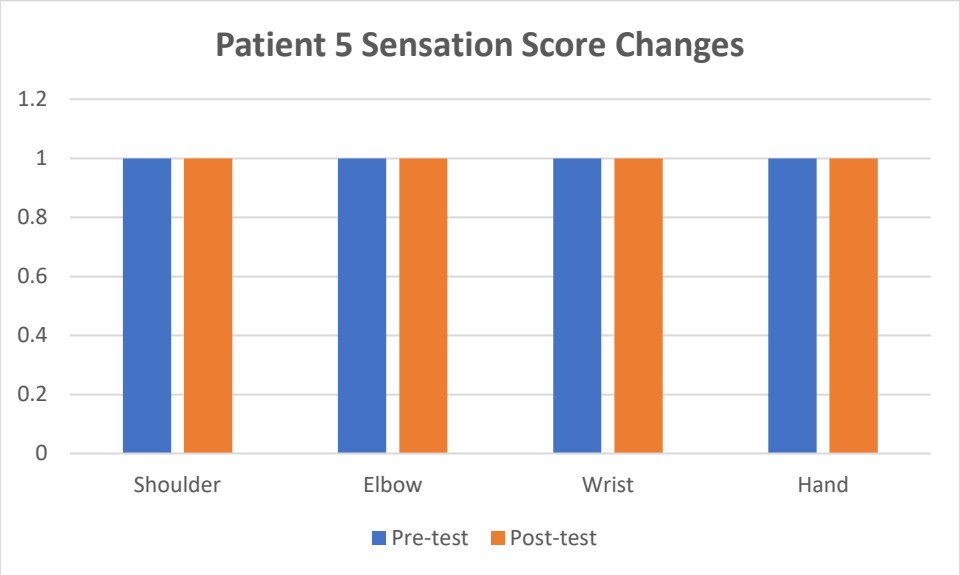

Patient 4 FIM Changes
2.5
2
1.5
1
0.5
0
Eating
Grooming
Bathing
UE Dressing
LE Dressing
Pre-test
Post-test

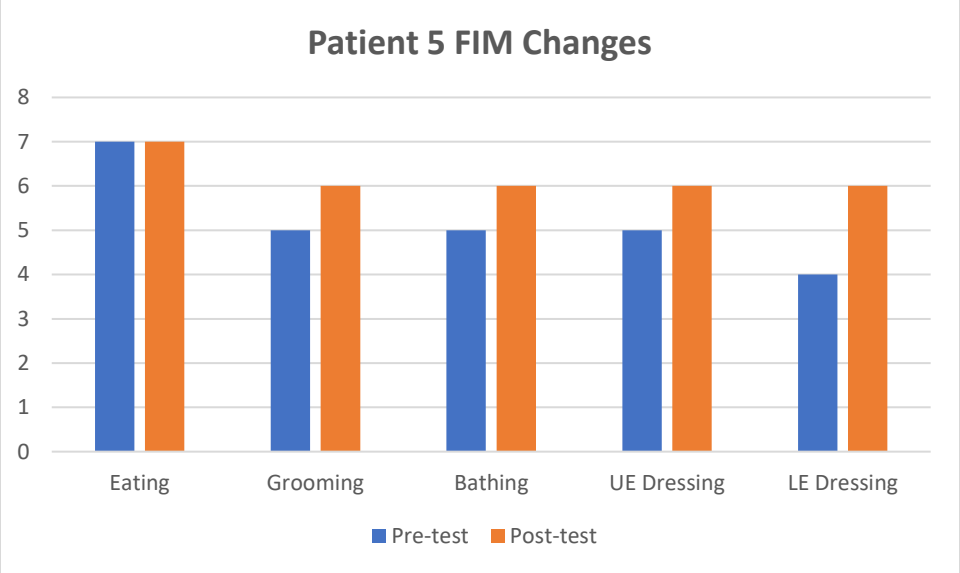
Appendix L

Patient 5 Pre/Post Test Results and Responses to Mirror Box Therapy



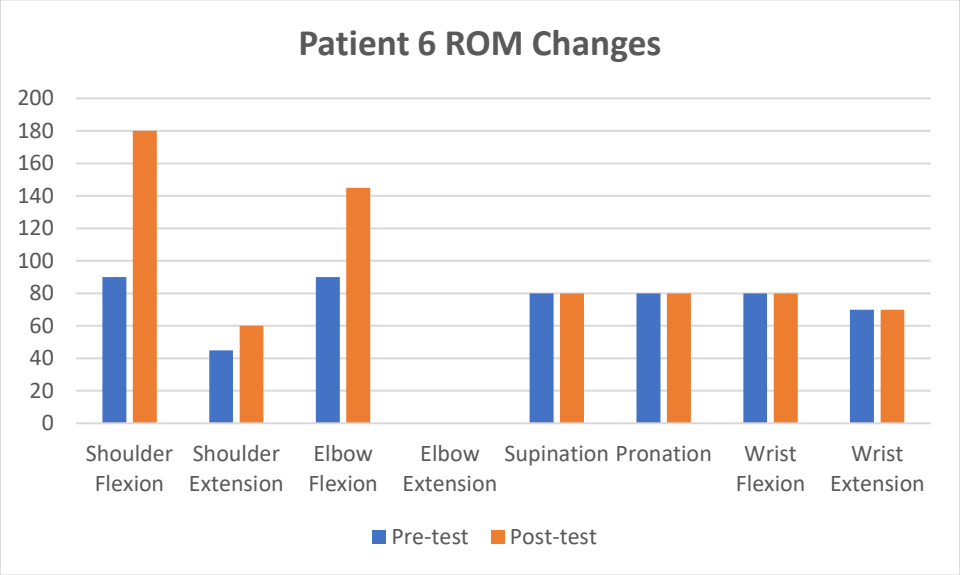


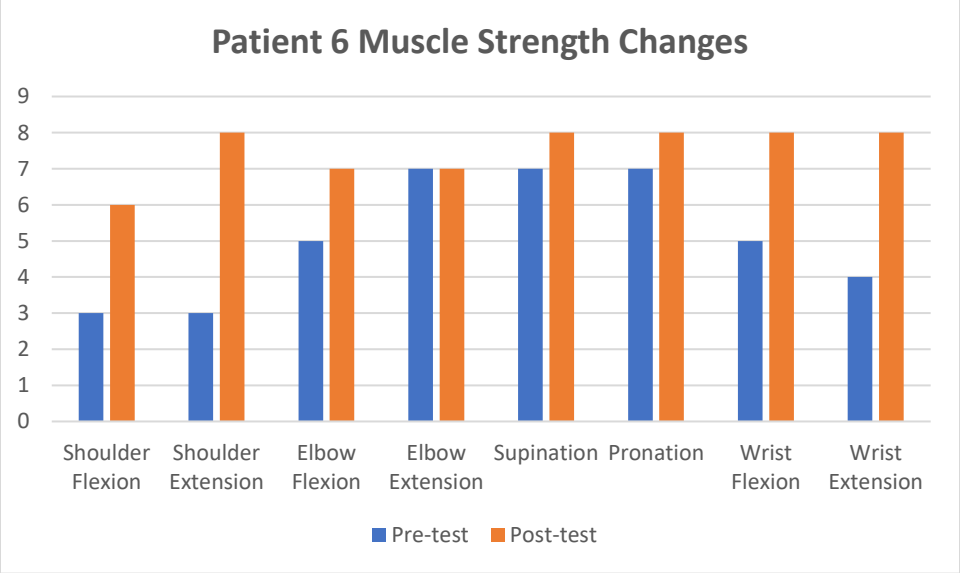

Patient 5 Sensation Score Changes
1.2
1
0.8
0.6
0.4
0.2
0
Shoulder
Elbow
Wrist
Hand
Pre-test
Post-test

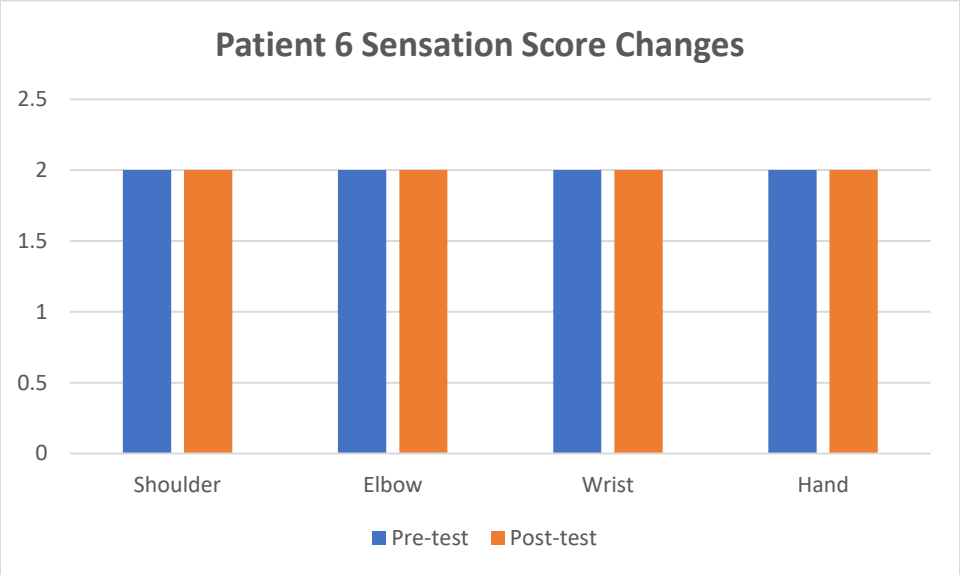

Patient 5 FIM Changes
8
7
6
5
4
3
2
1
0
Eating
Grooming
Bathing
UE Dressing
LE Dressing
Pre-test
Post-test

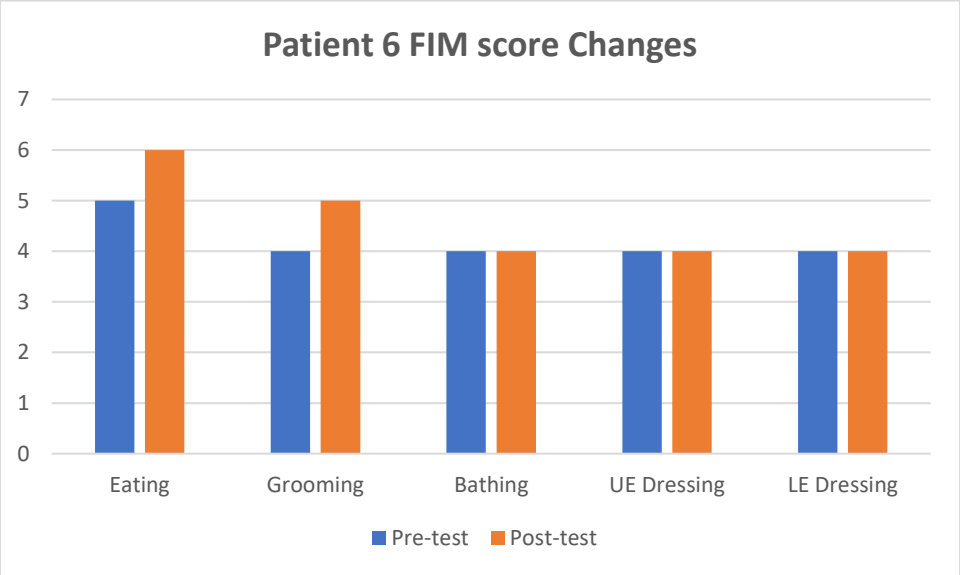
Appendix M

Patient 6 Pre/Post Test Results and Responses to Mirror Box Therapy



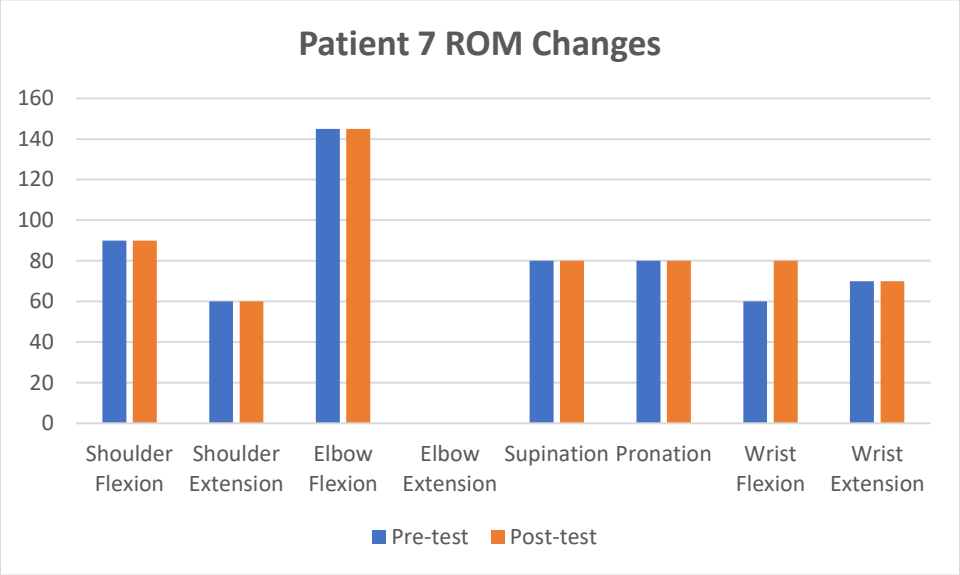


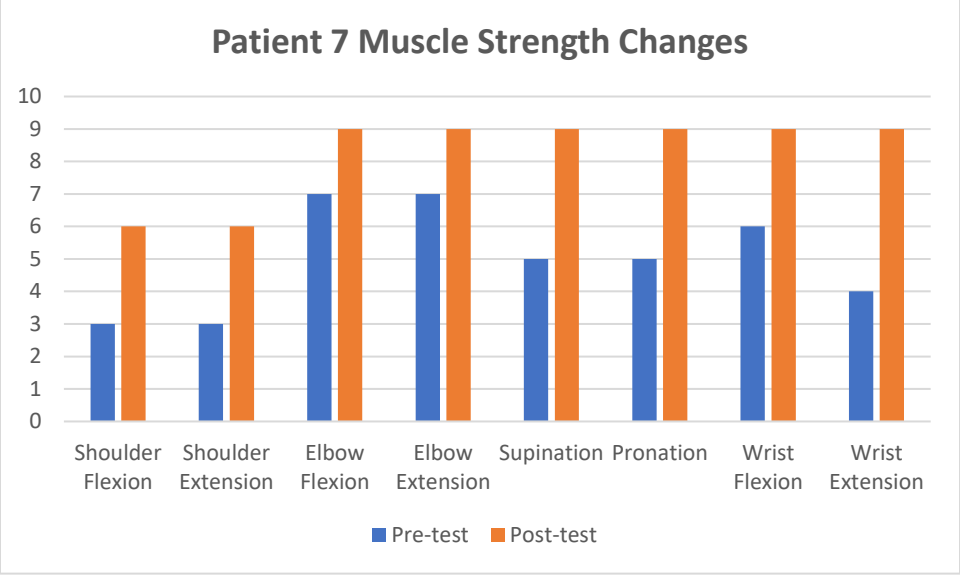

Patient 6 Sensation Score Changes
2.5
2
1.5
1
0.5
0
Shoulder
Elbow
Wrist
Hand
Pre-test
Post-test

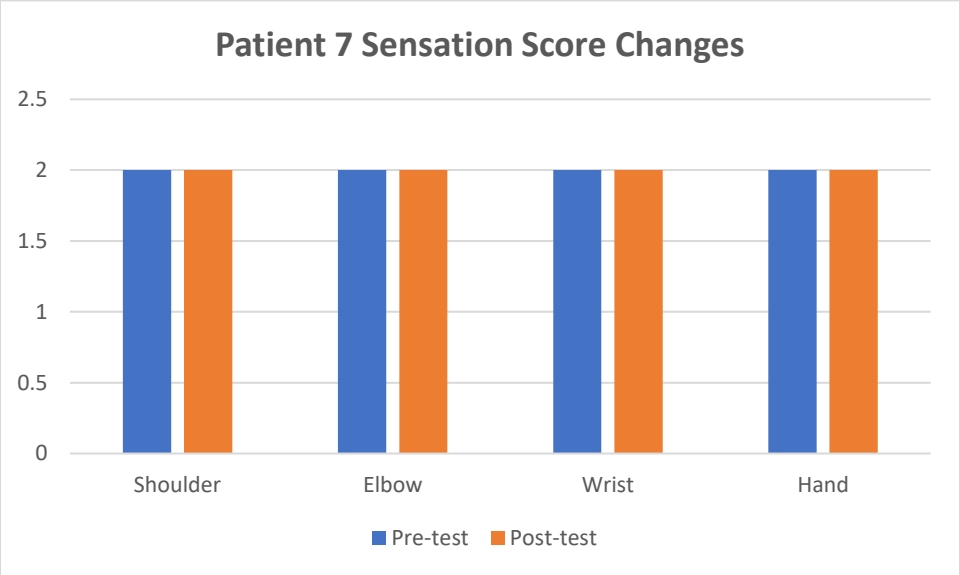

Patient 6 FIM score Changes
7
6
5
4
3
2
1
0
Eating
Grooming
Bathing
UE Dressing
LE Dressing
Pre-test
Post-test

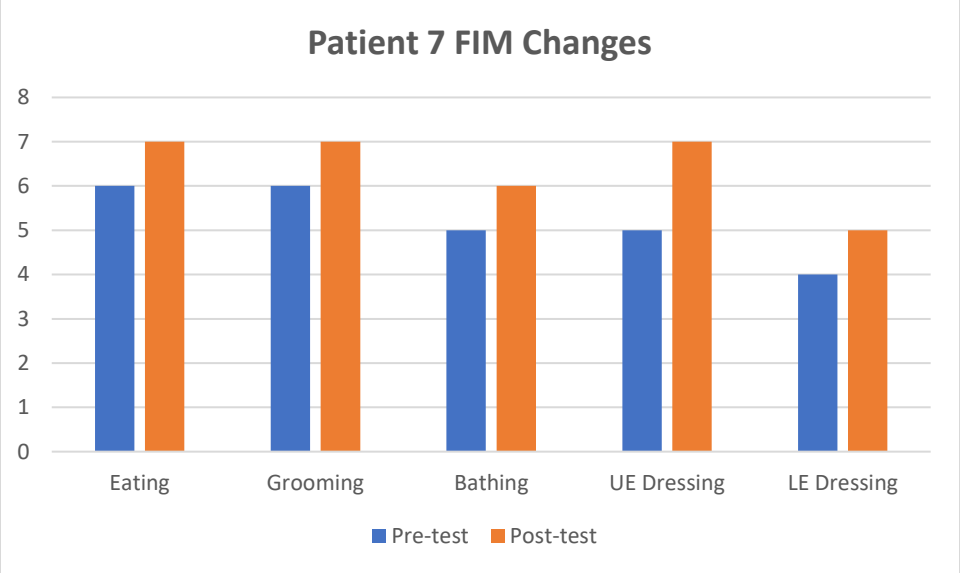
Appendix N

Patient 7 Pre/Post Test Results and Responses to Mirror Box Therapy






Patient 7 Sensation Score Changes
2.5
2
1.5
1
0.5
0
Shoulder
Elbow
Wrist
Hand
Pre-test
Post-test


Patient 7 FIM Changes
8
7
6
5
4
3
2
1
0
Eating
Grooming
Bathing
UE Dressing
LE Dressing
Pre-test
Post-test