THE FEASIBILITY OF A MENTAL PRACTICE PROTOCOL FOR SEVERE UPPER EXTREMITY HEMIPARESIS

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TERESA M. GREEN, MSOT

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ABSTRACT

TERESA M. GREEN

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Objective: To increase the efficacy of mental practice (MP) with severe upper extremity (UE) hemiparesis following a stroke and examine the feasibility of following an MP protocol in the acute inpatient rehabilitation setting.

Design: single-group, pretest-posttest

Setting: acute inpatient rehabilitation

Subjects: 11 patients, less than 1-month post-stroke with severe UE hemiparesis and 17 occupational therapists working in acute inpatient rehabilitation

Intervention: Patients completed an MP protocol of MP 5 days/week for 2 weeks of wiping a table and picking up a cup.

Outcome Measures: Wolf Motor Function Test (WMFT) and Fugl Meyer Assessment-UE (FMA-UE) assessed UE functional abilities and impairments. The Acceptability of Intervention Measure (AIM), the Intervention Appropriateness Measure (IAM), and the Feasibility of Intervention Measure (FIM) measured perceptions of MP.

Results: Wilcoxon signed-rank test demonstrated completing MP showed a statistically significant difference in FMA-UE scores from pretest (*Mdn* = 7.00, *M* = 8.36, *SD* = 5.46) to posttest (*Mdn* = 13.00, *M* = 16.27, *SD* = 11.11), *n* = 11, Z = 2.70, *p* = .007, r = .57. There was no statistically significant change in WMFT time scores from pretest (*Mdn* = 120.00, *M* = 114.48, *SD* = 18.32) to posttest (*Mdn* = 120; *M* = 81.25, *SD* = 54.72), *Z* = 1.82, *p* = .068, *r* = .39. There was a statistically significant change in WMFT-FAS from pretest (*Mdn* = 1.00, *M* = .91, *SD* =

.831) to posttest (*Mdn* = 1.00, *M* = 1.55, *SD* = 1.29), *Z* = 2.07, *p* = .041, *r* = .44. MP improved UE impairments with less effect on UE functional abilities. Mean AIM scores demonstrated 72.7% of patient responses and 70.6% of therapist responses were *agreeable* to the acceptability of MP as a treatment. Mean IAM and FIM scores for therapists and patients demonstrate >80% of patient responses were *agreeable* to MP as an appropriate and feasible intervention.

Conclusions: Although there is less acceptability of patients and therapist toward MP as an intervention, MP is a feasible and effective treatment for acute UE hemiparesis following a stroke.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Upper Extremity Hemiparesis

More than 795,000 people have a stroke annually in the United States (Virani et al., 2020). From a public health standpoint, the consequences of stroke are profound, affecting the public on both personal and societal levels. Health care expenses and missed time at work following a stroke contribute to an estimated $45.4 billion in costs each year (Virani et al., 2020). The majority of stroke survivors report a decrease in their quality of life (Chan & Au-Yeung, 2018; Chen et al., 2015; Herbert et al., 2017) including a significant impact on their ability to return to meaningful roles at home, school, or work (Chen et al., 2015; Stockley et al., 2021). Expectedly, stroke diagnosis is the leading cause of long-term disability (Patel et al., 2017).

These widespread effects of stroke are often caused by residual sensorimotor deficits resulting in hemiparesis. Hemiparesis is the paralysis of one side of the body resulting from damage to the central nervous system (Venes, 2017). Hemiparesis is understood as a dynamic and complex impairment of muscular activation including decreased ability to elicit muscular recruitment, abnormal timing or inappropriate muscle activation, and/or co-contraction of opposing muscle groups (Levin & Demers, 2021).

More specifically, upper extremity (UE) hemiparesis remains present in up to 80% of individuals (Pulman & Buckley, 2013) less than 6 months post-stroke (Hatem et al., 2016) and 62% of individuals greater than 6 months post-stroke (Kwakkel et al., 2003; Levin & Demers, 2021; Llorens et al., 2021). UE hemiparesis often leads to a significant decline in stroke survivors' occupational performance, participation, health, and well-being (Virani et al., 2020). Due to the serious and life-altering effects of UE hemiparesis following a stroke, the stroke

survivor needs occupational therapy (OT) interventions aimed to facilitate the functional recovery of the hemiparetic UE. One such promising approach is an intervention known as mental practice (MP).

MP is an adjunctive therapy that involves the cognitive rehearsal of a motor task without physical movement (Barclay et al., 2020) and is considered a safe and feasible intervention that reduces UE impairment (Page & Peters, 2014; Song et al., 2019). For example, in audio-guided MP, an individual listens to an audio recording that guides them through a multi-sensory cognitive rehearsal of a motor task, such as picking up a cup and drinking with the affected UE. The recording encourages the client to imagine the visual aspects of the drink: water and ice cubes in a clear glass; auditory aspects: the sound of the ice moving around in the glass; kinesthetic aspects: the temperature and feel of the cup (cold/moist); as well as the feeling of being satiated after swallowing the water.

It is widely agreed that MP improves UE impairments and functional abilities, enhances UE recovery following a stroke (Nilsen et al., 2010; Nilsen et al., 2012; Page et al., 2016), and is superior to traditional stroke rehabilitation (Peters & Page, 2015, Song et al., 2019, Stockley et al., 2021). Imaging studies demonstrate that thinking about a movement activates the same areas of the brain that are activated when a task is physically performed (Feenstra et al., 2016; Malouin et al., 2013). This finding is particularly advantageous for the patient with severe UE hemiparesis. Although the patient is unable to move their UE functionally, MP facilitates task-specific repetitions that can be performed independently and in addition to standard therapy.

Severe Upper Extremity Hemiparesis

Within the stroke population, individuals with severe UE hemiparesis seemingly experience the worst consequences of stroke. Individuals with severe UE hemiparesis are unable

to complete even simple tasks with the affected UE including, reaching, picking up, and/or manipulating objects. While individuals with mild to moderate UE hemiparesis have relatively better functional recovery (Hatem et al., 2016, Nijland et al., 2010), the prognosis for individuals with severe UE hemiparesis is poor (Nakayama et al., 1994). Researchers suggest that after 6 months post-stroke, 60% of this subgroup will not regain dexterity (Hatem et al., 2016; Kwakkel et al., 2003). Additionally, only 5% of individuals who initially have complete paralysis (severe impairment) will achieve functional use of the UE (Hatem et al., 2016). The absence of grip at 1-month post-stroke is associated with poor functional recovery. Conversely, active, voluntary movement of the hemiparetic UE within the first week post-stroke is considered a positive prognostic indicator (Kwakkel et al., 2003; Sunderland et al., 1989). A bleak prognosis, probability studies demonstrating poor outcomes (Sunderland et al., 1989), and the decreased ability to actively use the UE in therapeutic tasks (Patel et al., 2017), may be causes for the lack of intervention studies with a focus in this population. Subsequently, few effective rehabilitation treatment approaches aid in the functional recovery of the severely hemiparetic UE (Bigoni et al., 2022; Herbert et al., 2017)

Traditional stroke rehabilitation to address severe UE hemiparesis includes passive range of motion (Llorens et al., 2021), electrical stimulation, acupuncture, and massage (Sun et al., 2013). Unfortunately, these interventions require only passive participation from the patient, which limits neural reorganization. There are several efficacious OT interventions addressing the hemiparetic UE; however, most of these interventions (e.g., constraint-induced movement therapy, task-specific training, and bilateral arm training) are directed towards the individual with mild to moderate hemiparesis (Bigoni et al., 2022; López et al., 2019). Limited options are available for the acute, severe hemiparetic UE with minimal to no movement (Herbert et al.,

2017; Thrasher et al., 2008). Additionally, the literature demonstrates that most recovery from impairment occurs in the first 3 months following a stroke. However, most research studies that address neurorehabilitation are conducted in the chronic phase of recovery (Patel et al., 2017). Therefore, this research served to increase research and rehabilitation interventions for acute, severe UE hemiparesis.

Despite the potential benefits for survivors with severe UE hemiparesis, research in MP has largely been relegated to chronic stroke and in outpatient or home health settings (Malouin et al., 2013; Page et al., 2011). Additionally, most MP protocols require active wrist or finger flexion to be eligible (Page et al., 2016), eliminating a large segment of stroke survivors with limited UE movement. The question of efficacy should now shift from the minimal-moderate UE group to the more severe subgroup of the stroke population. A recent systematic review examined when, to whom, and how MP should be delivered (Stockley et al., 2021). Through meta-analysis, the researchers found that individuals with the most severe UE limb dysfunction may reap the most effect from MP. This is a novel concept that has not been thoroughly explored. Therefore, the current study was specifically focused on individuals with acute, severe UE hemiparesis (often underserved) who could potentially benefit most from MP.

Finally, the feasibility of following an MP protocol for both patients and occupational therapists in the acute stage has not been examined. Do occupational therapists perceive MP as a positive OT intervention for recovery of the hemiparetic UE? Also, active participation from the patient is required for MP to be effective. Are patients willing to perform MP and/or perceive MP will have a positive effect on their recovery? These answers will assist with determining the feasibility of MP in rehabilitation. This paper will describe the existing literature that provides efficacy for MP as a viable treatment option and identify the specific aims, methods, analysis,

and results of this dissertation research. The results of this study will provide the occupational therapist with important information about the implementation of MP with patients post-stroke. Although these results may be most applicable to occupational therapists and patients in the inpatient rehabilitation setting, they can have clinical implications in other settings.

Purpose Statement

The purpose of this feasibility study was to increase the efficacy of the use of MP with individuals with severe UE hemiparesis following a stroke and examine the feasibility of patients and occupational therapists in following an MP protocol in the acute inpatient rehabilitation setting.

Research Aims, Questions, and Hypotheses

Research has not established sufficient efficacy for interventions to address severe UE hemiparesis. This study aimed to address this gap in the literature. By promoting neuroplasticity and motor learning MP can be used as an isolated intervention, and/or as an adjunct to standard stroke therapy.

Research Aim 1

Research Aim 1 was to determine the feasibility of completing an MP protocol in acute inpatient rehabilitation with individuals with severe UE hemiparesis following a stroke.

Research Question 1

Do patients with UE hemiparesis following a stroke perceive MP to be an acceptable, positive, and feasible intervention to address their affected UE?

Hypothesis 1a. Patients will demonstrate overall acceptability of completing an MP protocol as measured by 80% agreeable survey responses on the Acceptability of Intervention (AIM).

Hypothesis 1b. Patients will overall perceive MP as an appropriate intervention as measured by 80% agreeable survey responses on the Intervention Appropriateness Measure (IAM).

Hypothesis 1c. Patients will overall perceive MP as a feasible intervention as measured by 80% agreeable survey responses on the Feasibility of Intervention Measure (FIM).

Research Aim 2

Research Aim 2 was to determine the feasibility of occupational therapists facilitating an MP protocol in acute inpatient rehabilitation with individuals with severe UE hemiparesis following a stroke.

Research Question 2

Do occupational therapists working in acute inpatient rehabilitation perceive MP to be an acceptable, positive, and feasible intervention to address UE hemiparesis following a stroke?

Hypothesis 2a. Occupational therapists will demonstrate overall acceptability of facilitating an MP protocol as measured by 80% agreeable survey responses on the AIM.

Hypothesis 2b. Occupational therapists will overall perceive MP as an appropriate intervention as measured by 80% agreeable survey responses on the IAM.

Hypothesis 2c. Occupational therapists will overall perceive MP as a feasible intervention as measured by 80% agreeable survey responses on the FIM.

Research Aim 3

Research Aim 3 was to examine the efficacy of an MP protocol on UE impairment and functional abilities of individuals with severe UE hemiparesis following a stroke.

Research Question 3

Does performing MP 5 days/week for 2 weeks significantly affect UE impairment and functional abilities for individuals with severe UE hemiparesis following a stroke?

Hypothesis 3a. Patients completing an MP protocol will demonstrate statistically significant reductions in UE impairment as measured by the Fugl Meyer Assessment-Upper Extremity (FMA-UE).

Hypothesis 3b. Patients completing an MP protocol will demonstrate statistically significant improvements in UE functional abilities as measured by the Wolf Motor Function Test (WMFT).

CHAPTER II

LITERATURE REVIEW

Theory and Principles

Examining previous research studies with a focus on severe UE hemiparesis and acute inpatient rehabilitation will lay ground for the impetus of MP as an OT intervention to address severe UE hemiparesis. The conceptualization of this dissertation emerged from three areas within research: (a) theory and principles, (b) MP efficacy, and (c) severe UE hemiparesis. Each area will be discussed in recognition of how the literature has influenced this study. Additionally, the research to support the methodology used for this study will be explained.

The roots of MP began with cognitive neuroscience literature that examines the concept of *motor imagery* (MI). MI is the cognitive state in which a representation of a motor act is internally rehearsed without actual motor execution (Decety & Grèzes, 1999; Harris & Hebert, 2015). MI can occur in various tasks performed in life such as watching someone with the desire to imitate their actions, preparing or intending to move, inhibiting movement, or remembering an action (Jeannerod & Decety, 1995). These tasks elicit representation that recruits neural activity specific to action planning (Decety & Grèzes, 1999). MI is also referred to as mental imagery and MP throughout the literature (Harris & Hebert, 2015). This study will differentiate MP from motor/mental imagery by defining MP as a construct in which imagery is used as a training technique with the express intent to improve motor performance. Throughout this paper the term MI will be used to refer to the cognitive state and MP as a training technique that utilizes MI.

Motor Imagery Theories

The use of MP as a clinical treatment in rehabilitation derives from theories that pose similarities in MI to motor execution; thereby, suggesting the ability to use MI to enhance and/or

supplement motor execution when needed. The mental simulation theory suggests a functional equivalence to the neural representation for action planning to motor execution (Decety & Grèzes, 1999). Furthermore, similarities between MI and motor execution are seen in physiological variables. Pioneering studies found that MI can increase physiological responses such as heart rate, proportional to the imagined effort, similar to motor execution (Decety et al., 1991; Decety et al., 1993; Kilteni et al., 2018). Additionally, the motor programming theory (Jeannerod & Frak, 1999) goes beyond stating similarities between the two constructs by suggesting the integral role that MI plays in motor execution. The authors of this theory argue that effective movement requires the ability to formulate neural representations of that movement (López et al., 2019). Later, these theories would serve as the theoretical underpinning for the physical, environment, task, timing, learning, emotion, and perspective model (PETTLEP; Holmes & Collins, 2001). The PETTLEP was designed to assist sports psychologists with the use of evidence-based MI programs that maximize functional equivalence, or the attempt to complete MI as close to the way in which the task would be physically executed (Wright & Smith, 2009).

Motor Learning Theories

Each of the aforementioned theories contributed to the hypothesis that MP can be utilized as a treatment protocol in rehabilitation. More specifically, researchers found the impetus to examine the use of MP in stroke rehabilitation to address motor deficits. The overarching theory of stroke rehabilitation derives from motor learning theories. Motor learning is characterized as the processes associated with practice or experience that lead to a change in the capability for skilled behavior (Schmidt et al., 2018). Operating under motor learning theory, occupational therapists attempt to alter conditions during task practice that influence learning. It can be

conceptualized that MP is an intervention directed toward the first phase of motor learning (acquisition). Presumably, the remaining phases (retention and transference; Gregor et al., 2021) are promoted through more challenging tasks and repetition. It is theorized that motor learning is a treatment effect of MP based on assumptions of motor learning in motor execution. MP is considered the rehearsal for future movements and motor plans (Di Rienzo et al., 2016; Maier et al., 2019) and it induces similar learning-dependent brain changes as physical practice (Di Rienzo et al., 2016).

Key elements identified to promote motor learning and neuroplasticity that were considered in the design of this study include the importance of (a) salience, (b) intensity, (Kwakkel, 2009; Levin & Demers, 2021), (c) repetitive task-specific practice (RTP), (d) goal-oriented practice, and (e) multi-sensory stimulation (Maier et al., 2019). The combination of these attributes in motor learning theory has been found to increase rehabilitation outcomes, improve functional performance, promote skill acquisition and retention, and transfer of motor skills (Haggerty et al., 2020). MP scholars combined elements of MI theories with motor learning theories to address the specific needs of the stroke population.

Occupational Therapy Frameworks

The OT Practice Framework (Gibbs et al., 2020) helps to identify the areas in which MP fits into the OT process. It is an intervention that addresses the performance motor skills of moving or interacting with objects, resulting in the successful performance of desired occupations. The desired outcome is the improvement of occupational performance, participation, and quality of life of the individual.

Task-Oriented Approach

It is important for OT interventions to remain aligned with the core theories and assumptions of the profession of OT that specify the importance of engagement in meaningful and goal-oriented occupations in rehabilitation. When facilitating MP, the occupational therapist should use a task-oriented approach that is considered the most current (Gillen & Nilsen, 2018) and the most critical approach to improving UE motor function and control (Gillen, 2013; López et al., 2019). The assumptions within this approach that relate to MP, include the understanding that (a) functional tasks aid in behavioral organization and (b) occupational performance emerges from the interaction between the person and their environment (Gillen & Nilsen, 2018). The task-oriented approach includes activity-based interventions with a focus on performance/motor skills.

Occupational Adaptation

In addition to hemiparesis, the occurrence of a stroke can lead to physical, cognitive, and psychosocial changes that disrupt and/or challenge an individual's ability to perform chosen occupational tasks. Occupational adaptation (OA) is a theoretical framework that describes a natural process of adaptation that occurs as individuals respond to these occupational challenges. It encompasses the dynamic interaction between the *person system* (considered sensorimotor, cognitive, and psychosocial systems) with their occupational environment (considered work, leisure, and play; Schkade & Schultz, 1992a; Schultz & Schkade, 1992b). The stroke survivor is faced with new occupational challenges due to changes in each *person system* that leads to an inability to resume previously assumed roles at home, school, or work. In OA terminology, these are known as periods of transition that directly disrupt the process of OA (Schkade & Schultz, 1992a). Consequently, the individual must develop methods to change the occupation,

environment, and/or physical capabilities to achieve relative mastery within their occupational roles. The OA framework provides a guide to occupational therapists in facilitating the OA process, promoting the OA state (positive adaptive response; Schkade & Schultz, 1992a; Williams & Murray, 2013), and achieving relative mastery.

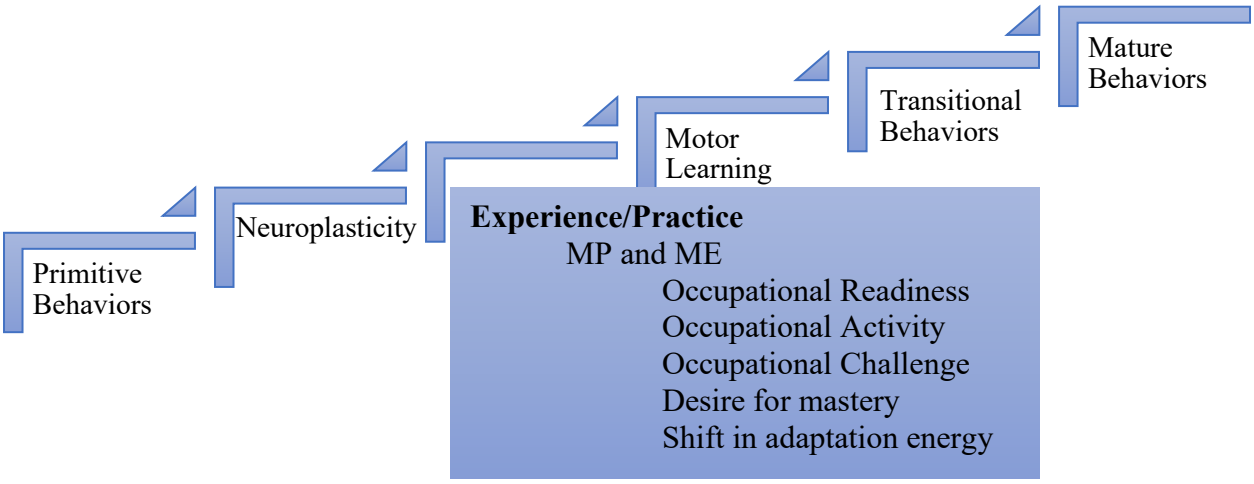
The use of the OA framework is particularly applicable to the stroke population due to the unique and large adaptive transition needs that occur with sensorimotor, psychosocial, and cognitive system changes following a stroke. The use of the intervention MP, guided by the OA framework, appears advantageous as it aligns with an emphasis on eliciting an adaptive response that appears critical to the overarching goal of motor learning in stroke rehabilitation. OA as a framework to facilitate motor recovery following neurological injury is most applicable in the adaptive response mechanism. Here several processes occur that align with motor learning principles and principles of neuroplasticity.

Within the OA process the transition from the initial neurological insult, that begins with primitive behaviors and progresses to mature behaviors, is displayed in Figure 1. When a stroke occurs, it is difficult for the patient to meet their occupational challenges. The patient may struggle during occupational challenges and learn to compensate with the unaffected UE perpetuating learned non-use (Molle Da Costa et al., 2019). Maladaptive responses such as anxiety, fear, neglect, and/or learned non-use exacerbate their efforts. The occupational therapist addresses these maladaptive responses that left unchecked will result in occupational dysfunction. The natural occurrence of neuroplasticity may facilitate adaptation as the brain is able to rewire and make new neural connections. The occupational therapist's role is to facilitate these connections through practice. Experience and practice lead to the brain's ability to find solutions to motor problems that arise in their environment. This ability of the brain to

solve motor problems is understood as motor learning. Following motor learning, the individual progresses to transitional and finally mature adaptive response behaviors to meet the demands of the occupational challenge.

Figure 1

Occupational Adaptation Framework Application



Note. MP = mental practice; ME = motor execution

Occupational therapists utilizing OA should combine occupational readiness and occupational activity into the intervention strategy (Gibson & Schkade, 1997). Within this framework, MP is considered occupational readiness, which uses cognitive strategies to prepare the individual for active engagement in the motor task, while motor execution is the occupational activity. Both MP and motor execution provide the occupational challenge, desire

for mastery, and promote a shift in adaptation energy. The desire for mastery is enforced through occupation-based and goal-oriented tasks. Primary energy can be shifted from a focus on the sensorimotor deficit of the inability to move their UE, to completing the occupational task. Occupational therapists understand the influence of occupations, and the person and environmental factors on performance, participation, and well-being. MP is a unique intervention that can facilitate occupational engagement despite debilitating person factors such as UE hemiparesis. Here, the occupational therapist serves as an agent for addressing the influences of UE hemiparesis on occupational performance, facilitating changes in person factors and the environment, through engagement in goal-oriented and functional activities.

Previous studies have had success with the use of OA as a framework for the treatment of individuals post-stroke. Gibson and Schkade (1997) sought to determine if a hallmark feature of OA (the focus on personally meaningful occupations) could result in better outcomes than typical protocols for patients following a stroke. The authors clearly define OA and give explicit instructions on the application of OA to clinical practice. Fifty subjects were assigned to either a control or an OA group. The control group received standard stroke interventions including self-care training, instrumental activities of daily living training, and a community outing. The OA group focused interventions on the subjects' identified occupational environment role (OE/R). Occupational activities that simulated the OE/R tasks were completed with occupational readiness training (ROM, ADL training). The OA group completed a weekly rating of their progress toward their OE/R. The results of this study found that subjects receiving interventions based on the OA framework demonstrated better functional outcomes at discharge including increased functional independence and the least restrictive discharge environment. The authors

propose that framing interventions with OA theoretical background meets the needs of patients following a stroke.

Rowe and Neville (2018) used OA as a theoretical framework to explore the effectiveness of a Task-Oriented Training and Evaluation at Home (TOTE) program on UE motor movement of individuals with subacute stroke. Four participants completed the TOTE program to include repetitive use of the affected UE in participant-chosen activities to facilitate skill acquisition. Participants completed a maximum of 30 one-hour sessions, 2-3 times/week with a therapist. In addition to the effectiveness of the intervention, the authors were interested in the effect of the intervention on confidence levels. Confidence and self-efficacy are considered a measure of relative mastery, which is a focal piece of OA. Confidence was measured using the Brief Self-Efficacy Scale (Winstein et al., 2013) and UE movement was measured with the use of accelerometry monitors. The study found that following the TOTE program, participants demonstrated increased UE movement, increased confidence, and an adaptive response was elicited.

Mental Practice Principles

Theoretical assertions and a considerable body of literature have emerged to solidify four principles of MP that have informed this dissertation study. Table 1 identifies each principle and the literature that supports the assumption. Examination of the background studies that influenced each principle aid in understanding the cortical and subsequent motor benefits of MP on the functional recovery of stroke survivors with hemiparesis.

Mental Practice Facilitates Neuroplasticity and Motor Learning

Stroke rehabilitation rests on the concept of neuroplasticity, or the ability of the brain to change and reorganize as a result of experience (Kleim & Jones, 2008; Maier et al., 2019; Nudo,

2013). The concept of neuroplasticity, supported by principles of psychology, neuroscience, and education has guided occupational therapy practice in the treatment of several neurological diagnoses, including stroke. The cortical activity occurring during MI includes activation in the premotor cortex, superior parietal lobe (Zabicki et al., 2017), the supplementary motor area (Hardwick et al., 2018), and basal ganglia (Hanakawa et al., 2003). This supports the benefit of MP with individuals with minimal movement in the UE, due to its ability to promote cortical activity with limited motor execution.

Table 1

Mental Practice Principles

Principle	Sources
1. MP facilitates neuroplasticity and motor learning.	Di Rienzo et al., 2016; Page et al., 2009
2. MI and ME share similar cortical activation.	Lacourse et al., 2004; Stephan et al., 1995; Zabicki et al., 2017
3. Cortical activity in MP is similar, yet distinguishable from physical practice.	Krüger et al., 2020; Macuga and Frey, 2012; Page and Peters, 2014; Zabicki et al., 2017
4. MP is most influential with the cognitive rehearsal of a functional task.	Kumar et al., 2016; Vingerhoets et al., 2009

Note. MP = mental practice; MI = motor imagery; ME = motor execution

A functional magnetic resonance imaging (fMRI) study by Page and colleagues (2009) provided momentum to the use of MP to facilitate neuroplasticity. Post-stroke participants with chronic, moderate UE hemiparesis, completed 30-minute MP sessions 3 days/week for 10 weeks. Following the intervention, fMRI results demonstrated significant increases in activation of the participants' wrist and hand, specifically the premotor area and primary motor cortex ipsilateral

and contralateral to the hemiparetic UE, and superior parietal cortex ipsilateral to the hemiparetic UE. Furthermore, this increased cortical activity coincided with improvements in FMA-UE and Action Reaction Arm Test (ARAT) scores, suggesting the treatment effect of MP is neuroplasticity.

In addition to principles of neuroplasticity, motor learning theories have also shaped the rehabilitation approach to addressing stroke. The repetitive rehearsal of functional tasks is an important principle of motor learning theory. Despite research that promotes the importance of intense, repetitious, and goal-oriented task practice, studies have shown that task-specific UE practice occurs in only 51% of therapy sessions, with an average of 32 repetition/session (Kimberley et al., 2010; Lang et al., 2009). However, researchers estimate the need for hundreds of repetitions to elicit neuroplasticity (Kimberley et al., 2010). This suggests that standard rehabilitation therapy alone may be limited in providing optimal practice to elicit cortical reorganization (Nilsen et al., 2010; Trammell et al., 2017). MP can be used to supplement standard therapy to narrow the gap between motor learning theory and clinical practice by providing the patient with additional means for task-specific repetitions resulting in increased potential for neuroplasticity.

Motor Imagery and Motor Execution Share Similar Cortical Activation

The foundational axiom of MP rests in neuroscience research that proclaims there is a significant overlapping of neural activation between MI and motor execution (Guillot et al., 2013; Lacourse et al., 2004; Stephan et al., 1995). In a seminal study, Stephan and colleagues (1995) used positron emission tomography (PET) and MRI to compare the neural substrates of MI to motor preparation and motor performance. During the PET scan, participants performed either execution of, imagined execution of, or preparation to perform a sequence of joystick

movements. Imaging findings demonstrate common neural substrates of MI and execution. This overlap is most substantial in the dorsal premotor cortex, superior and inferior parietal lobe, (Stephan et al., 1995; Zabicki et al., 2017), supplementary motor area (Decety et al., 1994; Decety & Grèzes, 1999; Stephan et al., 1995), and intraparietal sulcus (Filimon et al., 2007). These studies provide credence to a key principle of MP that assumes MP shares some of the same benefits of physical practice in relation to promoting cortical activation, and subsequent presumed motor recovery from a stroke.

Cortical Activity Is Similar Yet Distinguishable From Physical Practice

Although there is similar cortical activation between MI and motor execution, studies have also demonstrated each condition has distinct neural representations. This distinction is important to understand that MP is most effective when combined with physical practice. In a multivariate pattern analysis study participants either imagined or executed a squeezing task, a pointing task, and an extension-flexion task (Zabicki et al., 2017). These researchers found that during hand movements there are common neural representations as well as distinct representations for MI and motor execution. Similarly, a quantitative study used fMRI to examine the neural imprint created following an imagined manual pointing task when participants practiced using the modalities of MI or motor execution. Participants practiced two sequences physically, and two other sequences mentally, and completed a 2-week practice intervention. The data indicated that practicing the pointing task via both modalities, left a modality-specific imprint during MI, specifically noted in the posterior cerebellum. The authors propose that a different neural representation will occur if motor execution is performed following MI.

Macuga and Frey (2012) found that even within the shared neural representations, motor execution has a stronger activation when compared to MI. Therefore, to maximize neural activation and the potential for neuroplasticity, it appears MP and motor execution are more effective when combined than when used in isolation (Grabherr et al., 2015). This aligns with the assumption that MP has priming effects on physical performance (Malouin et al., 2013). This assumption has clinical implications that provide evidence for performing MP of a functional UE task followed directly by physical rehearsal of the same task to maximize outcomes. More specifically, the use of RTP as physical practice of the motor task is encouraged in MP protocols (Page & Peters, 2014), as well as other areas of stroke rehabilitation (Kumar et al., 2016). RTP is the repetitive physical rehearsal of goal-directed, intense, and task-specific movements (American Occupational Therapy Association [AOTA], 2015). RTP has been widely researched, leading to a consensus that the intervention is effective in improving occupational performance post-stroke, particularly UE hemiparesis. Thus, it is considered best practice for UE MP protocols to include an RTP component (Page & Peters, 2014).

Mental Practice Is Most Influential With the Cognitive Rehearsal of a Functional Task

The neuroscience literature also aids in understanding specific parameters that best leverage the cortical benefits of MP and its potential association with daily life tasks. Research has provided evidence to corroborate occupational therapists' understanding of the value of occupation in injury recovery. The highly influential review in neuroplasticity literature by Randolph Nudo (2013) posits that task-specific training drives cortical change. Studies in gait rehabilitation post-stroke now concur that the use of functional task training is a more effective treatment approach than route exercises such as muscle strengthening (Kumar et al., 2016). Likewise, MP is most influential when it includes the cognitive rehearsal of a functional task.

Imaging studies also found that imagined movements with functional intentions with familiar objects increased activation of the left inferior parietal lobe. The left inferior parietal lobe is predominantly responsible for the skillful manipulation of familiar tools (Vingerhoets et al., 2009). Therefore, familiar and functional tasks may be most beneficial in eliciting increased neural connections and promoting neuroplasticity for patients with UE impairment following neurological injury.

Mental Practice - Efficacy

Recent and early efficacy for MP provides the foundational inspiration for this dissertation research. Stephen Page, an OT researcher, performed numerous research studies that demonstrate efficacy for MP to address the hemiparetic UE. In his first OT study, he examined the effect of MP combined with standard OT in a 4-week MP protocol of 30 min of audio-guided MP 3 days/week (Page, 2000). The study included 16 chronic stroke patients with hemiparesis that either completed standard OT with MP or standard OT only. The standard OT plus MP group demonstrated significantly greater improvements in UE recovery than the standard OT group as indicated by FMA-UE pre/post scores.

The early promising results of this pilot study provided the rationale for several larger MP studies. In a randomized controlled trial (RCT) with 32 chronic stroke patients, Page and colleagues (2007) sought to expound upon the efficacy of MP in increasing the functional use of the UE in chronic stroke patients. In addition to standard therapy, participants either received 30 min of MP or 30 min of relaxation exercises, 2 days/week for 6 weeks. FMA-UE and ARAT scores demonstrated a significant improvement in both outcome measures. Later, Page and colleagues (2009) sought to determine the efficacy of MP when combined with modified constraint-induced therapy (mCIT) on improving UE function. Participants were randomized

into either a mCIT only group or mCIT with MP. Both groups received 30 min/day of their designated intervention 3 days/week for 10 weeks. The authors found that the mCIT plus MP group had significantly greater improvements on both FMA-UE and ARAT scores, immediately and 3 months post-intervention.

As the efficacy of the use of MP in stroke rehabilitation mounted, several reviews emerged to analyze the literature. A Cochrane review examined six RCTs to compare the intervention MP to standard stroke rehabilitation or no treatment (Barclay-Goddard et al., 2011). Based on their analysis, the authors proposed that MP has a significant effect on UE activity and impairments and appears to be more effective than other treatments alone. The most recent and more expansive Cochrane systematic review came to the same conclusion (Barclay et al., 2020). The authors analyzed 25 research studies to include 676 participants and concluded that there is "moderate-certainty evidence" that shows MP in addition to other treatments is more beneficial than the other treatment alone in improving UE activity and impairment.

These reviews indicated the need for more information for the appropriate application of the intervention (Malouin et al., 2013). Which patients will benefit from MP? What is the most effective and ideal dosage? Additional information is also needed on the required volume of MP needed to affect outcomes, and the long-term effects of the intervention (Barclay et al., 2020). Several studies would follow to address these identified gaps in MP literature.

Inpatient Rehabilitation

To assist with further defining the patients that would most likely benefit from MP, pilot studies involving MP were completed in the inpatient rehabilitation setting, which yielded mixed conclusions on the use of the intervention in acute stroke. The first study to examine the effect of MP as an adjunct intervention in the inpatient rehabilitation setting concluded MP was an

inexpensive, practical, acceptable, and beneficial method to address UE hemiparesis recovery following a stroke (Crosbie et al., 2004). Participants in this single-case design study completed video-guided MP of a reach and grasp task, daily for 2 weeks. The MP consisted of 20 repetitions of MP in combination with two repetitions of physical rehearsal of the task. A significant change in UE impairment was found for eight out of 10 participants in the study.

An additional study in the inpatient rehabilitation hospital that examined aspects of the feasibility of MP, implemented an MP protocol with patients following a stroke, traumatic brain injury, or multiple sclerosis. The protocol consisted of MP 3 days/per week for 3 weeks, followed by 2 days/week for 2 weeks (Bovend'Eerdt et al., 2010). Following completion of the protocol participants (n = 26) and occupational therapists completed a compliance questionnaire to determine feasibility. The results of the questionnaire demonstrated low compliance of therapists and patients in the completion of MP. These results are not conclusive as the treatment protocol was not standardized and hence varied between participants. Rather than mentally rehearsing a specific task, participants were taught the strategy to perform MP to apply to various contexts. The assumption that patients were able to implement these strategies may have contributed to the low compliance.

The largest MP RCT (n = 121) to date was performed in the inpatient and outpatient rehabilitation setting and examined the efficacy of independently performed MP sessions on UE recovery following a stroke (Ietswaart et al., 2011). Participants, 1 to 6 months post-stroke, with mild-severe UE hemiparesis, were randomly assigned to an MP, nonmotor rehearsal, or control group. The MP protocol consisted of 45-minute sessions of MP, 3 days/week for 4 weeks. The study found no significant difference between UE changes in the experiment and control groups. Timmermans and colleagues (2013) found similar results in a RCT that followed 42 subjects, 2-6

weeks post-stroke. The authors found no significant differences in change scores for UE abilities between an MP and a control group. MP scholars warn the results from both studies may be confounded by high heterogeneity of subjects and large variation in treatments, which could lead to type II errors (Page & Peters, 2014). Study limitations and the small number of studies warrant further examination of the use of MP for recovery of hemiparesis in the inpatient rehabilitation setting, to corroborate or disclaim previous findings.

Mental Practice Parameters

Currently, there is no consensus on the most effective parameters of an MP protocol (López et al., 2019; Malouin et al., 2013), making it difficult for an OT practitioner to implement MP into treatment. Specifically, a consensus on the most effective duration of each MP session is not evident in the literature (López et al., 2019). Limited studies focused on the most appropriate duration of MP to elicit motor improvement. In an RCT, Page and colleagues (2011) compared the effect of 20, 40, and 60 min of MP on UE impairment and UE functional abilities. The study examined 29 participants with chronic, mild hemiparesis following a stroke. Participants completed MP directly following therapy sessions 3 days/week for 10 weeks. The authors identified that 60 min of audio-guided MP is the most effective duration to reduce UE impairment as indicated by significant increases in FMA-UE scores when compared to 20 and 40 min. However, the relation of duration to UE functional abilities was not demonstrated with statistically significant changes in ARAT scores.

In another duration study, massed and distributed MP regimens were examined to determine the most efficacious MP schedule. Twenty-seven chronic stroke survivors were randomized into a “massed” practice group (60 min of MP during a single session) or a “distributed” practice group (20 min of MP occurring 3 times per day). Following 10 weeks of

MP results from FMA-UE and ARAT scores demonstrated that distributed practice yielded better results in the recovery of the hemiparetic UE when compared to massed practice (Page et al., 2016). This finding may be useful to patients with a limited attention span, who may benefit from shorter therapy sessions to remain engaged during MP.

MP research has also examined the parameters of perspective and delivery mode. An RCT of 19 participants with moderate, chronic hemiparesis compared the effect of facilitating MP from an internal (first person) and external (third person) perspective (Nilsen et al., 2012). When participants use a first-person perspective, they imagine completing the motor task, as if viewing it from their own eye, while a third-person perspective is as if observing themselves performing the motor task (Jeannerod & Decety, 1995). These authors found that internal and external perspective groups demonstrated similar improvements in UE impairment and functional ability measures. Likewise, in a study that examined the differences between internal and external imagery on basketball 3-point shot performance, no significant differences were found between the internal and external imagery groups (Lu et al., 2020). Therefore, performing MI from a first- or third-person perspective may not be an important parameter during MP (Nilsen et al., 2012). This provides occupational therapists with a greater ability to provide client-centered care where clients may select the perspective of their choice.

A large scoping review of MP by Harris and Hebert (2015) found that at least six different modes of MP were studied independently including audio or video recording, visual prompts, written instructions, and self-initiated or recorded pictures. Physical therapy MP protocols also included the use of a metronome or musical guides. To date, one study has compared the effectiveness of these methods. Green and colleagues (2021) examined differences in the effectiveness of audio-guided MP versus video-guided MP on UE impairment and

functional abilities. This RCT included participants with acute, moderate UE hemiparesis. Participants were assigned to audio or video-guided groups, an RTP group, or a control group. The study followed an MP protocol to include MP sessions of 10 repetitions of a functional UE task, 5 days/week in combination with therapist-guided RTP. The authors found improvements in UE impairment and functional abilities for the audio-guided and control groups. The video-guided and RTP group demonstrated improvements that were not statistically significant. These findings provide evidence for the use of audio-guided MP as the preferred mode of delivery when compared to video-guided MP.

Interdisciplinary Research

Sports Psychology. OT research has utilized and integrated knowledge gained from various disciplines to understand how MP is a beneficial rehabilitative intervention. Sports psychologists have found that MP can be used to improve athletes' performance and learning (Feltz & Landers, 1983; Munzert & Lorey, 2013), rehearse motor skills, and enhance skill acquisition (Feltz & Landers, 1983; Malouin, 2013). For example, a basketball player may mentally rehearse shooting free throws before a game to increase free throw accuracy. The athlete would be encouraged to evoke a multi-sensory experience, where they imagine the sound of the crowd cheering, the feel of the sweat on their forehead, and the sight of the basketball hoop rim in front of them. With this image in mind, the athlete would mentally rehearse the motor components of shooting the basketball and see themselves making the shot. In other sports, mentally rehearsing the ball trajectory was shown to significantly increase the accuracy and velocity of a tennis serve (Guillot et al., 2013). Besides increasing motor performance, MP has been shown to be beneficial in facilitating emotional functions in athletes such as increasing

motivation, self-confidence, and decreasing anxiety (Guillot et al., 2013, Munzert & Lorey, 2013).

Similar to MP research in neurological rehabilitation, sports psychologists have found the largest gains in athletes' performance are obtained when MP and physical practice are combined (Malouin, 2013). However, when physical rehearsal is difficult or impractical, such as during complex sports or the occurrence of severe UE hemiparesis, MP alone is beneficial. For instance, in gymnastics, a routine may be too physically demanding to practice before a competition. MP can serve as an advantageous means to refresh the kinesthetic memory of the routine without experiencing the heavy load of physical rehearsal.

More recent MP studies demonstrate the ability to use MP to address a diverse range of motor deficits and enhance motor performance. Researchers have found MP to be effective in improving BMX race performance (Daneshfar et al., 2021), postural control, weight shifting (Saruco et al., 2020), hand functioning in Parkinson's disease, strength enhancement, pain reduction, and physical activity improvement for individuals following total knee arthroplasty (Li et al., 2022).

Sports psychology also provided the PETTLEP practice model (Holmes & Collins, 2001), which can be used as a framework in the implementation of MP protocols for neurological rehabilitation. Due to positive findings from studies that utilized the PETTLEP model (Lu et al., 2020; Wright & Smith, 2009), several components of the model were utilized in the design of the MP protocol in this dissertation research.

The overall goal of PETTLEP is functional equivalence or closely matching motor execution (Harris & Hebert, 2015). Unfortunately, MP protocols typically incorporate aspects that contradict functional equivalence. For instance, most MP protocols include a relaxation

period before and after MP. However, most physical tasks do not require a relaxed state of arousal. Therefore, to maximize functional equivalence, this study omitted a relaxation period within the MP protocol. Likewise, with consideration to the *environment* component of the PETTLEP model, the natural setting in which the motor task is typically performed was utilized. For example, if the participant is cognitively rehearsing drinking from a cup, the participant will perform the MP of that task seated in a chair in front of a table. The *task* component of the PETTLEP claims that MP is more effective if the content of the MI is appropriate to the skill level and preferences of the participant (Wakefield & Smith, 2012). Therefore, the chosen tasks in this MP protocol are relatively low-level, gross motor, functional tasks that provide the appropriate challenge for individuals with minimal active UE movement. Additionally, the *perspective* component of the model or the viewpoint of the participants (Wakefield & Smith, 2012) during MP was considered. Typically, the internal perspective is considered closer to motor execution than the external perspective. Thus, all MP recordings were from a first-person (internal) perspective.

Neuroscience. Neuroscience literature has provided important information on the cortical effects of MP. Imaging studies by neuroscientists have aided in confirming the principle that assumes MP can promote neuroplastic changes in the brain in stroke as well as other neurological diagnoses. These studies influenced the MP principles that guided the application of the intervention in this study. Other studies within the neuroscience field should be noted. Sun and colleagues (2013) examined cortical reorganization following motor imagery training with chronic, severe UE hemiparesis following a stroke. The RCT of 39 subjects, studied a group receiving traditional stroke rehabilitation 5 days/week for 4 weeks and a group (n = 18) receiving 30 min of MI training 5 days/week for 4 weeks. fMRI demonstrated a cortical reorganization

pattern of increased activation of the contralateral sensorimotor cortex in most participants in the MI training group (67%). Furthermore, participants in the experimental group demonstrated significantly greater improvement in FMA-UE scores when compared to the control group.

Another neuroscience study examined the effect of MP in individuals with UE phantom pain following amputation (MacIver et al., 2008). Participants completed a 6-week MP training for movements and sensations of the phantom limb. The MP was completed during fMRI via audio recording. Pre/post testing revealed that nine out of the 13 participants had at least a 50% reduction in pain. Furthermore, this reduction in pain was associated with a decrease in cortical activation in areas associated with pain response, suggesting cortical reorganization or neuroplasticity as the treatment effect of the MP training.

Physical Therapy. Although the majority of MP rehabilitation research has explored the effect of MP on UE recovery, more recent studies on MP and lower extremity (LE) recovery in physical therapy are emerging. An RCT of forty individuals with LE hemiparesis following a stroke evaluated the effects of MP with physical practice on LE strength and gait performance (Kumar et al., 2016). The experimental group listened to an audio recording of cognitive visual images of LE task components such as bending and straightening the knee. MP was performed for 15 min, 4 days/week for 3 weeks, before and during the physical practice of task-specific training such as moving from a sitting position to standing. The outcome measures demonstrated the experimental group had significantly greater improvement in gait speed, and hip, knee, and ankle strength in comparison to the control group.

Cho and colleagues (2013) studied the effects of MP combined with gait training on balance, and gait abilities in chronic stroke patients. The authors found that 15 min of video-guided MP combined with gait training on a treadmill 3 days/week for 6 weeks, was more

effective than gait training alone. Recent studies in physical therapy are examining the effects of MP on motor recovery in diagnoses other than stroke. A systematic review explored the effects of MP on patients with multiple sclerosis (Gil-Bermejo-Bernardez-Zerpa et al., 2021). The authors concluded that despite a small number of studies with these diagnoses, overall, the use of MP improves walking speed and distance, decreases fatigue, and improves the quality of life in individuals with motor deficits due to multiple sclerosis.

Physical therapy studies further substantiate the use of audio-guided MP, task-oriented practice, the use of kinesthetic and visual cues for MI, and the positive effects of MP on motor recovery following neurological injury. These studies also corroborate our understanding that MP combined with traditional rehabilitation is more effective than traditional therapy alone.

Severe Upper Extremity Hemiparesis Research

A substantial body of evidence now exists to support the use of MP as an intervention to address chronic, minimal-moderate UE hemiparesis following a stroke. Based on the negative predictors for poor functional outcomes, some therapists suggest rehabilitation treatment efforts for individuals with severe stroke should take a compensatory approach rather than restorative. However, it is reasonable to question if these poor predictors are indicative of consequences that occur following severe cortical damage (that are less likely to be restored to pre-stroke levels), or due to a lack of empirical examination of interventions. Furthermore, a compensatory approach may lead to learned non-use, a phenomenon in which unsuccessful use of the affected UE leads to a reduction of attempts to use it (Patel et al., 2017) and hampers recovery of normal movement patterns (Bigoni et al., 2022). Learned non-use has been shown to have negative effects on the recovery of functional use of the hemiparetic UE and based on motor learning theories, should be prevented (Maier et al., 2019).

Although limited, previous therapy intervention studies with a focus on severe UE hemiparesis have found positive results, suggesting the potential for recovery with this group. Unfortunately, most research on this population has been small-scale feasibility studies and/or does not examine the intervention MP. This gap in the literature further substantiates the need for this dissertation work. One of the few MP studies to examine severe UE hemiparesis found that a 4-week regimen of MP improved the motor function of the severely hemiparetic UE in chronic stroke patients (Sun et al., 2013). A cohort study observed 95 stroke survivors with chronic, severe UE hemiparesis (Barry et al., 2022). The authors found that severe hemiparesis contributed to the involuntary coactivation of antagonist muscles and limited voluntary muscle activation. This study provides insight into the mechanisms that influence severe hemiparesis and provides reasons to explore interventions that support increased voluntary muscle activation.

A feasibility trial examined the benefits of visual and movement-based priming methods in acute, severe UE hemiparesis (Patel et al., 2017). The study included virtual reality-based, visual mirror feedback training with a force modulation pinch trace task. Following the intervention motor improvements were seen in ARAT and FMA-UE scores 6 months post-training. Additionally, a 12–16-week functional electrical stimulation program 5 days/week was found to improve hand function and reduce UE impairments in acute, severe UE hemiparesis when compared to traditional therapy alone (Thrasher et al., 2008).

Herbert and colleagues (2017) examined the feasibility of The MyndMove, a low energy electrical pulse device, used to elicit muscle contractions. The study included individuals with chronic, severe UE hemiparesis as defined by a score of less than 19 on the FMA-UE. Following the use of MyndMove for 20 one-hour sessions, 3-5 days/week for 4-6 weeks, participants demonstrated significant improvement in FMA-UE scores, and the intervention was found to be

feasible and safe. Llorens and colleagues (2021) found similar sensorimotor improvements in a group of chronic stroke patients with severe UE hemiparesis. The study investigated the effectiveness of a combined transcranial direct current stimulation (tDCS) and virtual reality-based intervention compared to traditional therapy. Twenty-nine participants were randomly assigned to an experimental group receiving 30 min of the combined tDCS and virtual reality-based therapy 5 days/week, or a control group, that received standard therapy alone. The experimental group demonstrated clinically meaningful improvement in WMFT, and FMA-UE scores greater than the control group which did not demonstrate clinically meaningful improvements. Chan and Au-Yeung (2018) investigated 41 patients with severe UE hemiparesis post-stroke. Although the authors found no significant difference between a group receiving mirror therapy and a control group, both groups demonstrated significant UE recovery in FMA-UE and WMFT scores. These studies bring promise to the subgroup of severe UE hemiparesis, who are often marginalized as "plateaued" with minimal hope for recovery.

This literature review provided valuable information to influence this dissertation work. Careful consideration was given to the limitations, benefits, and strengths of previous studies. These considerations are reflected and provide efficacy for the specific MP protocol, study design, and subsequent results of this research.

CHAPTER III

METHODOLOGY

Research Design

A single-group feasibility study with pretest-posttest design was deployed to address the research aims. A feasibility study was considered the most appropriate design due to the lack of MP research on this population. Acceptability and limited efficacy were the specific areas of focus of feasibility. The findings from this study can be used to indicate if a larger RCT with individuals with severe UE hemiparesis is necessary.

Design Rationale

Feasibility Study

A feasibility study was considered most advantageous in addressing both the feasibility and effectiveness of the intervention. Bowen and colleagues (2009) defined specific reasons why a feasibility study should be employed including:

- Previous intervention studies had positive outcomes in different settings.
- The population target needs unique consideration for the intervention.
- There are limited published studies with a specific population and/or intervention of interest.

This study focused on two areas of feasibility: acceptability and efficacy. Acceptability in a feasibility study explores the satisfaction, perceived effects of an intervention, and willingness to perform (Bowen et al., 2009; Orsmond & Cohn, 2015). These areas of feasibility will be measured via feasibility surveys with both patients and therapists. The focus of limited efficacy within this feasibility study was measured with UE assessments. These standardized assessments

were chosen with consideration to the specific needs of the stroke population, the inpatient rehabilitation setting, and each assessment's psychometric properties.

Feasibility Objectives

To examine the feasibility of MP in acute inpatient rehabilitation this dissertation utilized aspects of the five main objectives and guiding questions of a feasibility study provided by Orsmond and Cohn (2015). The authors state the overarching question of a feasibility study is "Can it work?" This dissertation will attempt to answer this question and address the following objectives:

- evaluation of recruitment capability and resulting sample characteristics
- evaluation and refinement of data collection procedures and outcome measures
- evaluation of acceptability and suitability of the intervention and study procedures
- evaluation of resources and ability to manage and implement the study and intervention
- preliminary evaluation of participant responses to intervention

Design Considerations

Based on the successful recruitment of stroke participants at this specific hospital (Green et al., 2021) and previous feasibility studies in acute inpatient rehabilitation (Waddell et al., 2014), the sample size goal for patient recruitment was 10 and therapists was 15. Additionally, the limitations of previous studies in the inpatient rehabilitation setting were considered and addressed in the methodology and design of this research study. The current study controlled for high heterogeneity by limiting the study to participants with severe UE hemiparesis as defined by a score of < 20 on the FMA-UE. In addition, although the current practice is to measure dosage by time, time neglects to take into consideration the variance in the number of repetitions that

occur in each time period. Consequently, the number of repetitions within the audio recording was chosen as a more effective means of calculating dosage for this study. Most MP studies do not report the number of repetitions performed in each MP and RTP session making it unclear how many repetitions of MP are optimal. To determine the minimal dosage needed for effect, the number of repetitions, MP sessions, and total minutes of MP for each participant was collected.

Participants

Patients and occupational therapists were recruited from Adventist HealthCare Rehabilitation in Rockville, MD and Silver Spring, MD through convenience sampling. Adventist HealthCare Rehabilitation has two inpatient rehabilitation hospital locations that combine for a total of 97 beds with a large stroke population.

The inclusion criteria for patients were as follows:

- age 18-90
- less than 1 month post-stroke
- hemiparesis of one UE
- severe UE impairment as defined by a score of < 20 on the FMA-UE

The exclusion criteria were as follows:

- history of prior stroke
- severe comorbidities (severe neurological, orthopedic, rheumatoid, or cardiac impairments)
- severe spasticity
- severe cognitive impairments, score < 22 on Mini-Mental State Examination (MMSE)

- inability to perform mental imagery, score < 25 on Movement Imagery Questionnaire-Revised Second Version (MIQ-RS)
- severe aphasia based on speech therapist evaluation
- low English proficiency
- severe pain

Licensed, full-time or part-time occupational therapists currently working in the inpatient rehabilitation unit of Adventist HealthCare Rehabilitation were included in the study to provide their perceptions on the use of MP as an intervention.

Measures

Three types of measures were used in the study: screening tools, feasibility surveys, and UE assessments. An overview of each measure including the purpose, administration, and psychometric properties are provided. Screening tools were administered to patients to determine eligibility to participate in the study based on inclusion and exclusion criteria for each tool. The feasibility surveys were used to measure the feasibility of MP for both occupational therapists and patients in the inpatient rehabilitation setting. The UE assessments were used to measure the UE impairment and functional abilities of each patient. Table 2 provides detailed information on each screening tool.

Screening Tools

The MMSE (Folstein et al., 1975; Folstein et al., 2002) was used to assess the ability of participants to cognitively participate in study activities. The MMSE is a brief screening tool that is commonly used to assess cognitive impairment for determining eligibility to participate in clinical stroke studies and it is often used in MP trials (Crosbie et al., 2004; Ietswaart et al., 2011;

Page et al., 2009; Page et al., 2011). The MMSE was considered advantageous because it does not require additional equipment and has a short administration time.

The MIQ-RS (Gregg et al., 2010) was chosen as a screening tool to determine if participants were able to complete MI and participate in the MP protocol. This tool was considered appropriate due to the successful use of the tool in previous stroke studies (Page et al., 2001). Additionally, this revised version of the assessment was designed for individuals with mobility restrictions, such as stroke survivors. The psychometric properties of the tool were also considered favorable. The MIQ-RS has good reliability (ICC range: .83-99) and internal consistency (Cronbach α: .95-.98; Butler et al., 2012). Participants are instructed to complete an action or movement on their unaffected side such as opening a swinging door with one hand. After completing the task, the participant is asked to mentally perform the same task and then rate the ease or difficulty in which it takes to perform the mental task (see Appendix A). The ratings are made from a visual imagery scale (attempting to see oneself completing the movement) or a kinesthetic scale (attempting to feel oneself making the movement).

Feasibility Surveys

The AIM, IAM, and FIM are implementation outcome surveys that are considered leading indicators of implementation success (Weiner et al., 2017). AIM measures stakeholders' perception that a given intervention, service, or practice is agreeable or satisfactory. IAM measures the stakeholder's perception of the fit, relevance, or compatibility of an intervention or practice in each practice setting and/or the perception of the fit of an intervention to address a particular problem. The FIM measures the extent to which an intervention can be successfully used in each setting (Weiner et al., 2017). The tests demonstrate good structural validity (Cronbach α: .85) and test-retest reliability (Cronbach α: .83; Weiner et al., 2017). The AIM,

IAM, and FIM were designed to allow the researcher to modify the questions to fit the needs of their measurement. Appendix B provides the surveys given to patients and therapists. Table 3 provides detailed information on each feasibility survey.

Table 2

Screening Tools

Measure	Description
MMSE	The MMSE is a brief screening tool that provides a quantitative assessment of cognitive impairment and can record cognitive changes over time. The MMSE consists of 11 simple questions or tasks grouped into 7 cognitive domains: (a) orientation to time, (b) orientation to place, (c) registration of three words, (d) attention and calculation, (e) recall of three words, (f) language, and (g) visual construction. The maximal score is 30, where a score of < 24 is considered abnormal and indicates some cognitive impairment. Administration time: 10-12 min
MIQ-RS	The MIQ-RS measures mental imagery ability in people with restricted mobility such as stroke survivors. It is a 14-item questionnaire that rates one's ability to imagine on a 7-point Likert scale where 1 = very hard to see, 2 = hard to see, 3 = somewhat hard to see, 4 = neutral (not easy not hard), 5 = somewhat easy to see, 6 = easy to see, and 7 = very easy to see. The tool includes seven visual imagery items and seven kinesthetic items. Administration time: 25-30 min

Note. MMSE = Mini-Mental Status Examination; MIQ-RS = Mental Imagery Questionnaire-Revised Second Version

Table 3

Feasibility Surveys

Measure	Description
AIM	AIM measures stakeholders' perception that a given intervention, service, or practice is agreeable or satisfactory. AIM is a four-item survey in which participants rate their level of acceptability on a 5-point Likert scale from (1) completely disagree, (2) disagree, (3) neither agree or disagree, (4) agree, and (5) completely agree. Scores from each item are summed, where higher scores indicate greater acceptability of the intervention (Weiner et al., 2017). Administration time: less than 5 min
IAM	IAM measures the stakeholders' perception of the fit, relevance, or compatibility of an intervention or practice in a given practice setting and/or the perception of the fit of an intervention to address a particular problem. IAM is a four-item survey in which participants rate their perception of the appropriateness of the intervention on a 5-point Likert scale from (1) completely disagree, (2) disagree, (3) neither agree or disagree, (4) agree, and (5) completely agree. Scores from each item are summed, where higher scores indicate a greater perception of the appropriateness of the intervention (Weiner et al., 2017). Administration time: less than 5 min
FIM	The FIM measures the extent to which an intervention can be successfully used in each setting. FIM is a four-item survey in which participants rate their perception of the feasibility of the intervention on a 5-point Likert scale from (1) completely disagree (2) disagree (3) neither agree or disagree (4) agree, and (5) completely agree. Scores from each item are added up, where higher scores indicate a greater perception of the feasibility of the intervention (Weiner et al., 2017). Administration time: less than 5 min

Note. AIM = Acceptability of Intervention Measure; IAM = Intervention Appropriateness Measure; FIM = Feasibility of Intervention Measure

Upper Extremity Assessments

The FMA-UE is a standardized quantitative measure of UE impairment designed to measure post-stroke recovery of the hemiparetic UE (Nilsen et al., 2012). The FMA-UE is based on the Brunnstrom stages of recovery (Brunnstrom, 1966), which are known as the stereotypical stages of UE hemiparesis recovery after a stroke. The widely used assessment is considered the gold standard for assessing the impairment of the UE following neurological injury in both rehabilitation and research. The shoulder, elbow, forearm, wrist, and digits of the UE are assessed for movement and coordination abilities. Appendix C provides the FMA-UE scoring sheet. This outcome measure is considered advantageous for clinical research and practice because it is easy to administer and has a short administration time. The FMA-UE has excellent psychometric properties including high test-retest reliability (r = 0.98-.995) and interrater reliability (r = .99; Duncan et al., 1992).

The WMFT is a standardized quantitative measure of UE motor ability through timed and functional tasks. This outcome measure was considered appropriate due to its sensitivity towards patients with limited UE movement. The functional tasks range from gross motor movements (such as lifting the forearm to a table) to gross motor tasks (such as lifting a can). Appendix D provides the WMFT recording form with a complete list of the functional tasks, the scoring sheet, and the functional ability scale (FAS). The WMFT is relatively simple to administer and time effective in relation to a busy inpatient rehabilitation setting. Additionally, the WMFT demonstrates excellent test-retest reliability (r = 0.95; 0.90), high inter-rater reliability (ICC = 0.93-0.99; Morris et al., 2001; Wolf et al., 2006), high internal consistency (Cronbach α: 0.92; Morris et al., 2001), and high validity properties (Edwards et al., 2012). Scoring includes

assessing the amount of time to complete each task (WMFT-time) and the quality of the movement (WMFT-FAS). Table 4 provides detailed information on each UE assessment.

Table 4

Upper Extremity Assessments

Measure	Description
FMA-UE	The FMA-UE is a standardized quantitative measure of UE impairment commonly used in the post-stroke assessment of the hemiparetic UE. Scoring is based on direct observation of 33 items. UE movements are rated on a 3-point ordinal scale where 0 = unable to perform, 1 = performs partially, and 2 = performs fully. Cumulative scores range from 0-66 where a higher score indicates lower impairment. Administration time: 30-35 min
WMFT	The WMFT is a standardized quantitative measure of UE motor ability through six timed joint movements and eight timed functional tasks. The 15 tasks are rated on a 6-point ordinal scale ranging from 0 = does not attempt with UE being tested, 1 = UE being tested does not participate functionally, 2 = does, but requires the assistance of the UE not being tested or requires more than two attempts to complete, 3 = does, but movement is influenced by synergy, 4 = does, movement is close to normal but slightly slower, 5 = normal movement. The median time and mode of the FAS are calculated to indicate the functional abilities of the UE. Administration time: 30 min

Note. FMA- UE = Fugl Meyer Assessment Upper Extremity Portion; WMFT = Wolf Motor Function Test; FAS = Functional Ability Scale

Procedure

Three procedures were conducted during this research study: screening, testing, and training.

Screening

After meeting initial eligibility criteria, patients and occupational therapists were approached for written informed consent approved by Adventist HealthCare Rehabilitation Institutional Review Board (see Appendix E). Patients were administered two screening tools at baseline to determine eligibility for full participation in the study. Patients that met the inclusion criteria for both screening tools were admitted in the study.

Testing

Testing was completed at two time periods for patients. Patients admitted to the study were administered the UE assessments within 3 days of starting the MP protocol and within 3 days following completion of the protocol. Occupational therapists were tested once during the study through feasibility surveys.

Training - Patients

Mental Practice Protocol. Patients were educated on the MP protocol including the schedule, MP stations, equipment, and how to properly perform MP. Each patient performed MP of the following two activity-based tasks: (1) wiping a table and (2) picking up a cup. These tasks were chosen as they are considered relatively low-level gross motor tasks that require a limited amount of physical movement to complete while remaining goal-oriented and meaningful. MP sessions were completed 5 days/week for 2 weeks, (3 days/week in combination with physical practice, and 2 days/week independently). Following MP, a research therapist

facilitated RTP of the same motor task. Patients participated in the MP protocol for two consecutive weeks. Table 5 describes the parameters and dosage for the MP protocol.

Table 5

Mental Practice Protocol

Parameters	Dosage
MP followed by RTP of the following tasks: Week 1: wiping a table Week 2: picking up a cup	20 MP repetitions and 10 RTP repetitions (3 days/week) 20 MP repetitions independently (2 days/week)

Note. MP = mental practice, RTP = repetitive-task specific practice

Mental Practice Facilitation. MP was completed at an MP station equipped with a tablet and noise-canceling headphones. Participants completed the recording that described the completion of the task with their affected UE. The audio recording was from a first-person view as if performing it with their own UE. The recording begins with instructions to take two deep breaths before beginning mental rehearsal of the task. Following deep breathing, the recording included 20 repetitions of the task and was facilitated using multisensory cues (visual, tactile, auditory, and kinesthetic). For example, the task of picking up a cup included describing how the drink looks (water with ice) and the temperature and feel of the cup (cold/moist). One repetition was considered whole task completion. The duration of the audio recording for wiping a table was 5 minutes, while the duration for picking up a cup was 10 minutes.

Mental Practice Sample - Picking Up a Cup. This section provides a short quote from the audio recording for the task of picking up a cup. Appendix F provides the full script for the audio recording.

> You are thirsty. The room is warm, your mouth is dry and you would like a cool drink of water. You are seated in a comfortable chair with your arms bent at the elbow resting on top of a cool and smooth table. The cup with no handle is directly in front of you, but out of arm's reach. It is a clear cup; you can see the four ice cubes and water filled to the top of the cup. You want to reach for the cup with your right hand. Start by leaning your chest towards the table, now straighten your elbow, and extend your wrist and fingers. You have reached the cup and feel it on the palm of your hand and fingers. It is cold and a little moist. Tighten your fingers around the cup to hold on to it. Lift the cup to your mouth by bending your elbow and lifting your arm. Tilt the cup towards your mouth as you bend your head back to take a drink. You hear the water go down your throat as you take two swallows. Straighten your elbow to bring the cup down to the table. Extend your wrist and fingers to release the cup. (Appendix F)

Mental Practice Sample - Wiping a Table. This section provides a short quote from the audio recording of the task wiping a table. Appendix F provides the full script for the audio recording.

> You are seated in a comfortable chair with your left arm bent at the elbow resting on top of a cool and smooth table. The table is brown, hard, and visibly dirty with sugar spilled all over the surface. You need to wipe the table to clean it up. There is a white washcloth on the table that you can use. Place your left hand on top of the washcloth. Press your palm and fingers into the table to hold onto the washcloth as you begin to wipe. The

washcloth is damp and cold. Straighten your elbow and fingers to wipe forward and then pull your elbow back to bring the washcloth to the front of the table. Slide your hand to the left to begin to clean the next section. Press your palm and fingers into the washcloth as you straighten your elbow. Feel a slight pull at your shoulder as you slide your arm forward to reach the back of the table. Pull your elbow back to wipe the front of the table. There is one section still dirty on the left of the table. Slide your hand to the left and straighten your elbow to wipe the back of the table. Pull your elbow back to wipe the front of the table. (Appendix F)

Repetitive Task - Specific Practice. Patients completed RTP of the motor tasks 3 days/week. Immediately following MP, patients completed 10 repetitions of the same motor task mentally rehearsed. Therapists provided physical assistance as needed such as hand-over-hand assistance to grasp the cup or assistance with sliding the affected UE.

During the task of wiping the table, therapists were limited to the use of a washcloth or sock over the hand and shaving cream. Wiping the table included horizontal and vertical wiping motions. During the task of picking up a cup, therapists were limited to the use of a clear cup without handles and the amount of ice/water could vary. The difficulty of the task was graded to increase or decrease the difficulty as needed. For instance, therapists could perform wiping on an inclined table, or perform the task standing. Following completion of the MP protocol, patients were administered the feasibility survey.

In addition to the MP protocol, participants received traditional OT stroke rehabilitation including stretching, range of motion, self-care training, functional mobility training, and neuromuscular re-education.

Training - Therapists

Occupational therapists completed a 45 min educational course on the science, indications, and instructions on facilitating MP with patients. Following the course, occupational therapists were administered the feasibility surveys.

All research therapists were trained on facilitating all aspects of screening, testing, and training to facilitate the MP protocol.

Data Collection

Each patient was coded with a participant number with all research activities stored in a file folder to protect personal privacy and follow Health Insurance Portability and Accountability Act (HIPAA) regulations. A participant key that identifies each patient to the coded number was stored in a double-locked drawer. Each MP and RTP session was recorded on a MP and RTP log, assigned to each participant, to track compliance with the protocol (see Appendix G).

Analyses

IBM SPSS Statistics for Mac, version 25, was used to analyze the data. Pretest-posttest scores and standard deviations for each outcome measure of each patient, and the group were examined. The descriptive statistics were used to explore nominal data such as the side of the stroke lesion, hand dominance, or years of experience for therapists. Frequencies were used to analyze the feasibility surveys.

Research Aims 1 and 2

1. To determine the feasibility of completing an MP protocol in acute inpatient rehabilitation with individuals with severe UE hemiparesis following a stroke.

2. To determine the feasibility of occupational therapists facilitating an MP protocol in acute inpatient rehabilitation with individuals with severe UE hemiparesis following a stroke.

The feasibility of completing an MP protocol was determined based on AIM, IAM, and FIM cumulative scores for each measure. Cut-off scores are not yet available for the surveys, therefore higher scores (agree or completely agree) were considered indicative of greater levels of acceptability, appropriateness, and feasibility. The mean score for each survey response and the total mean for each survey were analyzed.

Research Aim 3

3. To examine the efficacy of an MP protocol on UE impairment and functional abilities of individuals with severe UE hemiparesis following a stroke.

Pretest-posttest scores for each UE assessment were analyzed through Wilcoxon signed-rank test (Wilcoxon, 1945). Due to the small sample size, the data was not normally distributed; therefore, non-parametric testing was deemed most appropriate for statistical analysis. The Wilcoxon signed-rank test is appropriate to compare related samples or sets of scores from the same group (Field, 2013). The mean and median group scores were analyzed for clinical and statistical significance with significance level set at $p = .05$. Effect size was determined using Pearson r, with the following effect size criteria: 0.1 (small), 0.3 (moderate), and 0.5 (large).

CHAPTER IV

RESULTS

Assessment Results

Participants (Patients)

All patients with a primary diagnosis of cerebral vascular accident (stroke) admitted to Adventist Rehabilitation Hospital in Rockville, MD were screened for participation in the study. From September 2022-April 2023, 173 patients were screened. Of those screened, 148 were excluded for the following reasons:

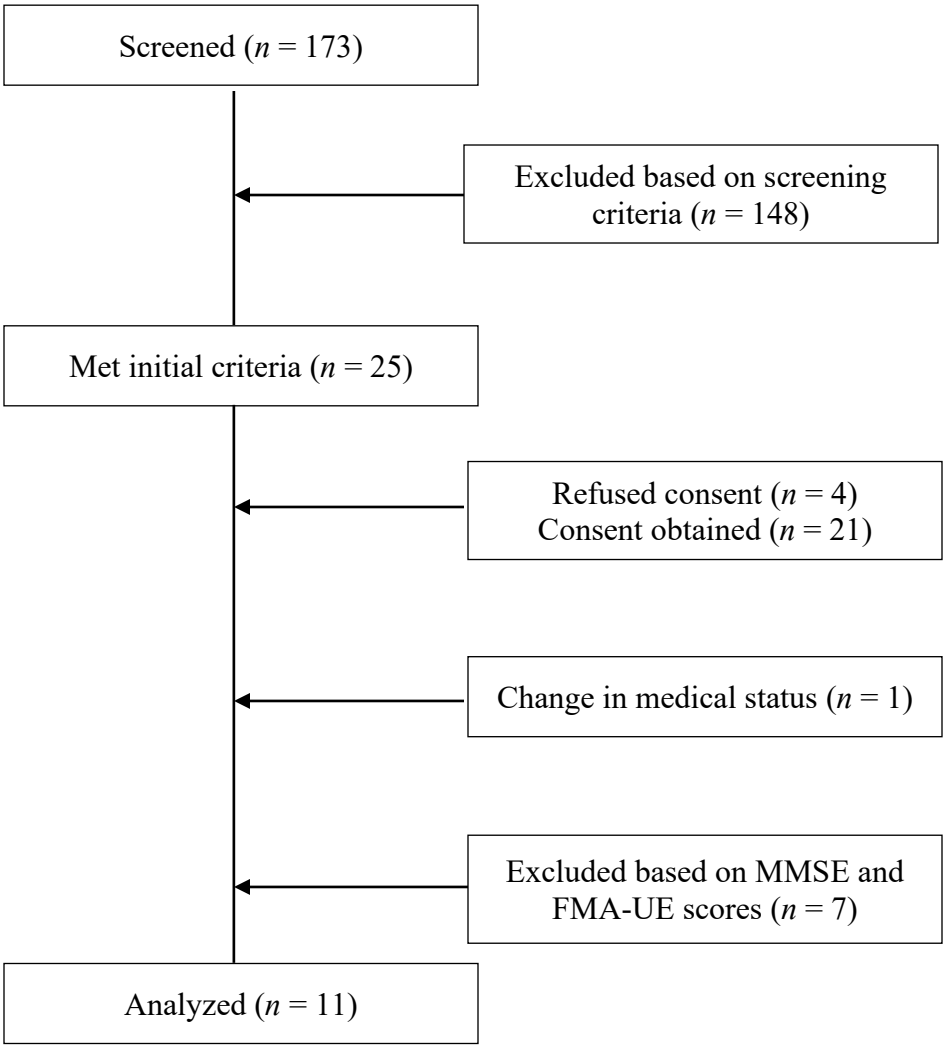
- history of previous stroke (n = 37)
- no significant UE hemiparesis (n = 63)
- severe comorbidities (n = 19)
- participant age greater than 90 years old (n = 4)
- severe aphasia (n = 14)
- low English proficiency (n = 11)

Patients who met the initial inclusion/exclusion criteria were approached by a research therapist for participation in the study. Four patients declined participation in the study. Written consent was obtained from 21 patients to participate in the study. One participant was unable to continue the study due to a change in medical status. After completing pretest assessments, one participant refused to continue in the study. Two participants were excluded for MMSE scores that did not meet the inclusion criteria, and five participants were excluded for FMA-UE scores that did not meet the inclusion criteria. Subsequently, 11 participants consented and completed all research study activities. Figure 2 provides details on the screening process. Patient

demographic information can be found in Table 6. The majority of participants were male (n = 6), Caucasian (n = 5), and attended college or held a college degree (n = 7).

Figure 2

Screening Process



Note. MMSE = Mini-Mental Status Examination

Table 6

Frequencies and Percentages for Participants' (Patients) Demographics

Demographic variable	*n*	%
Gender		
Male	6	54.5
Female	5	45.5
Ethnicity		
Caucasian	5	45.5
African American	4	36.4
African	1	9.1
Hispanic/Latino	1	9.1
Education		
High School Diploma	4	36.4
Some college or college graduate	4	36.4
Graduate Degree	3	27.3
Stroke Type		
Ischemic	9	81.8
Hemorrhagic	1	9.1
Both	1	9.1
Hand Dominance		
Right	11	100
Left	0	0
LUE Affected	8	72.7
RUE Affected	3	27.3
Age		
M(*SD*)	63.9(9.5)	
Range	4-80	
Days since stroke		
M(*SD*)	9.09(14.32)	

Note. RUE = right upper extremity; LUE = left upper extremity; RTP = repetitive task-specific practice

Participants (Therapists)

Written consent was obtained from 17 occupational therapists and occupational therapist assistants to participate in the study. All therapists participated in a 45 min MP educational session, followed by the completion of a survey. The majority of therapists were female (n = 14), held a master's degree (n = 10), with an average age of 32.41. Table 7 describes the demographics of the therapist group in detail.

Table 7

Frequencies and Percentages for Participants' (Therapists) Demographics

Demographic variable	*n*	%
Gender		
Male	3	17.6
Female	14	82.4
Education		
Associate	1	5.9
Master's	10	58.8
Doctorate	6	35.3
Age		
M(*SD*)	32.41(5.86)	
Range	26-47	
Years of Experience		
M(*SD*)	5.71(5.58)	
Range	1-17	

Upper Extremity Impairment and Functional Abilities

Upper Extremity Impairment

To determine changes in UE impairment, the FMA-UE pretest-posttest scores were used (see Table 8). The Wilcoxon signed-rank test demonstrated a statistically significant difference in FMA-UE scores from pretest (*Mdn* = 7.00, *M* = 8.36, *SD* = 5.46) to posttest (*Mdn* = 13.00, *M* = 16.27, *SD* = 11.11), *n* = 11, Z = 2.70, *p* = .007, effect size *r* = .57. MP improved participants' UE impairment with a large effect size. These results substantiate the hypothesis that completing a MP protocol would demonstrate statistically significant reductions in UE impairment.

Table 8

Change in Upper Extremity Impairment and Functional Ability

UE Assessment	Pretest		Posttest				
	Mdn	*M*(*SD*)	*Mdn*	*M*(*SD*)	*Z*	*p*	*r*
FMA-UE	7.00	8.36(5.46)	13.00	16.27(11.11)	2.70	.007	.57
WMFT-Time	120.00	114.48(18.32)	120.0	81.52(54.72)	1.82	.068	.39
WMFT-FAS	1.00	.91(.83)	1.00	1.55(1.29)	2.07	.041	.44

Note. UE = upper extremity; FMA-UE = Fugl-Meyer Assessment Upper Extremity; WMFT = Wolf Motor Function Test; Time (in seconds); FAS = Functional Ability Score

Upper Extremity Functional Abilities

Changes in the functional abilities of the UE were determined by WMFT time scores WMFT-FAS scores (see Table 8). There was no statistically significant change in WMFT time scores from pretest (*Mdn* = 120.00, *M* = 114.48, *SD* = 18.32) to posttest (*Mdn* = 120.00; *M* =

81.25, *SD* = 54.72), *Z* = 1.82, *p* =.068, *r* = .39. There was a statistically significant change in WMFT-FAS scores from pretest (*Mdn* = 1.00, *M* = .91, *SD* = .83) to posttest (*Mdn* = 1.00, *M* = 1.55, *SD* = 1.29), *Z* = 2.07, *p* =.041, *r* = .44, indicating some improvements in UE functional abilities with moderate effect size for WMFT-FAS and WMFT time. These results demonstrate our hypothesis that completing a MP protocol would demonstrate statistically significant improvements in UE functional abilities was partially substantiated.

Feasibility

Feasibility Survey Results - Patients

Acceptability. Individual scores of 4 (*agree*) or 5 (*completely agree*) were combined as one variable and considered "top box" to indicate the overall acceptability of the intervention. Mean AIM scores demonstrated that 72.7% of patient responses were top box, for acceptability of MP as a treatment to address their affected UE. This percentage was below the hypothesized percentage of 80% acceptability for MP; therefore, individuals in acute inpatient rehabilitation with severe UE hemiparesis may not perceive MP as an acceptable intervention to address their affected UE following a stroke. Table 9 provides descriptive statistics for the patients' responses to each survey.

Appropriateness. Individual scores of 4 (*agree*) or 5 (*completely agree*) were combined as one variable and considered "top box" to indicate the perception of overall appropriateness of the intervention. Mean IAM scores demonstrated that 81.8% of patient responses were top box, meeting the hypothesized percentage of 80% agreeable survey responses. These results indicate patients in acute inpatient rehabilitation with severe UE hemiparesis overall felt MP was an appropriate OT intervention to address UE hemiparesis following a stroke.

Feasibility. Individual scores of 4 (*agree*) or 5 (*completely agree*) were combined as one variable and considered "top box" to indicate overall feasibility of the intervention. Mean FIM scores demonstrated that 81.8% of responses were top box meeting the hypothesized percentage of 80% agreeable survey responses. These results indicate patients in acute inpatient rehabilitation with severe UE hemiparesis overall felt MP was a feasible OT intervention to address UE hemiparesis following a stroke.

Table 9

Frequencies and Percentages for Participants' (Patients) Survey Results

Feasibility survey	Top box scores	
	N	%
AIM	8	72.7
IAM	9	81.8
FIM	9	81.8

Note. Top box scores = scores of 4 (*agree*) or 5 (*completely agree*); AIM = Acceptability of Intervention Measure; IAM = Intervention Appropriateness Measure; FIM = Feasibility of Intervention Measure

Feasibility Survey Results - Therapists

Acceptability. Individual scores of 4 (*agree*) or 5 (*completely agree*) were combined as one variable and considered "top box" to indicate overall acceptability of the intervention. Mean AIM scores demonstrated that 70.6% of therapist responses were top box, for acceptability of MP as an OT intervention to address UE hemiparesis following a stroke. This percentage was

below the hypothesized percentage of 80% acceptability for MP, therefore therapists working in acute inpatient rehabilitation may not perceive MP as an acceptable intervention to address acute, severe UE hemiparesis following a stroke. Table 10 provides descriptive statistics for the therapists' responses to each survey.

Table 10

Frequencies and Percentages for Participants' (Therapist) Survey Results

Feasibility survey	Top box scores	
	N	%
AIM	12	70.6
IAM	16	94.1
FIM	15	88.2

Note. Top box scores = scores of 4 (*agree*) or 5 (*completely agree*); AIM = Acceptability of Intervention Measure; IAM = Intervention Appropriateness Measure; FIM = Feasibility of Intervention Measure

Appropriateness. Individual scores of 4 (*agree*) or 5 (*completely agree*) were combined as one variable and considered "top box" to indicate the perception of the overall appropriateness of the intervention. Mean IAM scores demonstrated that 94.1% of therapist responses were top box meeting the hypothesized percentage of 80% agreeable survey responses. These results indicate therapists working in acute inpatient rehabilitation overall felt MP was an appropriate OT intervention to address UE hemiparesis following a stroke.

Feasibility. Individual scores of 4 (*agree*) or 5 (*completely agree*) were combined as one variable and considered "top box" to indicate the overall feasibility of the intervention. Mean FIM scores demonstrated that 88.2% of therapist responses were top box meeting the hypothesized percentage of 80% agreeable survey responses. These results indicate therapists working in acute inpatient rehabilitation overall felt MP was a feasible OT intervention to address UE hemiparesis following a stroke.

CHAPTER V

RECOMMENDATIONS AND CONCLUSIONS

Discussion

The overarching goal of neurorehabilitation is to leverage the plastic nature of the brain for restoration of cognitive and motor-sensory function. With this goal as this study's guiding truth, all efforts must be made to promote neuroplasticity from the onset of neurological injury. Research in stroke rehabilitation has proven that interventions with a focus on intense, repetitive activity, harness the power of neural activation. Most of this research has excluded individuals with severe UE hemiparesis. This dissertation puts forward that the power of neuroplasticity and motor learning includes the acute, severely impaired individual post-stroke. Furthermore, the practical use of the intervention MP in acute inpatient rehabilitation has demonstrated promise for impacting the brain-behavior relationship with this population.

This chapter will identify the clinical implications that can significantly impact OT clinical practice with individuals with severe UE hemiparesis following a stroke. Additionally, this dissertation study examined aspects of the five main objectives of a feasibility study presented by Orsmond and Cohn (2015). Discussing these objectives assists in determining the need and feasibility for a large RCT with this population in this setting. Finally, the limitations of the study and future directions in research will be discussed.

Clinical Implications

Restorative Approach

This dissertation aimed to add to the discussion concerning the most appropriate treatment approach for individuals with acute, severe UE hemiparesis. This study provides empirical evidence that even the severely impaired UE has the potential to reap the benefits of

the plastic nature of the brain. Due to the poor prognosis and functional outcomes of individuals with severe UE hemiparesis, some therapists utilize a compensatory approach to maximize the capabilities of the non-affected side. These results suggest that therapists should be hesitant with using a compensatory approach in the acute phase of stroke recovery. The compensatory strategy may limit the opportunity to exploit the benefits of neuroplasticity.

The significant change in the UE assessments affirms our initial position that MP can be utilized as an effective intervention to improve UE impairment for individuals with acute UE hemiparesis following a stroke. It is widely understood that typical neurorehabilitation falls short of providing patients with the number of repetitions required for cortical change (Birkenmeier et al., 2010; Lang et al., 2009; Trammell et al., 2017). MP is an additional tool to provide task-specific repetitions and practice that are needed to promote neuroplasticity and subsequently improve motor outcomes. Using a restorative approach, in combination with traditional stroke rehabilitation, MP can assist with meeting high repetition goals despite the movement limitations of individuals with severe UE hemiparesis.

Goal Setting

This dissertation study is one of the few MP studies to include and focus on an OT intervention for individuals with severe UE hemiparesis. The hypothesis that MP would reduce UE impairments was substantiated by statistically significant changes in FMA-UE scores, indicating the acute, severely hemiparetic UE has the potential to improve. The second hypothesis that participants would demonstrate statistically significant improvements in UE functional abilities was partially substantiated with mixed results in the WMFT time and FAS scores. There was a statistically significant difference in WMFT- FAS that was not seen in

WMFT time scores. An explanation for the improvements in WMFT-FAS versus time may be found when analyzed with respect to the WMFT administration and scoring.

During the administration of the WMFT, patients are given a maximum of 120 seconds to complete each task. If following 120 seconds, the participant is unable to complete the task, the participant receives a score of 120. This group's mean WMFT pretest score (114.5) was relatively close to 120 seconds, indicating overall this group had difficulty in completing the functional tasks. The scoring instructions for the WMFT-FAS also provide insight into the clinical significance of these results. A score of (0) *does not attempt* and (1) *attempts, non-functional* are given if the patient does not functionally perform the task. The mean pre and posttest scores for the group are below (2) indicating the majority of the group was unable to complete the task. Therefore, although the WMFT-FAS scores demonstrated a statistically significant difference, it is important to consider the limitations of these functional improvements.

Limited improvements in the functional abilities of this group should be expected given the typical short length of stay (10-14 days) for patients post-stroke in acute inpatient rehabilitation. This study was completed in the acute phase of recovery with a protocol duration of just 2 weeks. Therapists working in acute rehabilitation may benefit from an understanding that this population is likely to see gains at the impairment level with less expectation to see gains at the functional level. Krakauer and colleagues (2012) concurred with this suggestion, stating a critical rule in stroke rehabilitation should be a focus on impairment rather than function. Understanding the realistic prognosis of individuals with acute, severe UE hemiparesis will allow therapists to set more realistic and achievable goals with this population.

Occupational Adaptation Framework

This study used OA as a framework to guide the treatment and implementation of the MP protocol. Using OA language, here the occupational therapist is preventing occupational dysadaptation and creating the building blocks necessary to elicit an internal adaptive response. Interventions such as MP, that focus on repetitive, intentional, and functional use of the affected UE, lay ground for the behavior patterns necessary for neurological reorganization and a mature adaptive response to occupational challenges. Therapists working in the acute inpatient rehabilitation setting have the privilege of potentially being the first to introduce the stroke survivor to the concept of neuroplasticity and the brain's potential for recovery following a stroke. As such, the acute inpatient rehabilitation setting can serve to play a critical role in creating a foundation for the requisite attitude, behaviors, and habits needed to promote neuroplasticity. Perhaps, more importantly, therapy in this setting can be integral in combatting unhealthy habits such as learned non-use, inattention, and neglect of the affected UE. A focus on healthy habit development and eliciting an internal adaptive response early in the neurorehabilitation process may provide individuals with severe UE hemiparesis the best opportunity to regain the functional use of their affected UE later in the stroke recovery process.

Mental Practice Protocol Implementation

MP delivery continues to be inconsistent, with MP facilitated in various formats, modes of delivery, and an agreed-upon protocol has not been established. This reduces the ability of researchers to replicate studies and it is difficult for occupational therapists to implement MP into clinical practice. Following completion of this study aspects of MP protocol implementation were examined. The information gained from this study will be helpful to occupational therapists for clinical practice application.

Intensity. Despite previous studies that examined the effectiveness of various MP durations, it is still unclear how many repetitions of MP are needed for cortical change. In comparison to other MP protocols in the literature, this protocol was purposely designed as relatively low intensity, to accommodate the various demands of inpatient rehabilitation (discharge planning, equipment procurement, family training, self-care training, etc.). While having positive results from a low-intensity MP protocol is considered a strength of the study, the number of repetitions used within this protocol may be considered suboptimal. According to animal studies, hundreds of repetitions are needed for cortical rewiring (Birkenmeier, 2010) and typical rehabilitation is falling exponentially short of this number (Lang et al., 2009; Trammell et al., 2017). Additionally, it is understood that increased practice leads to greater skill ability (Lohse et al., 2014); therefore, more is considered better.

One potential strategy to increase the intensity could be utilizing a spacing strategy for the facilitation of MP. A previous study demonstrated that distributed practice of MP 20 min per day three times per day was more beneficial to UE functional recovery than the blocked practice of 60 min of MP in a single session (Page et al., 2016). Occupational therapists in acute inpatient rehabilitation may consider enhancing the MP protocol used in this study by completing the protocol two times per day in lieu of a single session. This would double the amount of MP and RTP repetitions, potentially increasing the effect of the intervention.

Adjunct Therapy. The feasibility survey results indicate lower acceptability of MP for both therapists and patients. This protocol included MP within the therapy sessions. Therapists and patients may be more acceptable to the use of MP as an adjunct therapy, listening to the audio-recording before therapy. Naturally, completing MP independently creates the challenge of ensuring protocol compliance. Having scheduled MP time before therapy may be a plausible

option for settings similar to acute inpatient rehabilitation. Therapy technicians are often responsible for transporting patients to group therapy or other therapy activities. Patients could be transported by a technician to a dedicated MP station before their therapy session. Completing MP before the therapy session allows MP to act as a priming technique that enhances physical practice within the session.

Audio Recordings. The variety of the audio recordings and the order in which patients listen to the recordings should also be considered in MP protocol implantation. To maintain the rigor of the research, this study followed a consistent structure of each task being completed for five consecutive sessions. However, in clinical practice, occupational therapists may consider frequently alternating or presenting additional functional MP tasks to combat occasional fatigue or boredom during MP.

Feasibility Objective 1: Evaluation of Recruitment Capability and Resulting Sample Characteristics

The main question regarding this objective was, "Can we recruit appropriate participants?" (Orsmond & Cohn, 2015, p. 171). This study was able to meet the initial goal for sample size for both patients (n = 11) and therapists (n = 17) within a 7-month recruitment period. Adjustments to the exclusion criteria could yield increased recruitment rates. Eleven participants were excluded from the study due to low English proficiency. There is potential for the MP recordings to be translated into other languages as well as translation of the standardized assessments.

Additionally, while this study focused on severe UE hemiparesis, future studies may widen the inclusion criteria to include other levels of UE impairment severity. This study established efficacy for the use of MP with individuals with severe UE hemiparesis. Previous

studies in this setting have demonstrated efficacy for MP with moderate UE impairment (Green et al., 2021). To increase recruitment rates, the next steps may be to include moderate to severe UE impairment (score <50 on the FMA-UE) with stratified results to increase the sample size and compare the effectiveness of the intervention in both groups.

Regarding sample characteristics, the diversity within this small sample size provides promise for generalizable results with a larger sample size from this setting. Despite the strict eligibility criteria, appropriate recruitment for this population appears feasible.

Feasibility Objective 2: Evaluation and Refinement of Data Collection Procedures and Outcome Measures

The main question regarding this objective was, "How appropriate are the data collection procedures and outcome measures for the intended population and purpose of the study?" (Orsmond & Cohn, 2015, p. 172).

Screening Tools

The MMSE and feasibility surveys appear to be appropriate and feasible for individuals with severe UE hemiparesis in the acute inpatient rehabilitation setting. The MMSE was brief and easy to administer while assessing the required cognitive domains needed to perform MI. The feasibility surveys were also time efficient with participants completing the surveys in less than 5 min. Also, the readability of the surveys is at the fifth-grade level, allowing participants to complete the surveys independently.

While the MMSE and the feasibility surveys appear to be appropriate screening tools for clinical studies in the acute inpatient rehabilitation setting, the MIQ-RS may need further consideration. Research therapists noted that the administration time (25-30 min) of the MIQ-RS hinders the efficiency of the screening process. Research therapist also noted participants

demonstrated difficulty maintaining attention throughout MIQ-RS administration. Participants reportedly rushed their responses, giving ratings before hearing the entire question. This may be the participants' attempt to speed up administration. Moreover, given the average length of stay in acute inpatient rehabilitation is typically 2 weeks, quick screening tools and outcome measures are important to enable the prompt initiation and completion of the intervention protocol prior to discharge. A MI measure with a shorter administration time may be more advantageous for clinical trials in this setting.

Upper Extremity Assessments

The FMA-UE and WMFT appear to be appropriate and feasible for the acute inpatient rehabilitation setting. Both assessments seem particularly appropriate for the assessment of severe UE impairment with rating scales sensitive to relatively low levels of active movement.

Feasibility Objective 3: Evaluation of Acceptability and Suitability of Intervention and Study Procedures

The main question regarding this objective was, "Are the study procedures and intervention suitable for and acceptable to participants?" (Orsmond & Cohn, 2015, p. 172).

Acceptability

Although the feasibility survey results indicate an overall positive perception of the use of MP, subjective comments from both therapists and patients indicate that MP may be more favorable when implemented outside of the therapy session as an adjunct therapy. Therapists appear to be ambivalent about using MP in their treatment plans. When asked, "I like using MP in my treatment plan," the majority (58%) of respondents reported they neither agree nor disagree. When an occupational therapist was asked about their subjective opinion on the use of MP, the therapist noted, "I don't like to use MP, because we have so many other things that we

have to do in our sessions. In inpatient rehabilitation we need to focus on getting the patient home, we don't have time for it [MP]." This comment may provide an increased understanding of the results of the feasibility surveys. AIM scores for patients (72.7%) and therapists (70.6%) were under the hypothesized percentage of 80% acceptability. These scores were markedly lower than the scores from the IAM and FIM, indicating that although MP is considered appropriate and feasible, there is less acceptability for the use of the intervention in the acute inpatient rehabilitation setting.

A patient commented, "The mental practice by itself doesn't feel like it's helpful, because there isn't anything physical." Patients may associate therapy and progress with a physical component and thereby have decreased acceptability toward non-physical interventions. This concern may be addressed through the use of MP as an adjunct therapy. MP provides the opportunity for repetitive practice without interjecting into traditional therapy time, potentially increasing acceptability. Considering the overall results of the feasibility surveys, the objective of acceptability and suitability for MP were partially met. Acceptability may be improved by restructuring MP as an adjunct therapy in addition to standard OT sessions.

Feasibility Objective 4: Evaluation of Resources and Ability to Manage and Implement the Study and Intervention

The main question regarding this objective was, "Does the research team have the resources and ability to manage the study and intervention?" (Orsmond & Cohn, 2015, p. 173). For this objective, the unique demands of the acute inpatient rehabilitation setting were examined to determine the feasibility of managing a MP protocol with acute, severe UE hemiparesis.

Acute Inpatient Rehabilitation

This study served to build upon the efficacy previously established for MP in other rehabilitation settings and increase efficacy for the intervention in acute inpatient rehabilitation. Previous acute inpatient rehabilitation studies demonstrated poor results for the effectiveness of MP in inpatient rehabilitation (Ietswaart et al., 2011; Timmermans et al., 2013). However, the high heterogeneity of subjects and variations in the MP treatments used in these studies, limits the ability to generalize these results to other acute inpatient rehabilitation settings. This study addressed heterogeneity by limiting the severity of participants to severe UE hemiparesis. Additional large-scale studies in acute inpatient rehabilitation are needed to solidify the effectiveness of MP in this setting.

Scholars are consistent in noting that the most impactful period of neuroplasticity generally takes place within the first month to three months following a stroke. Krakauer (2012) posited that high-intensity rehabilitation should occur within the first month following a stroke to maximize cortical plasticity. Stroke survivors in acute inpatient rehabilitation are typically within this time frame in their recovery. Thus, interventions such as MP may be best served in the acute inpatient setting to aid in maximizing this critical period. Previous studies concur that the inpatient rehabilitation setting provides the greatest opportunity for recovery (Waddell et al., 2014). Likewise, a meta-analysis and systematic review of MP concluded that MP is most effective in the first 3 months after a stroke (Stockley et al., 2021).

The MP protocol used in this study was specifically designed for the structure of acute inpatient rehabilitation where patients are scheduled for 3 hours of therapy, 5 days/week. Due to staffing limitations and insurance regulations, therapy is inconsistently provided on the weekend. To augment sedentary time outside of therapy, patients could be scheduled to complete MP on

the weekend. The need for increased therapy dosage, intensity, and activity levels for patients in the acute inpatient rehabilitation setting has been reported (Trammell et al., 2017; Zalewski et al., 2010). A multi-center study observing the physical activity of individuals <14 days post-stroke in inpatient rehabilitation found on average patients spent most of their time alone (60%) and inactive (Bernhardt et al., 2004). Performing MP in addition to standard therapy will increase patient activity and mobilization which is believed to improve outcomes (Indredavik et al., 1999).

MP as an intervention in acute inpatient rehabilitation has other benefits. Unlike other settings, patients in inpatient rehabilitation hospitals are residents and can be scheduled and transported to MP sessions as needed. Despite this unique benefit, most MP research has been performed in the outpatient and home health setting (Malouin et al., 2013; Page et al., 2011). Consistent access to patients in acute inpatient rehabilitation increases the ability to ensure protocol compliance in clinical trials. Despite the demands and barriers of the acute inpatient rehabilitation setting, this research team was able to manage implementation of the MP protocol. This setting is considered a viable option for future intervention studies in MP and UE hemiparesis.

Feasibility Objective 5: Preliminary Evaluation of Participant Responses to Intervention

The main question regarding this objective was, "Does the intervention show promise of being successful with the intended population?" (Orsmond & Cohn, 2015, p. 173). The statistical analysis discussed in the results chapter provides credence to the promise of MP as a successful intervention to treat severe UE hemiparesis. UE assessment scores were also analyzed for clinical significance that should be discussed.

Upper Extremity Impairment

Clinically important difference (CID) provides clinicians with the minimal change in assessment scores for clinical relevance and meaningfulness to patients (Page et al., 2012). Page and colleagues (2016) report a change in FMA-UE scores from 4.25 to 7.25 points indicates a CID. Posttest FMA-UE scores demonstrate a 7.91-point improvement in the mean scores, which exceeds the estimated CID. This demonstrates MP can improve UE impairment to an extent that is meaningful to the patient and clinicians.

Upper Extremity Functional Abilities

Although WMFT-time scores did not indicate statistical significance, there was a CID for WMFT-time and WMFT-FAS. The CID for WMFT scores for a stroke group has been reported as a change in the mean score between 1.5-2 seconds (time score) and 0.2-0.4 points (FAS; Lin et al., 2009). WMFT mean time changed by 33.23 seconds and FAS scores by .64 points indicating a CID. These findings warrant continued investigation as this established CID range was calculated from individuals with chronic stroke with minimal to moderate UE hemiparesis and may not be generalizable to the severely impaired hemiparetic UE.

Examination of the five objectives of a feasibility study assists in answering the overarching question, “Can it work?”(Orsmond & Cohn, 2015, p. 170). The positive results of this feasibility study for both UE assessments and the overall positive perception of MP for patients and therapists justifies the potential for clinical MP research in this setting and substantiates the need for a large RCT to establish more efficacy with this group.

Future Directions

This dissertation work provides useful information on future directions for MP research and clinical application. Researchers may gain insight from this study's design, the MP protocol and application, and addressing the limitations of this study.

Study Designs

Translational Research. Although therapists understand MP to be efficacious, feasible, and appropriate, low acceptability may indicate minimal use of the intervention. This seems to be in alignment with other efficacious interventions that are seldom used in clinical practice. This research-to-practice gap is well documented in health care and OT literature (Juckett et al., 2019). Low compliance of patients and therapists in the completion of MP was demonstrated in previous studies (Bovend'Eerdt, et al., 2010; Stockley et al., 2019). The next step may be in translational research studies to identify barriers or facilitators to the use of MP in clinical settings. OT researchers are encouraged to collaborate with implementation science scholars to conduct translational research that will increase the use of evidence-based practice in clinical practice (Juckett et al., 2019). This study addressed one area of implementation research with a focus on the feasibility of MP in acute inpatient rehabilitation. Additional studies with the use of specific implementation strategies may be warranted to address what appears to be a research-to-practice gap.

Randomized Controlled Trial. A previous MP pilot study in acute inpatient rehabilitation demonstrated improvements in UE impairments and concurred with the need for RCT's in this setting (Crosbie et al., 2004). Additionally, the effect of MP on neurophysiological changes in the acute phase of stroke recovery is largely unknown. Previous MP studies have examined the neural substrates of MP in the chronic stroke population (Page et al., 2009). Future

MP studies should include a randomized-controlled design that examines neural mechanisms via fMRI testing.

This study identified that the primary focus of acute stroke rehabilitation may not be on functional goals, but rather on improvement at the impairment level, and discouraging maladaptive responses such as learned non-use. A focal piece of combating learned non-use is increased attention, use, and movement of the affected limb as much as possible. The question then becomes does MP increase UE motor capabilities *and* UE motor performance? Motor performance focuses on what involvement the affected limb has in real-world settings, not what the limb is capable of doing, but rather what the limb actually does (Bailey et al., 2015). RCTs that include accelerometry monitors on the affected limb could aid in providing information on the effect of MP on arm use.

Additionally, examining patients across the continuum of rehabilitation care would yield more information about the effects of MP on motor learning and functional outcomes. If MP provides the building blocks for neuroplastic changes, do these changes progress to improved functional outcomes? Can participation in MP in acute inpatient rehabilitation positively affect functional outcomes later in stroke recovery? Longitudinal RCTs will provide more information on the long-term effects of MP on UE motor improvement.

Self-Efficacy. OA is understood as a natural process that will occur naturally without intervention. However, the type of adaptation and outcome of this process can be influenced by occupational therapists. Following the occupational adaptation response, the individual will either thrive in their occupational pursuits as demonstrated by relative mastery or wither by occupational dysadaptation. Developing an adaptive response and relative mastery may be influenced by levels of self-efficacy. Future studies should consider the use of self-evaluation

rating scales to evaluate if MP affects the confidence and satisfaction of using the affected limb (relative mastery). A hallmark component of utilizing OA as a framework includes the use of self-evaluation ratings (efficiency, effectiveness, and satisfaction) throughout the intervention process to evaluate the patients' relative mastery (Gibson & Schkade, 1997). This dissertation study evaluated participants' satisfaction with MP as an intervention to address the weakness of the affected limb post-intervention. Therapists should build on the information gained from this study and include self-efficacy measurement to effectively build a collaborative relationship that empowers and supports the individuals' path to relative mastery.

Mental Practice Protocol Design

This protocol was designed with consideration to the functional limitations of a severely hemiparetic UE, the time constraints of acute inpatient rehabilitation, and concerns with boredom and/or decreased capacity of patients to cognitively attend to long periods of MP. Despite these limitations, this patient group tolerated the protocol well, with almost complete compliance. Patients with acute, severe UE hemiparesis may have the ability to tolerate more MP and RTP, potentially increasing the effect on UE recovery. Future research studies should trial increasing the intensity of MP and RTP repetitions greater than what was given in this study. Within an increased intensity protocol, efficacy and feasibility can be re-examined to determine the effect on UE recovery, patient tolerance, and acceptability of the protocol.

In addition, this study designed the MP protocol based on successful findings from several frameworks and protocols from previous studies. Aspects of the MP protocol design were novel including the use of repetitions for dosage and a focus on functional equivalence. Researchers are encouraged to follow a specific framework to assist with the replication of studies and consistency in clinical practice. The design of the MP protocol used in this study

drew from principles of the sports framework PETTLEP (Holmes & Collins, 2001). Stockley and colleagues (2021) encouraged MP researchers to adopt a consistent framework and suggest PETTLEP as a viable choice.

Audio Recordings. This study measured dosage by considering whole-task completion as one repetition. For instance, one repetition of picking up a cup included grasping, bringing the cup to mouth, drinking, and releasing the cup. Previous MP studies utilized time as a measure of dosage. The use of time as a measure again creates difficulty for the replication of MP in research and clinical practice. Within 30 min of MP, the amount and intensity of cognitive rehearsal are highly variable within different studies. Additionally, other neurorehabilitation intervention studies typically use repetitions as the most accurate measure of dosage. MP should be in alignment with other neurorehabilitation intervention efficacy studies. Future MP research is encouraged to count the repetitions given in each MP session to increase replication and data collection efforts.

The dosage of 20 repetitions within the audio recordings proved to be advantageous for protocol compliance within this study. Compliance was high as all but one participant completed all MP and RTP sessions at the specified duration. This single participant fell asleep during the MP but was able to arouse for participation in the RTP. High protocol compliance in this study was likely due to the short duration of the audio recordings (5-10 minutes). It stands to reason that individuals in the acute post-stroke recovery phase may not tolerate long durations of MP (60 min) as suggested in previous literature (Page et al., 2011). This study indicates that a low-intensity MP protocol in the acute inpatient rehabilitation setting is sufficient for improvements in UE impairment in individuals with severe UE hemiparesis. Future studies should consider adopting this low intensity protocol for individuals with severe UE hemiparesis.

Limitations

Although the results of this dissertation are encouraging, there are a few limitations that need further work to validate the findings beyond this feasibility study. The small sample size (n = 11) for patients limits the ability to generalize these results to the entire population of individuals with UE hemiparesis and more specifically to individuals with severe UE hemiparesis post-stroke. However, this sample size was considered appropriate for a feasibility study to provide credence for larger studies in the future.

The design of this study also lacked a control group which is considered a limitation. Individuals in acute inpatient rehabilitation are within the time frame of spontaneous recovery where gains in motor performance are credited to natural physiological healing and time (Cassidy & Cramer, 2017; Kwakkel et al., 2003). The lack of a control group challenges the ability to separate the effects of the intervention from the natural occurrence of spontaneous recovery. However, researchers purport that changes in stroke patients are typically due to the dynamics of an intervention, with less effect from spontaneous recovery alone (Colombo et al., 2013). To control the influence of spontaneous recovery, future large control trials are needed in the acute inpatient rehabilitation setting.

Additionally, the acute inpatient rehabilitation setting is often unpredictable in which frequent changes to the patient's schedule and the patient's availability may change. Due to this diverse environment, a few deviations in the protocol were made and should be noted. On a few occasions' MP was not performed at the designated MP station due to patient fatigue, refusal, or time limitations. This is also considered a unique benefit of MP, where the intervention can easily be performed in various settings. The majority of participants (n = 10) completed all MP

and RTP sessions at 5 days/week (MP) and 3 days/week (MP & RTP) for 2 weeks. However, one participant completed nine out of ten MP sessions due to fatigue.

Finally, the presence of social desirability bias should also be considered when analyzing the feasibility survey results. The research team was known by participants and patients which may have caused respondents to feel obligated to give a positive reply or the mainstream answer to survey questions.

Conclusion

In summary, this study proposes the following clinical implications should be considered by OT practitioners in the acute inpatient rehabilitation hospital setting:

1. A feasible MP protocol for acute inpatient rehabilitation includes MP 3 days/week in combination with physical practice, and 2 days/week with MP only, for a duration of 2 weeks.
2. MP can be used as a scheduled adjunct therapy performed at a designated MP station before a scheduled therapy session.
3. For individuals with severe UE hemiparesis, occupational therapists should set goals with a focus on UE impairment, preventing maladaptive responses, and promoting healthy habits with the affected UE.

Given the growing efficacy of the use of MP with mild-moderate UE hemiparesis, this study encourages occupational therapists to also consider MP as a feasible treatment option for individuals with severe UE hemiparesis. Moreover, the study results indicate this option can be implemented as early as in the acute inpatient rehabilitation setting. UE assessment posttest scores suggest MP affects both UE impairment and functional ability of individuals with severe UE hemiparesis following a stroke. This is encouraging for a population that is often treated

from a compensatory approach, which may reduce the potential benefits of neuroplasticity. This study served to address what appears to be a void in both rehabilitation and research efforts in this population. Furthermore, this study defined which clients benefit from MP, increasing the occupational therapist ability to make more informed decisions in their intervention choices. Most importantly, this preliminary research could increase the ability to explore ways to improve occupational performance, occupational participation, and maximize the health of the individual with severe UE hemiparesis following a stroke.

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APPENDIX A

MOVEMENT IMAGERY QUESTIONNAIRE REVISED 2ND VERSION

MIQRS – Motor Imagery Questionnaire, Revised Second Edition
Assesses ability to imagine movement: kinesthetically and visually.

INSTRUCTIONS:

This questionnaire concerns two ways of mentally performing movements that are used by some people more than by others and are more applicable to some types of movements than others. The first is attempting to form a visual image or picture of a movement in your mind. The second is attempting to feel what performing a movement is like without actually doing the movement. You are requested to do both of these mental tasks for a variety of movements in this questionnaire, and then rate how easy/difficult you found the tasks to be. The ratings that you give are not designed to assess the goodness or badness of the way you perform these mental tasks. They are attempts to discover the capacity individuals show for performing these tasks for different movements. There are no right or wrong ratings or some ratings that are better than others.

Each of the following statements describes a particular action or movement. Read each statement carefully and then actually perform the movement as described with your unaffected side. Only perform the movement a single time. Return to the starting position of the movement just as if you were going to perform the action a second time. Then, depending on which of the following you are asked to do, either (i) form as clear and vivid a visual image as possible of the movement just performed, or (ii) on your affected side, attempt to feel yourself making the movement just performed without actually doing it.

After you have completed the mental task required, rate the ease or difficulty with which you are able to do the task. There are two scales: the visual imagery scale and the kinesthetic scale or feeling scale. Be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each movement. You may choose the same rating for any number of movement, seen or felt, and it is not necessary to utilize the entire length of the scale.

There are two ways to imagine: seeing or feeling. I'll give you an example. If you imagine seeing yourself on a roller coaster, you can either see yourself from a third person perspective and what you look like on the roller coaster, or you can imagine from the first person perspective and see the tracks in front of you going up or down. If I asked you to imagine what you feel like going up a roller coaster, you would imagine the tracks rumbling or feeling a little nauseous.

Visual Imagery Scale

1 Very hard to see	2 Hard to see	3 Somewhat hard to see	4 Neutral (not easy not hard)	5 Somewhat easy to see	6 Easy to see	7 Very easy to see

Kinesthetic Imagery Scale

1 Very hard to feel	2 Hard to feel	3 Somewhat hard to feel	4 Neutral (not easy not hard)	5 Somewhat easy to feel	6 Easy to feel	7 Very easy to feel

Kinesthetic Imagery Scale

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy not hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

Be as accurate as possible and take as long as you feel necessary to arrive at the proper rating for each movement. You may choose the same rating for any number of movements "seen" or "felt" and it is not necessary to utilize the entire length of the scale.

1. Starting Position: Stand with your feet and legs together and your arms at your sides.

Action: Raise your one knee as high as possible so that you are standing on one leg with your other leg flexed (bent) at the knee. Now lower your leg so that you are again standing on two feet.

Mental task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy not hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

Rating:_____

2. Starting Position: While sitting, put your hand on your lap and make a fist.

Action: Raise your hand above your head until your arm is fully extended, keeping your fingers in a fist. Next, lower your hand back to your lap while maintaining a fist.

Mental task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat hard to see	Neutral (not easy not hard)	Somewhat easy to see	Easy to see	Very easy to see

Rating:_____

3. Starting Position: Extend your arm straight out to your side so that it is parallel to the ground, with your fingers extended and your palm down.

Action: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly. Now move your arm back to the starting position, straight out to your side.

Mental task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy not hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

Rating:_____

4. Starting Position: Stand with your arms fully extended above your head.

Action: Slowly bend forward at the waist and try and touch your toes with your fingertips. Now return to the starting position, standing erect with your arms extended above your head.

Mental task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat hard to see	Neutral (not easy not hard)	Somewhat easy to see	Easy to see	Very easy to see

Rating:_____

5. Starting Position: Put your hand in front of you about shoulder height as if you are about to push open a swinging door. Your fingers should be pointing upwards.

Action: Extend your arm fully as if you are pushing open the door, keeping your fingers pointing upwards. Now let the swinging door close by returning your hand and arm to the starting position.

Mental task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat hard to see	Neutral (not easy not hard)	Somewhat easy to see	Easy to see	Very easy to see

Rating:_____

6. Starting Position: While sitting, put your hand in your lap. Pretend you see a drinking glass on a table directly in front of you.

Action: Reach forward, grasp the glass and lift it slightly off the table. Now place it back on the table and return your hand to your lap.

Mental task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy not hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

Rating:_____

7. Starting Position: Your hand is at your side. Pretend there is a door in front of you that is closed.

Action: Reach forward, grasp the door handle and pull open the door. Now gently shut the door, let go of the door handle and return your arm to your side.

Mental task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy not hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

Rating:_____

8. Starting Position: Stand with your feet and legs together and your arms at your sides.

Action: Raise your one knee as high as possible so that you are standing on one leg with your other leg flexed (bent) at the knee. Now lower your leg so that you are again standing on two feet.

Mental task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat hard to see	Neutral (not easy not hard)	Somewhat easy to see	Easy to see	Very easy to see

Rating:_____

9. Starting Position: While sitting, put your hand on your lap and make a fist.

Action: Raise your hand above your head until your arm is fully extended, keeping your fingers in a fist. Next, lower your hand back to your lap while maintaining a fist.

Mental task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy not hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

Rating:_____

10. Starting Position: Extend your arm straight out to your side so that it is parallel to the ground, with your fingers extended and your palm down.

Action: Move your arm forward until it is directly in front of your body (still parallel to the ground). Keep your arm extended during the movement and make the movement slowly. Now move your arm back to the starting position, straight out to your side.

Mental task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat hard to see	Neutral (not easy not hard)	Somewhat easy to see	Easy to see	Very easy to see

Rating:_____

11. Starting Position: Stand with your arms fully extended above your head.

Action: Slowly bend forward at the waist and try and touch your toes with your fingertips. Now return to the starting position, standing erect with your arms extended above your head.

Mental task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy not hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

Rating:_____

12. Starting Position: Put your hand in front of you about shoulder height as if you are about to push open a swinging door. Your fingers should be pointing upwards.

Action: Extend your arm fully as if you are pushing open the door, keeping your fingers pointing upwards. Now let the swinging door close by returning your hand and arm to the starting position.

Mental task: Assume the starting position. Attempt to feel yourself making the movement just performed without actually doing it. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to feel	Hard to feel	Somewhat hard to feel	Neutral (not easy not hard)	Somewhat easy to feel	Easy to feel	Very easy to feel

Rating:_____

13. Starting Position: While sitting, put your hand in your lap. Pretend you see a drinking glass on a table directly in front of you.

Action: Reach forward, grasp the glass and lift it slightly off the table. Now place it back on the table and return your hand to your lap.

Mental Task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat to see	Neutral (not easy not hard)	Somewhat easy to see	Easy to see	Very easy to see

Rating:_____

14. Starting Position: Your hand is at your side. Pretend there is a door in front of you that is closed.

Action: Reach forward, grasp the door handle and pull open the door. Now gently shut the door, let go of the door handle and return your arm to your side.

Mental Task: Assume the starting position. Attempt to see yourself making the movement just performed with as clear and vivid a visual image as possible. Now rate the ease/difficulty with which you were able to do this mental task.

1	2	3	4	5	6	7
Very hard to see	Hard to see	Somewhat to see	Neutral (not easy not hard)	Somewhat easy to see	Easy to see	Very easy to see

Rating:_____

APPENDIX B

FEASIBILITY SURVEYS

ICTP
Implementation
Capacity for Triple P

Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), & Feasibility of Intervention Measure

The Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), and Feasibility of Intervention Measure (FIM; Weiner et al., 2017) are four-item measures of implementation outcomes that are often considered "leading indicators" of implementation success (Proctor et al., 2011). These measures can be administered to a wide range of stakeholders (e.g., parents, direct service providers, administrators) to determine the extent to which they believe an intervention (e.g., Triple P) or an implementation strategy (e.g., training, coaching, data collection, technical assistance) is acceptable, appropriate, and feasible. The measures can be used independently or together. The IAM items could be modified to specify a referent organization, situation, or population (e.g., my clients). The measures were designed to be as pragmatic as possible. Readability is at the 5th grade level. No specialized training is needed to administer, score, or interpret the measures. Cut-off scores for interpretation are not yet available; however, higher scores indicate greater acceptability, appropriateness, and feasibility.

The AIM, IAM, and FIM demonstrated strong psychometric properties in a series of three studies conducted by Weiner et al. (2017). Specifically, the measures demonstrated content validity, discriminant content validity, reliability, structural validity, structural invariance, known-groups validity, and responsiveness to change. The predictive validity of the measures is currently being evaluated.

Response Scale:
1 = Completely disagree, 2 = Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Completely agree

Scoring Instructions: Scales can be created for each measure by averaging responses. Scale values range from 1 to 5. No items need to be reverse coded.

Acceptability of Intervention Measure (AIM)

1) [Triple P/Implementation Strategy] meets my approval.
2) [Triple P/Implementation Strategy] is appealing to me.
3) I like [Triple P/Implementation Strategy].
4) I welcome [Triple P/Implementation Strategy].

Intervention Appropriateness Measure (IAM)

1) [Triple P/Implementation Strategy] seems fitting.
2) [Triple P/Implementation Strategy] seems suitable.
3) [Triple P/Implementation Strategy] seems applicable.
4) [Triple P/Implementation Strategy] seems like a good match.

Feasibility of Intervention Measure (FIM)

1) [Triple P/Implementation Strategy] seems implementable.
2) [Triple P/Implementation Strategy] seems possible.
3) [Triple P/Implementation Strategy] seems doable.
4) [Triple P/Implementation Strategy] seems easy to use.

References

Proctor, E., Silmere, H., Raghavan, R., Hovmand, P., Aarons, G., Bunger, A., Griffey, R., & Hensley, M. (2011). Outcomes for implementation research: Conceptual distinctions, measurement challenges, and research agenda. *Administration and Policy in Mental Health and Mental Health Services Research, 38*, 65-76. doi: 10.1007/s10488-010-0319-7

Weiner, B. J., Lewis, C. C., Stanick, C., Powell, B. J., Dorsey, C. N., Clary, A. S., Boynton, M. H., & Halko, H. (2017). Psychometric assessment of three newly developed implementation outcome measures. *Implementation Science, 12*(108), 1-12. doi: 10.1186/s13012-017-0635-3

Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), Feasibility of Intervention Measure (FIM)

GENERAL INSTRUCTIONS: Please carefully read each question and circle the answer that best describes your opinion about the treatment mental practice.

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
1. Mental practice meets my approval.	①	②	③	④	⑤
2. Mental practice is appealing to me.	①	②	③	④	⑤
3. I like mental practice.	①	②	③	④	⑤
4. I welcome mental practice.	①	②	③	④	⑤

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
1. Mental practice seems fitting for the recovery of my affected arm.	①	②	③	④	⑤
2. Mental practice seems suitable for the recovery of my affected arm.	①	②	③	④	⑤
3. Mental practice seems applicable to the recovery of my affected arm.	①	②	③	④	⑤
4. Mental practice seems like a good match for the recovery of my affected arm.	①	②	③	④	⑤

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
1. Performing mental practice seems possible.	①	②	③	④	⑤
2. Performing mental practice seems doable.	①	②	③	④	⑤
3. Mental practice seems easy to use.	①	②	③	④	⑤

Acceptability of Intervention Measure (AIM), Intervention Appropriateness Measure (IAM), Feasibility of Intervention Measure (FIM)

GENERAL INSTRUCTIONS: Please carefully read each question and circle the answer that best describes your opinion about the treatment mental practice.

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
1. Mental practice meets my approval for the treatment of upper extremity hemiparesis, post stroke.	①	②	③	④	⑤
2. Mental practice is an appealing intervention for the treatment of upper extremity hemiparesis, post stroke.	①	②	③	④	⑤
3. I like using mental practice in my treatment plan.	①	②	③	④	⑤
4. I welcome the use of mental practice as an adjunctive therapy for the stroke population.	①	②	③	④	⑤

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
1. Mental practice seems fitting for the recovery of the hemiparetic upper extremity following a stroke.	①	②	③	④	⑤
2. Mental practice seems suitable for acute post stroke rehabilitation.	①	②	③	④	⑤
3. Mental practice seems applicable for stroke rehabilitation.	①	②	③	④	⑤
4. Mental practice seems like a good match for promoting neuroplasticity.	①	②	③	④	⑤

	Completely disagree	Disagree	Neither agree nor disagree	Agree	Completely agree
1. Incorporating mental practice into the inpatient rehabilitation setting seems possible.	①	②	③	④	⑤
2. Performing mental practice seems doable for stroke patients with upper extremity hemiparesis.	①	②	③	④	⑤
3. Mental practice seems easy to use.	①	②	③	④	⑤

APPENDIX C

FUGL MEYER ASSESSMENT- UPPER EXTREMITY

Fugl-Meyer Assessment Upper Extremity

Patient Initials _____ Team_____

A. Upper Extremity (sitting)			Date	Evaluation	Re-test	Re-test	Re-test	Re-test
I. Reflex Activity 0=No Reflex 2= Reflex activity	Biceps							
	Triceps							
			Subtotal I (Max 4)					
II. Voluntary Movement within synergy 0= cannot be performed at all 1= partial 2= full								
Flexor synergy: Hand from contralateral knee to ipsilateral ear. From extensor synergy (shoulder adduction/ internal rotation, elbow extension, forearm pronation) to flexor synergy (shoulder abduction/ external rotation, elbow flexion, forearm supination).	Shoulder	Retraction						
		Elevation						
		Abduction (90°)						
		External Rotation						
	Elbow	Flexion						
	Forearm	Supination						
Extensor synergy: Hand from ipsilateral ear to the contralateral knee	Shoulder	Adduction/ Internal rotation						
	Elbow	Extension						
	Forearm	Pronation						
		Subtotal II (max 18)						

III. Voluntary Movement Mixing Synergies

Hand to Lumbar Spine	0=Cannot be performed hand in front of ASIS 1= hand behind ASIS (without compensation) 2= hand to lumbar spine					
Shoulder Flexion 0°- 90° Elbow at 0° Pronation-supination 0°	0= immediate abduction or elbow flexion 1=supination or elbow flexion during movement 2= abduction 90°, maintains 0° at elbow					
Pronation-supination Elbow at 90° Shoulder at 0°	0= no pronation/supination, starting position impossible 1= limited pronation/supination, maintains position 2= complete pronation/supination, maintains position					
	Subtotal III (max 6)					

C. HAND support may be provided at the elbow to keep 90° flexion, no support at the wrist, compare with unaffected hand, the objects are interposed, active grasp		Evaluation date	Re-test	Retest	Re-test	Re-test
Mass flexion from full active or passive extension	**0**= none **1**= partial **2**= full					
Mass extension from full active or passive flexion	**0**= none **1**= partial **2**= full					
Grasp						
A – flexion in PIP and DIP (digits II-V) extension in MCP II-V	**0**=cannot be performed **1**= can hold position but weak **2**=maintains position against resistance					
B – thumb adduction 1-st CMC, MCP, IP at 0°, scrap of paper between thumb and 2-nd MCP joint	**0**=cannot be performed **1**=can hold paper but not against tug **2**= can hold paper against a tug					
C – opposition pulpa of the thumb against the pulpa of 2-nd finger, pencil, tug upward	**0**=cannot be performed **1**= can hold pencil but not against tug **2**= can hold pencil against a tug					
D – cylinder grip cylinder shaped object (small can) tug upward, opposition in digits I and Ii	**0**=cannot be performed **1**=can hold cylinder but not against tug **2**=can hold cylinder against a tug					
E – spherical grip fingers in abduction/flexion, thumb opposed, tennis **ball**	**0**=cannot be performed **1**=can hold ball but not against tug **2**= can hold ball against a tug					
	Total C (max 14)					

D. COORDINATION/SPEED after one trial with both arms, blind-folded, tip of the index finger from knee to nose, 5 times as fast as possible		Evaluation	Re-test	Re-test	Re-test	Re-test
Tremor	**0**= marked **1**= slight **2**= none					
Dysmetria	**0**= marked **1**= slight **2**= none					
Time	0= more than 5 seconds slower than unaffected side 1= 2-5 seconds slower than unaffected side 2= maximum difference of1 second between sides					
	Total D (max 6)					
Clinical change = 5 points, Severe impairment <19, Mild impairment >50 **Total A-D** (max 66)						

CJ 2016

APPENDIX D

WOLF MOTOR FUNCTION TEST

UAB Training for CI Therapy

WOLF MOTOR FUNCTION TEST
DATA COLLECTION FORM

Subject's Name: _____ Date: _____

Test (check one): Pre-treatment _____ Post-treatment _____ Follow-up ____

Arm tested (check one): More-affected _____ Less-affected _____

	Task	Time	Functional Ability	Comment
1.	Forearm to table (side)		0 1 2 3 4 5	
2.	Forearm to box (side)		0 1 2 3 4 5	
3.	Extend elbow (side)		0 1 2 3 4 5	
4.	Extend elbow (weight)		0 1 2 3 4 5	
5.	Hand to table (front)		0 1 2 3 4 5	
6.	Hand to box (front)		0 1 2 3 4 5	
7.	Weight to box	_____lbs.		
8.	Reach and retrieve		0 1 2 3 4 5	
9.	Lift can		0 1 2 3 4 5	
10.	Lift pencil		0 1 2 3 4 5	
11.	Lift paper clip		0 1 2 3 4 5	
12.	Stack checkers		0 1 2 3 4 5	
13.	Flip cards		0 1 2 3 4 5	
14.	Grip strength	_____kgs.		
15.	Turn key in lock		0 1 2 3 4 5	
16.	Fold towel		0 1 2 3 4 5	
17.	Lift basket		0 1 2 3 4 5	

 26

Functional Ability Scale

0 – Does not attempt with upper extremity (UE) being tested.

1 –UE being tested does not participate functionally; however, attempt is made to use the UE. In unilateral tasks the UE not being tested may be used to move the UE being tested.

2 – Does, but requires assistance of the UE not being tested for minor readjustments or change of position, or requires more than two attempts to complete, or accomplishes very slowly. In bilateral tasks the UE being tested may serve only as a helper.

3 – Does, but movement is influenced to some degree by synergy or is performed slowly or with effort.

4 – Does; movement is close to normal *, but slightly slower; may lack precision, fine coordination or fluidity.

5 – Does; movement appears to be normal *.

(*) For the determination of normal, the less-involved UE can be utilized as an available index for comparison, with pre-morbid UE dominance taken into consideration.

APPENDIX E

CONSENT FORMS

Adventist HealthCare

CONSENT TO TAKE PART IN A RESEARCH STUDY
and
AUTHORIZATION TO USE AND DISCLOSE PROTECTED HEALTH INFORMATION

Study Title: The Feasibility of a Mental Practice Protocol for Severe Upper Extremity Hemiparesis

Principal Investigator: Teresa M. Green **Office Number: 240-864-6196**

RESEARCH STUDY SUMMARY

Your participation in this study is entirely voluntary. Please read this document completely before making a decision.

Study Purpose:

You are being asked to take part in a research study at Adventist Healthcare Rehabiliation because you have recently had a cerebral vascular accident (stroke) that resulted in weakness in one of your arms. People who have had a stroke may experience weakness in one or more of their limbs that results in a decreased ability to perform their self-care or other functional tasks. Mental practice is a treatment hat has been shown to improve arm movements following a stroke. Mental practice is simply thinking about a movement without physically moving. By listening to an audio recording, mental practice can be used to help you imagine performing tasks with your affected arm. Research has shown that following a stroke, the affected arm improves more when mental practice is combined with traditional therapy. The purpose of this study is to identify if patients with severe arm weakness will benefit from mental practice and find it to be a useful treatment. If you decide to participate in the study you may receive traditional therapy and additional time to complete mental practice.

Duration of Study Participation:

You will participate in the treatment phase of the study for 2 weeks while you are a patient at Adventist Healthcare Rehabilitation. Participation in the study will include 2.5-3 hours of additional activity hours that is not included in traditional therapy.

Principal Study Risks:

There are no physical risks to participating in the study. Due to additional therapy time you may experience fatigue. Your therapist will explain how to avoid fatigue. As with any medical research study, there may be risks or side effects that are currently unknown.

APPROVED
July 30, 2022
Institutional Review Board
Adventist HealthCare, Inc.
Expires: July 29, 2023

Adventist HealthCare

You will be promptly told if we learn of any new risks, findings, or information which may cause you to change your mind about continuing in the study.

Potential Study Benefits:

Based on experience with mental practice in people following a stroke, researchers believe it may help people with decreased arm movement. Of course, because people respond differently to therapy, no one can know in advance if it will be as effective or more effective as standard therapy in your particular case. The potential benefits may include improved arm movements and increased ability to complete tasks with your affected arm. Also, we hope that what we learn will help other people who experience a stroke in the future.

Study Alternatives:

If you decide not to take part in this study, you will get the standard occupational therapy treatment for stroke rehabiliation. This standard care may involve self care training, strengthening, stretching, electrical stimulation, and/or repetitive task practice. Your therapist may perform mental practice with you but it will not be consistent and will not be included on your schedule. The Principal Investigator is available to discuss and answer your questions regarding alternatives to taking part in this research.

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CONSENT TO TAKE PART IN A RESEARCH STUDY

You are being asked to take part in a research study at Adventist Healthcare Rehabilitation because you recently had a stroke that caused weakness in your arm.

Your participation in this study is entirely voluntary. If you choose not to take part, your choice will not affect the quality of your medical care, hurt your relationship with the hospital or your doctors in any way, or cause you to lose any benefits to which are otherwise entitiled.

You should read all of the information below and ask questions about anything you do not understand. You may discuss this information with your family and friends before deciding whether or not to take part in the research study.

You may not take part in this study if you are enrolled in another research study. Please let us know if you are enrolled in another study or if you are not sure.

What is the purpose of the study?

The purpose of this study is to identify if patients with severe arm weakness following a stroke will benefit from mental practice and find it to be a useful treatment.

How many people will take part in this study?

About 20 people will take part in this study.

What procedures are involved in this study?

Study Procedures:

The study will progress in the following order of events:

1. Pre-treatment assessment: we will measure the movement in your affected arm, your thinking ability, and your ability to imagine. These are additional assessments that may not be performed if you are not enrolled in the study.
2. Education: you will be taught the benefits of mental practice and how to perform it. Your therapist will further explain the schedule to include when and where you should perform mental practice.
3. Treatment: You will perform mental practice a 5 days/week for two weeks. Three days out of the week you will perform mental practice before your occupational therapy session. Your therapist will help you physically practice the tasks you mentally practiced. These sessions will be setup by your therapist. On the weekends you will be expected to complete mental practice one time/day.

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4. Post-treatment assessment: before you are discharged the movement in your affected arm will be measured again. You will be asked to complete a survey that asks your opinion about mental practice as a treatment.

In addition to study procedures, you will receive traditional stroke therapy to include but not limited to, electrical stimulation, strengthening, weight bearing, stretching, and/or self-care practice.

Will research results be shared with me?

This study involves research tests that may produce clinical information that could be useful to you. The change in your assessment scores following treatment may help you to understand if your effected arm has gained strength. We will share this information with you.

How long will I be in the study?

We estimate that you will be involved in study activities from for no more than 3 weeks. 3-4 days you will complete assessments and 2 weeks of treatment.

What are the risks and discomforts of the study?

There are no physical risks to participating in the study. You may experience fatigue. Your therapist will explain how to avoid fatigue. As with any medical research study, there may be risks or side effects that are currently unknown. You will be promptly told if we learn of any new risks, findings, or information which may cause you to change your mind about continuing in the study.

What are the benefits of participating in this study?

Based on experience with mental practice in people following a stroke, researchers believe it may help people with decreased arm movement. Of course, because people respond differently to therapy, no one can know in advance if it will be as effective or more effective as standard therapy in your particular case. The potential benefits may include improved arm movements and increased ability to complete tasks with your affected arm. Also, we hope that what we learn will help other people with your condition in the future.

What other choices do I have besides taking part in this study?

If you decide not to take part in this study, you will get the standard occupational therapy treatment for stroke rehabilitation. This standard care may involve self-care training, strengthening, stretching, electrical stimulation, and/or repetitive task practice.

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Your therapist may perform mental practice with you, but it will not be consistent and will not be included on your schedule. The Principal Investigator is available to discuss and answer your questions regarding alternatives to taking part in this research.

Will I be paid for taking part in the study?

You will not receive any payment for taking part in the study.

Will I be charged for taking part in the study?

You will not be charged for taking part in the study.

Are the researchers being paid for the study?

The research therapists are not being paid to complete this study. This research is funded in part by Texas Woman's University Student Research Center. The funds given were used to purchase study materials.

What about privacy and confidentiality?

As part of this study, we will be collecting, using, and sharing information about you. Please review this section carefully as it contains information about the federal privacy rules and the use and disclosure of your information. Because information about you and your health is personal and private, it is protected by a federal law called the Privacy Rule of the Health Insurance Portability and Accountability Act (HIPAA) and generally cannot be used for research without your written authorization. You may have already been given the Adventist HealthCare Notice of Privacy Practices, which contains more information about the confidentiality of your health information. If you have not already been given a copy or would like another copy of the Notice of Privacy Practices, please ask and we will provide a copy. Also, if you have any questions about the Privacy Rule you can speak to the Adventist HealthCare Privacy Officer by calling the Organizational Integrity hotline at 1-800-814-1434.

Permission to Use and Share Your Protected Health Information

As part of this study, we will be collecting, using and sharing information about you. Please review this section carefully as it contains information about the federal privacy rules and the use and disclosure of your information.

Because information about you and your health is personal and private, it is protected by a federal law called the Privacy Rule of the Health Insurance Portability and Accountability Act (HIPAA) and generally cannot be used for research without your written authorization.

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You may have already been given the Adventist HealthCare Notice of Privacy Practices, which contains more information about the confidentiality of your health information. If you have not already been given a copy or would like another copy of the Notice of Privacy Practices, please ask and we will provide a copy. Also, if you have any questions about the Privacy Rule you can speak to the Adventist HealthCare Privacy Officer by calling the Organizational Integrity hotline at 1-800-814-1434.

Why Sign This Document?
If you sign this document, you give researchers from Adventist Healthcare Rehabilitation permission to use and share your protected health information for this study. We will give you a signed copy.

What Information Will We Use and Share for the Study?
The health information that we may use for this research may include information such as your name, medical records, medical histories, research records, the results of this study, results of physical examinations, admissions information, and any other data created or collected during the study.

Any information collected as part of this study may be de-identified and used for future research studies involving mental practice without additional consent. See below for the list of people that the information collected could be released to. You will not be informed of any of the details of research studies using your information. Information will be stored, maintained, and used for research purposes.

The health information will be stored in a locked drawer in the department for no longer than 5 years following collection. The health information listed above may be used by and disclosed (released) to the following:

- Teresa M. Green (Principal Investigator), Dr. Nicole Fromm (Secondary Investigator), Farida Gayle (Research Therapist), Susan Nam (Research Therapist), Selena Liang (Research Therapist).
- The sponsor of the study, Advenstist Healthcare Rehabiliation administrative leadership.
- Adventist Healthcare Rehabilitation and/or Texas Woman's University may conduct future research studies with your de-identified information
- Research monitors and committees such as the Adventist HealthCare Institutional Review Board (IRB)
- Accrediting agencies and legal counsel
- Clinical staff who are not involved in the study who may become involved in your care, if it might be relevant to treatment
- Others if required by law.

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Adventist HealthCare is required by law to protect your health information. Those who receive your protected health information may not be required by federal privacy laws to protect it and may share your information with others without your permission, if permitted by laws governing them.

What Happens if I Say No?

You will not be able to take part in this research study if you do not allow the use and disclosure of your protected health information. The quality of care you get from your doctor will not change and you will not lose any benefits. You should ask questions about anything you do not understand before deciding whether or not to provide permission for us to use your protected health information.

Can I Access My Medical Records?
During and after your involvement in this study, you will have access to your medical records and any study information that is part of those records. However, you may not have access to research-specific information that is not part of your medical records.

What Happens if I Say Yes, but Change My Mind Later?
If you decide to stop participating in this study later, it will not affect the quality of your medical care in any way. To withdraw from this study, please call or email the principal investigator:

- Teresa M. Green (240) 864-6196 tgreen3@adventisthealthcare.com

If you do withdraw your consent during the study, the research staff will not collect additional personal information from you, although personal information already collected may be retained and reviewed.

How Long Will My Health Information be Used?
This Authorization does not have an expiration date. You may change your mind and revoke (i.e., cancel or take back) this Authorization at any time. Once you revoke this Authorization, no further information about you will be collected, used or disclosed; however, the research team may still use or disclose health information about you that they already collected for this study.

If the results of this research are published or discussed in conferences, no information will be included that would reveal your identity. If photographs, videos, or audio-tape recordings of you will be used for educational purposes, your identity will be protected or disguised.

Can the researchers decide to take me out of the study?

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The investigator(s) may decide to take you out of the study under certain circumstances. You may be taken out of the study if:

- Staying in the study would be harmful.
- You need treatment not allowed in the study.
- You fail to follow instructions.
- You become pregnant.
- The study is canceled.

The decision may be made to protect your health and safety, or because it is part of the research plan that people who develop certain conditions may not continue to take part in the study. The investigator will tell you if this happens.

Whom do I contact if I have problems or questions?

For questions about the research study, or if you have a research related injury or medical problem, please contact Teresa M. Green at (240) 864-6196 during regular business hours.

For questions about your rights as a research subject, please contact the Adventist HealthCare IRB Office at 301-315-3400 during regular business hours.

If you experience an emergency, you should get treatment immediately.

SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

I have read (or someone has read to me) the information provided in this document. I have been given time to consider taking part in the study. I have had a chance to ask questions, and my questions have been answered to my satisfaction. I have received a copy of the Research Subjects Bill of Rights. I will receive my own signed and dated copy of this consent form.

By signing this form, I agree to take part in the research it describes.

Name of Subject (or Legal Representative)	Legal Representative's Relationship to Subject (if applicable)
Signature of Subject (or Legal Representative)	Date
Name of Witness	

APPROVED
July 30, 2022
Institutional Review Board
Adventist HealthCare, Inc.
Expires: July 29, 2023

Adventist HealthCare

Signature of Witness | Date

Name of Interpreter

Signature of Interpreter | Date

SIGNATURE OF INVESTIGATOR OR APPROVED REPRESENTATIVE

I have discussed and explained the research to the subject or his/her legal representative, including any risks and adverse reactions that may reasonably be expected to occur, encouraged the subject or his/her legal representative to ask questions, and have answered all questions. The subject or his/her legal representative has been provided a copy of the Research Subject's Bill of Rights, and a signed and dated copy of this consent form.

Name of Investigator or Representative

Signature of Investigator or Representative | Date

Adventist HealthCare

RESEARCH SUBJECTS' BILL OF RIGHTS

As someone being asked to volunteer as a subject in a clinical research study, I have the following rights:

- to be told what the study is trying to determine;
- to be told what will happen to me, including the procedures, drugs and devices that will be used, and whether any of these are different from what would be used in standard practice;
- to be told about the risks, side effects, or discomforts that may be expected from the research;
- to be told if I can expect any benefit from being in the study, and if so, what the benefit might be;
- to be told about the other alternatives I have and how they may be better or worse than taking part in the study;
- to be told what kind of medical treatment is available if any medical problems arise;
- to ask any questions about the study before I agree to take part and during the course of the study;
- to choose not to take part at all or to change my mind and withdraw from the study after it is started. My decision will not affect my right to receive the care I would receive if I were not in the study;
- to receive a copy of the signed and dated consent form; and
- to be free of any pressure when deciding whether I wish to participate in the study.

If you have any questions about the research, feel free to talk with your doctor or one of the researchers or research coordinators. If you have any questions or comments about your rights as a research subject, Adventist HealthCare has a department that you should call. This department, called the IRB Office, exists to protect your rights. The phone number of the Adventist HealthCare IRB Office is 301-315-3400.

Adventist HealthCare

CONSENT TO TAKE PART IN A RESEARCH STUDY
and
AUTHORIZATION TO USE AND DISCLOSE PROTECTED HEALTH INFORMATION

Study Title: The Feasibility of a Mental Practice Protocol for Severe Upper Extremity Hemiparesis

Principal Investigator: Teresa M. Green **Office Number: 240-864-6196**

RESEARCH STUDY SUMMARY

Your participation in this study is entirely voluntary. Please read this document completely before making a decision.

Study Purpose:

You are being asked to take part in a research study at Adventist Healthcare Rehabilitation because you are an occupational therapist that works with patients to rehabilitate following a cerebral vascular accident (stroke). People who have had a stroke may experience weakness in one or more of their limbs that results in a decreased ability to perform their self-care or other functional tasks. Mental practice is a treatment hat has been shown to improve arm movements following a stroke. Mental practice is simply thinking about a movement without physically moving. By listening to an audio recording, mental practice can be used to help patients imagine performing various arm movements. Research has shown that the affected arm improves more when mental practice is combined with traditional therapy. The purpose of this study is to that examine your opinions, perceptions, and feelings about the use of the intervention mental practice in the recovery of the weak arm following a stroke. This examination will help researchers understand if mental practice is a feasible intervention for the inpatient rehabilitation setting.

Duration of Study Participation:

Your participation in the study will be for one hour. You will participate in a 45 minute education session. Following the session, you will be asked to complete a survey that will take no more than 15 minutes to complete.

Principal Study Risks:

There are no physical or mental risks to participating in the study.

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Potential Study Benefits:

Based on experience with mental practice in people following a stroke, researchers believe it may help people with decreased arm movement. The potential benefits of this study may include information that will influence occupational therapy clinical practices. This study may increase researchers understanding of the acceptability and/or how useful the intervention mental practice is in the inpatient rehabilitation hospital setting. It may also increase occupational therapists' knowledge and use of mental practice.

Study Alternatives:

If you decide not to take part in this study, you will not receive the 45 minute educational session. The Principal Investigator is available to discuss and answer your questions regarding alternatives to taking part in this research.

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CONSENT TO TAKE PART IN A RESEARCH STUDY

You are being asked to take part in a research study at Adventist Healthcare Rehabilitation because you are an occupational therapist that works with patients to rehabilitate following a cerebral vascular accident (stroke).

Your participation in this study is entirely voluntary. If you choose not to take part, your choice will not affect your current position as an occupational therapist at Adventist Rehabilitation, hurt your relationship with the organization, your therapy colleagues and/or hospital administrators in any way, or cause you to lose any benefits to which are otherwise entitled.

You should read all of the information below and ask questions about anything you do not understand. You may discuss this information with your family and friends before deciding whether or not to take part in the research study.

You may not take part in this study if you are enrolled in another research study. Please let us know if you are enrolled in another study or if you are not sure. You may not be involved as an occupational therapist in any other aspect of a research process pertaining to mental practice while enrolled in this research study.

What is the purpose of the study?

The purpose of this study is to that examine your opinions, perceptions, and feelings about the use of the intervention mental practice in the recovery of the weak arm following a stroke. This examination will help researchers understand if mental practice is a feasible intervention for the inpatient rehabilitation setting.

How many people will take part in this study?

About 20 people will take part in this study.

What procedures are involved in this study?

Study Procedures:

The study will progress in the following order of events:

1. Education: you will participate in a 45 minute education session about the science, indications, and instructions to facilitate mental practice as an intervention.
2. Assessment: Following the session, you will be asked to complete an anonymous survey that will take no more than 15 minutes to complete. The survey will as questions concerning your opinion about mental practice as an intervention. The research therapist will not be aware of what your specific answers are to each question.

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Will research results be shared with me?

This study involves research that may be useful to you as an occupational therapist working with individuals following a stroke. The overall results of the survey will be shared with the occupational therapists at Adventist Healthcare Rehabiliation upon request.

How long will I be in the study?

We estimate that you will be involved in study activities from for no more than 1 hour, to include a 45 minute educational session and a 15 minute survey.

What are the risks and discomforts of the study?

There are no mental or physical risks to participating in the study. As with any medical research study, there may be risks or side effects that are currently unknown. You will be promptly told if we learn of any new risks, findings, or information which may cause you to change your mind about continuing in the study.

What are the benefits of participating in this study?

The potential benefits of this study may include information that will influence occupational therapy clinical practices. This study may increase researchers understanding of the feasibility and/or how useful the intervention mental practice is in the inpatient rehabilitation hospital setting. It may also increase occupational therapists' knowledge and use of mental practice.

What other choices do I have besides taking part in this study?

If you decide not to take part in this study, you will not receive the 45 minute educational session on mental practice. The Principal Investigator is available to discuss and answer your questions regarding alternatives to taking part in this research.

Will I be paid for taking part in the study?

You will not receive any payment for taking part in the study.

Will I be charged for taking part in the study?

You will not be charged for taking part in the study.

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Are the researchers being paid for the study?

The research therapists are not being paid to complete this study. This research is funded in part by Texas Woman's University Student Research Center. The funds given were used to purchase study materials.

What about privacy and confidentiality?

As part of this study, we will be collecting, using, and sharing information about you. Please review this section carefully as it contains information about the federal privacy rules and the use and disclosure of your information. Because information about you and your health is personal and private, it is protected by a federal law called the Privacy Rule of the Health Insurance Portability and Accountability Act (HIPAA) and generally cannot be used for research without your written authorization. You may have already been given the Adventist HealthCare Notice of Privacy Practices, which contains more information about the confidentiality of your health information. If you have not already been given a copy or would like another copy of the Notice of Privacy Practices, please ask and we will provide a copy. Also, if you have any questions about the Privacy Rule you can speak to the Adventist HealthCare Privacy Officer by calling the Organizational Integrity hotline at 1-800-814-1434.

Permission to Use and Share Your Protected Health Information

As part of this study, we will be collecting, using and sharing information about you. Please review this section carefully as it contains information about the federal privacy rules and the use and disclosure of your information.

Because information about you and your health is personal and private, it is protected by a federal law called the Privacy Rule of the Health Insurance Portability and Accountability Act (HIPAA) and generally cannot be used for research without your written authorization.

You may have already been given the Adventist HealthCare Notice of Privacy Practices, which contains more information about the confidentiality of your health information. If you have not already been given a copy or would like another copy of the Notice of Privacy Practices, please ask and we will provide a copy. Also, if you have any questions about the Privacy Rule you can speak to the Adventist HealthCare Privacy Officer by calling the Organizational Integrity hotline at 1-800-814-1434.

Why Sign This Document?

If you sign this document, you give researchers from Adventist Healthcare Rehabilitation permission to use and share your information for this study. We will give you a signed copy.

Adventist HealthCare

What Information Will We Use and Share for the Study?
The health information that we may use for this research may include information such as your name, age, years of experience as an occupational therapist, and any other data created or collected during the study.

Any information collected as part of this study may be de-identified and used for future research studies involving mental practice without additional consent. See below for the list of people that the information collected could be released to. You will not be informed of any of the details of research studies using your information. Information will be stored, maintained, and used for research purposes.

This information will be stored in a locked drawer in the department for no longer than 5 years following collection. The health information listed above may be used by and disclosed (released) to the following:

- Teresa M. Green (Principal Investigator), Dr. Nicole Fromm (Secondary Investigator), Farida Gayle (Research Therapist), Susan Nam (Research Therapist), Selena Liang (Research Therapist).
- The sponsor of the study, Adventist Healthcare Rehabiliation administrative leadership.
- Adventist Healthcare Rehabilitation and/or Texas Woman's University may conduct future research studies with your de-identified information
- Research monitors and committees such as the Adventist HealthCare Institutional Review Board (IRB)
- Accrediting agencies and legal counsel
- Clinical staff who are not involved in the study who may become involved in your care, if it might be relevant to treatment
- Others if required by law.

Adventist HealthCare is required by law to protect your personal information. Those who receive your protected health information may not be required by federal privacy laws to protect it and may share your personal information with others without your permission, if permitted by laws governing them.

What Happens if I Say No?

You will not be able to take part in this research study if you do not allow the use and disclosure of your protected personal information. Your position as an occupational therapist with Adventist Healthcare will not change and you will not lose any benefits. You should ask questions about anything you do not understand before deciding whether or not to provide permission for us to use your protected personal information.

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What Happens if I Say Yes, but Change My Mind Later?
If you decide to stop participating in this study later, it will not affect your position as an occupational therapist for Adventist Healthcare Rehabilitation in any way. To withdraw from this study, please call or email the principal investigator:

- Teresa M. Green (240) 864-6196 tgreen3@adventisthealthcare.com

If you do withdraw your consent during the study, the research staff will not collect additional personal information from you, although personal information already collected may be retained and reviewed.

How Long Will My Health Information be Used?
This Authorization does not have an expiration date. You may change your mind and revoke (i.e., cancel or take back) this Authorization at any time. Once you revoke this Authorization, no further information about you will be collected, used or disclosed; however, the research team may still use or disclose health information about you that they already collected for this study.

If the results of this research are published or discussed in conferences, no information will be included that would reveal your identity. If photographs, videos, or audio-tape recordings of you will be used for educational purposes, your identity will be protected or disguised.

Can the researchers decide to take me out of the study?

The investigator(s) may decide to take you out of the study under certain circumstances. You may be taken out of the study if:

- You are no longer a full-time or part-time occupational therapist working in the inpatient rehabilitation department of Adventist Healthcare Rehabilitation.
- You fail to follow instructions.
- The study is canceled.

The investigator will tell you if this happens.

Whom do I contact if I have problems or questions?

For questions about the research study please contact Teresa M. Green at (240) 864-6196 during regular business hours.

For questions about your rights as a research subject, please contact the Adventist HealthCare IRB Office at 301-315-3400 during regular business hours.

If you experience an emergency, you should get treatment immediately.

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SIGNATURE OF RESEARCH SUBJECT OR LEGAL REPRESENTATIVE

I have read (or someone has read to me) the information provided in this document. I have been given time to consider taking part in the study. I have had a chance to ask questions, and my questions have been answered to my satisfaction. I have received a copy of the Research Subjects Bill of Rights. I will receive my own signed and dated copy of this consent form.

By signing this form, I agree to take part in the research it describes.

Name of Subject (or Legal Representative)	Legal Representative's Relationship to Subject (if applicable)
Signature of Subject (or Legal Representative)	Date
Name of Witness	
Signature of Witness	Date
Name of Interpreter	
Signature of Interpreter	Date

SIGNATURE OF INVESTIGATOR OR APPROVED REPRESENTATIVE

I have discussed and explained the research to the subject or his/her legal representative, including any risks and adverse reactions that may reasonably be expected to occur, encouraged the subject or his/her legal representative to ask questions, and have answered all questions. The subject or his/her legal representative has been provided a copy of the Research Subject's Bill of Rights, and a signed and dated copy of this consent form.

Adventist HealthCare

Name of Investigator or Representative

Signature of Investigator or Representative

Date

Adventist HealthCare

RESEARCH SUBJECTS' BILL OF RIGHTS

As someone being asked to volunteer as a subject in a clinical research study, I have the following rights:

- to be told what the study is trying to determine;
- to be told what will happen to me, including the procedures, drugs and devices that will be used, and whether any of these are different from what would be used in standard practice;
- to be told about the risks, side effects, or discomforts that may be expected from the research;
- to be told if I can expect any benefit from being in the study, and if so, what the benefit might be;
- to be told about the other alternatives I have and how they may be better or worse than taking part in the study;
- to be told what kind of medical treatment is available if any medical problems arise;
- to ask any questions about the study before I agree to take part and during the course of the study;
- to choose not to take part at all or to change my mind and withdraw from the study after it is started. My decision will not affect my right to receive the care I would receive if I were not in the study;
- to receive a copy of the signed and dated consent form; and
- to be free of any pressure when deciding whether I wish to participate in the study.

If you have any questions about the research, feel free to talk with your doctor or one of the researchers or research coordinators. If you have any questions or comments about your rights as a research subject, Adventist HealthCare has a department that you should call. This department, called the IRB Office, exists to protect your rights. The phone number of the Adventist HealthCare IRB Office is 301-315-3400.

APPENDIX F

MENTAL PRACTICE SCRIPTS

Wiping a table LEFT

You are seated in a comfortable chair with your left arm bent at the elbow resting on top of a cool and smooth table. The table is brown, hard, and visibly dirty with sugar spilled all over the surface. You need to wipe the table to clean it up. There is a white washcloth on the table that you can use. Place your left hand on top of the washcloth. Press your palm and fingers into the table to hold onto the washcloth as you begin to wipe. The washcloth is damp and cold. Straighten your elbow and fingers to wipe forward and then pull your elbow back to bring the washcloth to the front of the table. Slide your hand to the left to begin to clean the next section. Press your palm and fingers into the washcloth as you straighten your elbow. Feel a slight pull at your shoulder as you slide your arm forward to reach the back of the table. Pull your elbow back to wipe the front of the table. There is one section still dirty on the left of the table. Slide your hand to the left, straighten your elbow to wipe the back of the table. Pull your elbow back to wipe the front of the table.

The left side of the table is clean, but you still see sugar in the middle and right side of the table. Keeping your elbow straight, slide your hand across your body to wipe the right side of the table. Wipe the right side of the table and slide it back to the left corner of the table like a windshield wiper. Press your hand and fingers into the table to hold the damp washcloth. The washcloth is cold and slides easily across the table. Feel a pull at your shoulder as you slide your hand across your body to wipe the right side of the table. You hear a soft “whooshing” sound as you slide the washcloth back to the left corner. Slide the washcloth toward the center of your body by bending your elbow and pulling your arm towards the front of the table until it is back on the left side of the table.

You want to wipe the table with circular motions. You start with a small circle directly in front of your chest. As you slide your hand forward and around you hear a soft “whooshing” sound as the washcloth slides along the table. You feel the pull and push motion at your left shoulder as the circles become larger and larger. You see a light streak of water left behind as the sugar is wiped away. With your fingers spread wide and pressed into the table continue to wipe in the circular motion until you have reached the outside corners of the table. Begin to make your circles smaller as you push and pull the washcloth around. Your circles are now small and in the center of the table where you started.

You see sugar further than arms reach. Bring your chest towards the table as you reach to wipe the back of the table. With your elbow straight wipe to the left corner. Pull your left shoulder to the right to wipe the middle and then the far-left corner of the table. You see a light streak of water from the damp washcloth. Pull the washcloth back to the front of the table by bending your elbow and pulling your chest away from the table. You look at the table and are pleased that is now clean.

You are seated in a comfortable chair with your left arm bent at the elbow resting on top of a cool and smooth table. The table is brown, hard, and visibly dirty with sugar spilled all over the surface. You need to wipe the table to clean it up. There is a white washcloth on the table that you can use. Place your left hand on top of the washcloth. Press your palm and fingers into the table to hold onto the washcloth as you begin to wipe. The washcloth is damp and cold. Straighten your elbow and fingers to wipe forward and then pull your elbow back to bring the washcloth to the front of the table. Slide your hand to the left to begin to clean the next section. Press your palm and fingers into the washcloth as you straighten your elbow. Feel a slight pull at your shoulder as you slide your arm forward to reach the back of the table. Pull your elbow back to wipe the front of the table. There is one section still dirty on the left of the table. Slide your hand to the left, straighten your elbow to wipe the back of the table. Pull your elbow back to wipe the front of the table.

The left side of the table is clean, but you still see sugar in the middle and left side of the table. Keeping your elbow straight, slide your hand across your body to wipe the right side of the table. Wipe the right side of the table and slide it back to the left corner of the table like a windshield wiper. Press your hand and fingers into the table to hold the damp washcloth. The washcloth is cold and slides easily across the table. Feel a pull at your shoulder as you slide your hand across your body to wipe the right side of the table. You hear a soft “whooshing” sound as you slide the washcloth back to the left corner. Slide the washcloth toward the center of your body by bending your elbow and pulling your arm towards the front of the table until it is back on the left side of the table.

You want to wipe the table with circular motions. You start with a small circle directly in front of your chest. As you slide your hand forward and around you hear a soft “whooshing” sound as the washcloth slides along the table. You feel the pull and push motion at your left shoulder as the circles become larger and larger. You see a light streak of water left behind as the sugar is wiped away. With your fingers spread wide and pressed into the table continue to wipe in the circular motion until you have reached the outside corners of the table. Begin to make your circles smaller as you push and pull the washcloth around. Your circles are now small and in the center of the table where you started.

You see sugar further than arms reach. Bring your chest towards the table as you reach to wipe the back of the table. With your elbow straight wipe to the left corner. Pull your left shoulder to the right to wipe the middle and then the far-left corner of the table. You see a light streak of water from the damp washcloth. Pull the washcloth back to the front of the table by bending your elbow and pulling your chest away from the table. You look at the table and are pleased that is now clean.

Picking up a cup RIGHT

You are thirsty. The room is warm, your mouth is dry and you would like a cool drink of water. You are seated in a comfortable chair with your arms bent at the elbow resting on top of a cool and smooth table. The cup with no handle is directly in front of you, but out of arms reach. It is a clear cup, you can see the four ice cubes and water filled to the top of the cup. You want to reach for the cup with your right hand. Start by leaning your chest towards the table, now straighten your elbow, and extend your wrist and fingers. You have reached the cup and feel it on the palm of your hand and fingers. It is cold and a little moist. Tighten your fingers around the cup to hold on to it. Lift the cup to your mouth by bending your elbow and lifting your arm. Tilt the cup towards your mouth as you bend your head back to take a drink. You hear the water go down your throat as you take two swallows. Straighten your elbow to bring the cup down to the table. Extend your wrist and fingers to release the cup. With your palm facing down, slide your elbow back until your hand is back to your side.

Imagine the cup is now to the right of your body and out of arms reach. Feel your right shoulder and hands rotate to the right to reach for the cup. Straighten your elbow and lean your body to the right. Slightly turn your wrist and hand to the right and extend your fingers to place your hand around the cup. Feel the cool moist cup around your thumb and fingertips as your grasp it. Begin to bend your elbow, lift the cup and bring it to your mouth. Tilt the cup with your thumb and fingers to drink from the cup. You notice that the water is cool as you swallow. Straighten your elbow to bring the cup down to the table. You hear it softly land on the table. Extend your wrist and fingers to release the cup. With your palm facing down, slide your elbow back until your hand is back to your side.

Imagine the cup located on the left side of your body. Begin moving your right arm across your chest and feel the slight rotation of your trunk as your reach for the cup. Stretch your fingers and thumb out wide as you feel the moist and cool cup on your palm. The cup is light as you bring the cup towards your mouth by pulling your elbow back towards your body. Bend your elbow, tilt your wrist and fingers and see the cup getting closer and closer until it reaches your lips. The water is cool and delicious. Straighten your elbow to bring the cup down to the table. Extend your wrist and fingers to release the cup. You hear the ice jingle softly against the cup as it lands on the table. With your palm facing down, slide your elbow back until your hand is back to your side.

Imagine the cup is on the top of a low shelf directly in front of you. Reach for the cup with your right hand by lifting from your shoulder, extend your elbow and rotate your hand until your thumb is pointing towards the ceiling. Extend your fingers until you reach the cup and feel the cold and smooth cup on the palm of your hand. Tighten your grip around the cup to hold onto it as your lift it down from the shelf. Pull your elbow back and bend your elbow to begin bringing your hand towards your mouth. You feel the wet rim of the cup as it reaches your lips. Tilt the cup towards your mouth as you bend your head back to take a drink. Straighten your elbow to bring the cup down to the table. Extend your wrist and fingers to release the cup. With your palm facing down, slide your elbow back until your hand is back to your side. You see that the cup is now halfway full of water.

Imagine the cup is directly in front of you, but out of arms reach. You want to reach for the cup with your right hand. Start by leaning your chest towards the table, now straighten your elbow, and extend your wrist and fingers. You have reached the cup and feel it on the palm of your hand and fingers. Tighten your fingers around the cup to hold on to it. The ice jingles against the side of the cup as you begin to move it. Lift the cup to your mouth by bending your elbow and lifting your arm. Tilt the cup towards your mouth as you bend your head back to take a drink. Straighten your elbow to bring the cup down to the table. Fee your wrist and fingers extend to release the cup. With your palm facing down, slide your elbow back until your hand is back to your side. You see the ice beginning to melt in the cup.

Imagine the cup is now to the right of your body and out of your arms reach. Feel your right shoulder and hands rotate to the right to reach for the cup. Straighten your elbow and lean your body to the right. Slightly turn your wrist and hand to the right and extend your fingers to place your hand around the cup. Feel the cool moist cup around your thumb and fingertips as you grasp it. You hear the cup softly scrap against the table as you slide it towards your body. Begin to bend your elbow, lift the cup and bring it to your mouth. Tilt the cup with your thumb and fingers to drink from the cup. You notice that the water is cool as you swallow. Straighten your elbow to bring the cup down to the table. Extend your wrist and fingers to release the cup. With your palm facing down, slide your elbow back until your hand is back to your side.

Imagine the cup located on the left side of your body. The ice has begun to melt leaving only three ice cubes. Begin moving your right arm across your chest and feel the slight rotation of your trunk as your reach for the cup. Stretch your fingers and thumb out wide as you feel the moist and cool cup on your palm. The cup is light as you bring the cup towards your mouth by pulling your elbow back towards your body. Bend your elbow, tilt your wrist and fingers to take a drink. Straighten your elbow, extend your wrist and fingers to release the cup onto the table. You hear the ice jingle as the cup lands softly on the table.

Imagine the cup is on the top of a low shelf directly in front of you. Reach for the cup with your right hand by lifting from your shoulder, extend your elbow and rotate your hand until your thumb is pointing towards the ceiling. Extend your fingers until you reach the cup and feel the cold and smooth cup on the palm of your hand. Tighten your grip around the cup told hold onto it as you lift it down from the shelf. Pull your elbow back and bend your elbow as you see the cup getting closer and closer to your mouth. As you feel the smooth surface of the cup on your lips, tilt the cup and bend your head to take a drink. You hear the water going down your throat as you take two swallows of water. Straighten your elbow to bring the cup down to the table. Extend your wrist and fingers to release the cup. With your palm facing down, slide your elbow back until your hand is back to your side.

Imagine the cup is directly in front of you, but out of arms reach. You want to reach for the cup with your right hand. Start by leaning your chest towards the table, now straighten your elbow, and extend your wrist and fingers. You have reached the cup and feel it on the palm of your hand and fingers. Tighten your fingers around the cup to hold on to it. The ice jingles against the side of the cup as you begin to move it. Lift the cup to your mouth by bending your elbow and lifting your arm. Tilt the cup towards your mouth as you bend your head back to take a drink. Straighten your elbow, extend your wrist and fingers to release the cup onto the table.

Imagine the cup is now to the right of your body and out of your arms reach. You see there is only a small amount of water beneath two ice cubes. Reach for the cup with your right hand. Straighten your elbow and extend your wrist and fingers. You have reached the cup and feel the cool, moist cup on your thumb and fingertips as you grasp it. Tighten your fingers around the cup to hold on to it. Lift the cup to your mouth by bending your elbow and lifting your arm. Tilt the cup towards your mouth as you bend your head back to take a drink. Straighten your elbow, extend your wrist and fingers, and see the cup as it softly lands on the table. Your thirst is satisfied.

APPENDIX G

DATA COLLECTION

Mental Practice Log [1]
Participant ID #_____

Date	Start Time	Observations	Completed?	Therapist Supervising
Wiping the Table				
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Picking up the Cup				
Day 6				
Day 7				
Day 8				
Day 9				
Day 10				

Repetitive Task Practice Log [1]
Participant ID #_____

Date	Repetitions	Equipment	Position	Therapist Supervising
Wiping the Table				
Day 1				
Day 2				
Day 3				
Day 4				
Day 5				
Picking up the Cup				
Day 6				
Day 7				
Day 8				
Day 9				
Day 10				