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Implementation of mirror therapy for upper limb motor function in stroke survivors on two levels of creative ability

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2018

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IMPLEMENTATION OF MIRROR THERAPY FOR UPPER LIMB FUNCTION IN STROKE SURVIVORS ON TWO LEVELS OF CREATIVE ABILITY

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WITS
UNIVERSITY

A research report submitted to the Faculty of Health Sciences, University of Witwatersrand, Johannesburg, in partial fulfilment of the requirements for the degree of Master of Science in Occupational Therapy.

Johannesburg, 2018

DECLARATION

I, Bhavna Bahgoo, declare that this research report is my own unaided work. It is being submitted for the degree of Master of Science in Occupational Therapy at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

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Bhavna Bahgoo

11th day of June 2018

DEDICATION

This effort is dedicated to the loving memory of my grandfather, Mr Mothilal Prakash Bahgoo, who never lost faith in my potential and taught me to never give up. I also dedicate this to my patients who continue to inspire me with their hard work and perseverance.

ABSTRACT

Keywords: Mirror therapy, Vona du Toit's Model of Creative Ability, mental impairments

Stroke rehabilitation aimed at younger stroke survivors with severe impairments is needed. Mirror therapy is an effective tool within stroke rehabilitation, however is limited to those with fair to good mental functions. The aim was to determine the effectiveness of MT in upper limb motor function of stroke survivors with mental impairments on two different levels of the Vona du Toit's Model of Creative Ability.

This study consisted of 13 participants on the self-differentiation and self-presentation levels of Creative Ability. Participants were assessed and received mirror therapy during inpatient admission. Motor and mental functioning was re-assessed after mirror therapy. The results showed a significant improvement in voluntary movement of the affected upper limb, and a clinical significance in improvement of mental functioning was found in both groups after receiving mirror therapy. It was concluded that this tool is effective with acute inpatients when adapted accordingly.

ACKNOWLEDGEMENTS

- Juliana Freeme, for having faith in my vision, supporting me throughout this process and continuing with me on this journey. Thank you for your mentorship and kindness.
- Denise Franzsen, for sharing your invaluable knowledge and lending support through my journey.
- Staff of Kopanong and Sebokeng Hospitals for allowing me to use their facilities during data collection, especially to Bianca Luwes for your hard work and willingness to learn and assist with the study.
- The participants who took part in the study and my colleagues for their continual support.
- Roshni Bahgoo, Nervin Bahgoo and Neelam Bahgoo for your love and support. Thank you for being my pillars of strength throughout the years.
- Niren Gooroocharan for being my patronus.

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DEFINITIONS

Vona du Toit's Model of Creative Ability: a model used by occupational therapists which evaluates a person's occupational performance based on their interaction of motivation and action. A philosophy which is key to occupational therapy is one which describes the engagement of participants in meaningful occupations to achieve an improvement or maintenance of their occupational performance and general quality of life. Creative ability fits into this philosophy by the way in which it allows the therapist to assess a person's occupational performance in a functional manner and encourages a holistic view of the person. The model breaks up the continuum of occupational performance into 10 levels of action and 6 levels of motivation. Furthermore, the model provides treatment outcomes which address handling principles, structuring principles, how to present the activity, activity requirements and grading of tasks to ensure a 'just-right-challenge" for the participant. These treatment outcomes are provided for each level of creative ability and assist in transitioning the participant up the levels to achieve a level of premorbid or higher than premorbid functioning(1).

Creative Ability: as defined by Vona du Toit as "the ability to present oneself, freely, without anxiety, limitations or inhibitions." The main goal and purpose of the use of Creative Ability ia facilitating the growth of a person in their occupational performance by adapting and structuring the environment, activity, handling and presentation of a task(1).

Mental impairments (for the purpose of this study): were linked to components assessed within the Vona du Toit's Model of Creative Ability. It included mainly cognitive components which varied from basic skills such as attention span and orientation to more complex skills such as planning, organising and problem solving. These skills, as seen in the Vona du Toit's Model of Creative Ability are linked to functional ability and engagement in a task and not addressed in isolation.

Motivation (for the purpose of this study): is linked to Vona du Toit's Model of Creative Ability. "The inner force that initiates or directs all behaviour and results in the creation of a tangible or intangible product."(1) "Motivation govern action and action is the manifestation of motivation."(2)

Task Concept: this is a concept within Vona du Toit's Model of Creative Ability. It comprises of the components required for active engagement in any task and develops through the levels of this model(1).

ABBREVIATIONS

AIDS:	Acquired Immune Deficiency Syndrome
APOM:	Activity Participation Outcome Measure
CIMT:	Constraint Induced Movement Therapy
FMA:	Fugl-Meyer Assessment
HIV:	Human Immunodeficiency Virus
HREC:	Human Research Ethics Committee
MT:	Mirror Therapy
NSA:	Nottingham Sensory Assessment
TENS:	Transcutaneous Electrical Nerve Stimulation
VdTMoCA:	Vona du Toit's Model of Creative Ability

CHAPTER 1: INTRODUCTION

1.1 Introduction to the study

Stroke has several devastating results, such as motor dysfunction and mental impairments, which cause a decline of a stroke survivor's functioning in everyday life. Hemiplegia, where one side of the body is paralysed, and hemiparesis, where the one side is nearly paralysed, are deficits most commonly seen(3)(4)(5)(6)(7). This can affect the upper and lower limb, trunk, facial and oral sensorimotor functions(8). Stroke survivors may also present with cognitive, emotional and perceptual impairments(4)(9)(10). These impairments can have a mild to severe effect on the survivor's ability to perform activities required for functioning in everyday life, and rehabilitation addresses these concerns(10)(11).

Due to the advancement in medical intervention, there is a higher survival rate of persons after suffering a severe stroke. A more severe stroke could be considered a stroke where a larger area of the brain has been affected resulting in absent or partial voluntary movement of the affected limbs, absent or diminished sensation and a wider spectrum of mental, visuospatial and communication impairments(a wider spectrum would include basic and complex functioning)(12). The high incidence and increased severity result from the deteriorating health of the South African population, caused by the consequences of HIV/AIDS, hypertension, unhealthy lifestyles, obesity, an increasing incidence of Diabetes Mellitus, cholesterol and cardiac disease(3). The South African stroke guidelines have acknowledged the burden of stroke care in the country and its financial implications on the health systems and families. It has been identified that stroke is the third leading cause of death and the number of incidence per year is unknown(3).

The guidelines further discuss the implementation of the stroke unit model, which discusses the benefits of a dedicated unit for stroke survivors who receive specialized treatment using a multidisciplinary team approach. However, this model has not been well implemented and stroke rehabilitation challenges include: patients being admitted and treated in general medical wards, survivors not receiving timeous treatment which includes allied healthcare (physiotherapy, occupational therapy, speech therapy, psychology), early discharge due to lack of beds and the reality of survivors returning home once medically stable with poor education on stroke and poor access to rehabilitative services(3).

Severe hemiplegia and hemiparesis are thus one of the resultant common impairments in South African stroke survivors. Therefore, due to the severity of resulting impairments, stroke

rehabilitation can be very challenging in the South African context(7). Although there are some rehabilitation interventions available for severely affected stroke survivors, with some of the latest well researched methods such as constraint induced movement therapy (CIMT) and transcutaneous electrical nerve stimulation (TENS) treatment, it is not always clear whether these interventions are appropriate in a South African context, or suitable for every single patient(3)(13). The South African context, with regards to the health system consists of both private and public sectors. Both sectors have their challenges, especially regarding financial resources which have an effect on treatment received by the South African population. Often in the acute phase of stroke rehabilitation, survivors are not always seen within the first week of having had a stroke, which is problematic in both sectors. This is due to poor referral systems between doctors and allied healthcare professionals, lack of staff and the quick discharge rate. Survivors are then either transferred into acute rehabilitation units (however, these units are few and often filled to capacity) or are discharged home where they are expected to access outpatient rehabilitation services. The rehabilitation units also consist of other patients recovering from spinal cord injuries, traumatic brain injuries and other neurological conditions. Bed space is limited, and private patients are limited to the financial contribution of their medical aids which dictate their length of stay. The reality is that the majority of South African stroke survivors make use of the public health system. They do not have access to continuing rehabilitation at a rehabilitation unit and have to make use of local hospitals and clinics for outpatient therapy. Many clinics and local hospitals have 1-2 therapists available to treat survivors and their intervention resources are limited to basic materials and equipment. Many of the therapists are newly qualified and inexperienced in stroke rehabilitation and specialized treatment techniques such as the use of CIMT, MT and TENS do not form part of their treatment options. Furthermore, patients have difficulty getting to their local clinics and hospitals and are usually only able to attend therapy once or twice a month. The protocol for the use of interventions such as CIMT, MT and TENS require consistent use of the technique over a specific period of time by the therapist. Based on the South African context most of the stroke population would not fully benefit from these techniques on an outpatient basis. Patients do not have resources to purchase their own equipment or the luxury of full time caregivers to assist with following such strict programs at home(7).

Mirror therapy (MT) is one rehabilitation intervention method that has been found effective in improving motor function, especially in severe hemiparesis, activities of daily living, pain and visuospatial neglect post stroke(14). It is considered a cost-effective treatment method as basic resources are required, which are available in private and public rehabilitation departments within Gauteng. The training can be accessed by therapists through one-day courses or training from senior therapists who have experience with the modality.

Furthermore, it can be continued at home as part of a home program when patients and family members/caregivers are adequately educated(7)(14).

The stroke survivor requires a fair amount of cognitive and perceptual ability in order for MT to be effective and the patient cannot be a passive participant. It is suggested in most protocols that the survivor is required to have a minimum of ten minutes attention span, the ability to visualise an abstract concept, and the ability to follow instructions. The exact amount of mental ability is not specified in most protocols. It has been of common belief that these factors are required for survivors to benefit from this treatment modality as the ability to sustain the experience of "feeling the affected limb move and function" requires higher functioning mental abilities. When considering survivors whom present with various mental impairments and absent or minimal motor abilities, a poor functional prognosis is usually made. However, it needs to be further explored if the presentation of therapeutic activities, handling techniques and purpose of activities are supportive of activity engagement and improvement in these stroke impairments(6)(7)(9).

Although there are several studies showing the effectiveness of MT in stroke survivors, most of these studies have included participants with varying forms of mental impairments. The main mental impairments which would be considered as part of exclusion criteria in past research includes decreased attention span and working memory. Some protocols required that participants had a 10 minute attention span and other studies required a 30 minute attention span. In some studies, adequate memory was important and in other studies, the ability to follow basic instructions were important. It was not specified if these were written, verbal or demonstrative instructions. Hence, the inclusion and exclusion of mental impairments varied and was often vague(1)(2)(7)(9)(10)(16). Therapists are therefore reluctant to use MT in the rehabilitation of stroke survivors with mental impairments, due to the uncertainty as to whether the effectiveness is really impacted by varying levels of mental impairment. The problem is therefore twofold; on the one hand there is insufficient evidence for the effectiveness of MT in stroke rehabilitation in the case of a patient with varying levels of mental impairments. And on the other hand, it is unclear at which level of mental impairment a therapist can be more certain it would be the most effective(7)(6)(10)(14)(15).

Due to the fact that mental impairments can vary significantly between stroke survivors, exclusion of some patients on different levels of mental impairment in this intervention limits its scope of use. A clear description of stroke survivors with varying levels of mental impairments that could possibly benefit from this treatment method is thus greatly needed for the advancement of stroke rehabilitation. Forming a clear picture of who would benefit from MT treatment will provide clinicians with the confidence to use this tool competently. Furthermore, it will highlight the needs as well as capabilities of the stroke survivors with high

mental impairments and less motor functions as this is the group which is increasing in number over the years and who have not benefitted from a responsive rehabilitative program which allows for improved independence in daily activities, occupational performance and better quality of life.

In conclusion, MT has been found in previous studies to be effective in improvement of motor function after stroke. Due to the inclusion of stroke patients with varying levels of mental impairments in these studies, it is difficult to ascertain at what level of mental impairments MT would be the most effective. The Vona du Toit Model of Creative Ability (VdTMoCA) can be used as a functional measure to indicate mental impairments and could possibly assist the occupational therapist in deciding whether MT would be an effective intervention choice for stroke survivors. The VdTMoCA is a model which can be used to assess a person's occupational performance. A person's occupational performance is believed to be influenced by their level of motivation and action. It is further thought that a person's level of motivation and action is influenced by a variety of external and internal factors which may inhibit or support and promote their occupational performance. Vona du Toit placed the continuum of occupational performance on a model of 10 levels of action and 6 levels of motivation. Level 1 would be the lowest functioning person with an increase in performance as one goes higher up the levels. The model has been mainly used amongst occupational therapists working with psychiatric conditions however, the model is not limited and has been applied in paediatric cases as well as adult neurological conditions where mental impairments can be affected.

Occupational therapists are uniquely positioned in stroke rehabilitation as they are trained and skilled in motor and mental intervention methods. Mental impairments in stroke rehabilitation does not have a specific category or protocol of treatment and is dependent on the therapist's experience and clinical reasoning. The VdTMoCA is an appropriate tool to determine mental functioning as it assesses the person in a functional and holistic manner and provides treatment outcomes which consider the person's attention span, ability to follow instructions, the type of instructions which are appropriate, activities which would be meaningful to a person (based on their level on the model) and creates a therapeutic environment with appropriate handling techniques which allow for the person to experience success and increase their motivation to further participate. A study where an occupational therapist uses the levels of the VdTMoCA to group stroke survivors and use the treatment outcomes, and then compare the effectiveness of MT, would therefore aid the advancement of MT for stroke survivors as a whole.

1.2 Problem statement

Mirror therapy has been proven to be an effective treatment modality for the improvement of movement of the hemiparetic side in patients recovering from stroke. However, occupational therapists are uncertain whether stroke survivors with higher mental impairments would benefit from MT as part of the treatment due to lack of evidence.

1.3 Purpose

The purpose of the study is to narrow the research gaps of MT in upper limb treatment of stroke survivors, particularly those with mental impairments. This can be done by establishing criteria for MT for stroke survivors with lower levels of VdTMoCA in the use and benefits of MT. This study would contribute further to the body of knowledge surrounding MT in occupational therapy practice.

Further research surrounding this intervention would therefore establish a reference point for clinicians to identify appropriate stroke survivors who would benefit the most for this treatment modality using evidence-based studies.

1.4 Research question

Is MT effective when used with stroke survivors who have mental impairments?

1.5 Aim

To determine the effectiveness of MT in upper limb motor function of stroke survivors with mental impairments on two different levels of the Vona du Toit's Model of Creative Ability.

1.6 Objectives

1.6.1 To determine the improvement in upper limb motor function (determined by the Fugl-Meyer Assessment) in stroke survivors on two levels of VdTMoCA (Self-differentiation and Self-presentation) after the implementation of MT.

1.6.2 To determine at which level of VdTMoCA (Self-differentiation or Self-presentation), the use of MT would be the most effective in the treatment of upper limb motor function in stroke survivors (determined by the Fugl-Meyer Assessment)

1.6.3 To determine whether there is an association between the level of VdTMoCA scores on the APOM, according to levels of Self-differentiation and Self-presentation, and

improvement in scores for upper limb motor function in stroke survivors (determined by the Fugl-Meyer Assessment) after implementing MT.

1.7 Justification for research

Stroke survivors often present with motor, cognitive, perceptual, communication and emotional deficits of varying degrees depending on the extent and location of the damage to the brain. These factors affect a person's ability to perform tasks in all areas of occupation, and therefore occupational therapy plays a massive role in stroke rehabilitation. The dilemma of spending limited and essential time on rehabilitation of a severely affected arm versus equipping the patient with compensatory techniques to ensure partial to full independence in basic daily activities is a reality. There is a gap in South African stroke rehabilitation regarding a successful treatment technique and protocol which is accessible to poorly resourced centres (which is in majority). Due to all the contextual difficulties discussed, making use of compensatory techniques within the acute stages of recovery is most often the chosen option. Owing to the acute nature of most settings in South Africa, most survivors have severe impairments with limited resources to access consistent therapyand so interventions that are effective during the short acute hospital admissions need to be investigated. Stroke makes up the highest percentage of an occupational therapist's caseload in general practice, therefore intervention studies for this population is essential in South Africa(3).

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction to the literature review

In this literature review, the researcher will explore stroke and its impairments within the South African context. The pressures and challenges therapists face with the treatment of acute stroke survivors during their hospital stay is discussed and current methods of treatment is considered. The acute stage of recovery appears to be where there is limited treatment provided to the affected upper limb however, therapy during this stage needs to be as effective as possible so that maximum change can be made and then carried over to the community setting, if therapy is available within the community setting(3)(16). The specific impairments of stroke in relation to occupational therapy is included and the use of Vona du Toit's Model of Creative Ability is reviewed as an outcome measure for mental impairments presented in stroke survivors. Mirror therapy will be discussed in terms of its history and uses with a variety of conditions as well its applicability to specifically stroke survivors.

2.2 Description of stroke

Stroke arises as a result of cerebrovascular disease. It is a focal neurological deficit which can occur in the cerebral, intracerebral or subarachnoid areas which can have disabling effects on the survivor. Stroke is usually classified as either ischaemic (usually a blockage of a cerebral vessel due to an embolus or thrombosis) or haemorrhagic (usually occurs as a result of a rupture of a cerebral blood vessel). It has been considered the most common cause of death and disability internationally(3)(17)(5). Previously, stroke was considered to be most prominent in the elderly population as it was a result of cerebrovascular disease, however, within recent times the stroke population has expanded significantly and is inclusive of a much younger population. This raises many other concerns as the working population has been affected which has had an impact on the burden of care to the healthcare system and economy. It has also further complicated stroke rehabilitation where return to work and returning to full functioning is of high importance as young survivors feel the pressure of fulfilling their roles expected of them(5)(17))(19).

As the stroke population includes a high number of previously-working people, the requirements for stroke rehabilitation has changed its focus from previous years. It is of necessity that stroke survivors are able to return to work or continue to contribute meaningfully

to the country's economy and remain independent of government support. However, stroke rehabilitation is a lengthy process with many factors to consider in order to provide the patient with the best functional prognosis. Thus, therapists should be equipped with the most updated and effective treatment techniques available with the return-to-work goal in mind. This requires that survivors receive effective treatment from as early as possible with therapists on all levels of rehabilitation working towards the same goal using the same approach. Therefore, therapists working in the acute phase need to communicate effectively with therapists who carry over into sub-acute stages of recovery(3)(5)(17)(18)(19).

2.3 Stroke within the South African context

Recent literature has shown that haemorrhagic stroke is higher in developing countries in comparison to ischaemic stroke. It has also been shown that there is an increase in the prevalence of stroke in the younger population(3)(19)(17). This has been thought to be the case in South Africa as a result of lifestyle changes and the population having higher exposure to stroke risk factors(3). The burden of HIV/AIDS within the South African context contributes significantly to the prevalence of stroke in the youth. This is due to compromised immune systems resulting in opportunistic infections and heart complications(3).

The South African guidelines for ischaemic stroke and transient ischaemic attacks recommends that acute stroke survivors should receive treatment within a dedicated stroke unit which has a multidisciplinary team approach. It further recommends that post-acute and rehabilitative services as well as community reintegration services should be made available to all stroke survivors. The guideline places focus on primary preventative approaches and the use of brain imaging for minor stroke and transient ischaemic attack patients(3). Stroke research within South Africa has identified that there is still a gap between the set recommendations and implementations of these in practice(3).

The number of stroke survivors seen within the country are numerous and resources are inadequate to meet the guideline requirements. Many stroke survivors are treated in general medical wards and inpatient treatment does not have a multidisciplinary approach. With regards to allied health teams, physiotherapy appears to be the most common therapy received with occupational therapy following and only a few patients receiving speech and language therapy. It was reported that this was mostly due to a lack of referrals to appropriate therapy professions and a lack of therapists within the various settings(11). On top of inadequate referral systems and low numbers of staff, the average length of stay in a district hospital was gathered to be 6-10 days which was viewed as insufficient to allow for therapy which focused on functional goals and outcomes. Also, the short stay often resulted in the

development of compensatory techniques by survivors in order to attain independence in daily tasks. These compensatory techniques have been shown to reinforce the phenomenon of learned non-use and complicates therapeutic techniques which attempt to improve the motor control and functional use of the affected limbs. It is also incongruent with neuroplasticity principles which focus on early intervention of the affected limb with repetition and purposeful use(11)(20).

There are many obstacles faced by the health services including patient bed-availability and the accessibility of rehabilitation services to survivors(3). Stroke survivors are discharged at a fast rate which is dependent on their medical stability and not their functional ability(3). This often results in survivors being discharged into environments which hinder their recovery rather than promote it due to lack of resources, physical obstacles (such as rough terrain, distance of toilets) and isolation from the community(21). This places much importance on effective inpatient rehabilitation therapy to stable stroke survivors. It has been shown that the earlier the survivor receives medical intervention the better their prognosis(22).There are further challenges for survivors who are discharged from hospital and cannot afford inpatient rehabilitation in rehabilitative units. Patient adherence to outpatient therapy is poor, especially within rural and sub-rural settlements(23). There are many factors which have contributed to this, including financial and environmental strains. These stressors contribute significantly to the stroke risk factors, which in turn places a person at risk of suffering another stroke(22)(23).

According to the South African stroke guidelines, stroke rehabilitation within South Africa has the right idea however, in practice the high number of stroke survivors and lack of human and physical resources have made the process challenging and created a wide gap of reality from the ideal. Poverty, lack of community support, the burden of care of orphaned children and ill family members, have contributed to a poor prognostic outcome for these survivors and so South Africa’s burden of care within the population continues to gradually rise(3)(11)(20).

The need for efficient and effective therapy techniques has not been of a greater need than now. Hospital stays cannot be increased as bed availability is required to address the ever-growing stroke population amongst the other challenging health conditions faced by South African citizens. There is a high patient turnover rate within primary care hospitals and limited options for discharged survivors in terms of stroke rehabilitation. The next step is usually a transfer to a rehabilitation hospital or receiving services from local clinics. The application process and requirements to transfer a survivor into a rehabilitation hospital within the public sector is complex however, if successful it is most beneficial to stroke survivors. Community services such as clinics have a large load of patients which require assistance and few therapists. This often leads to stroke survivors only being seen once or twice a month for 1-2

hours. This does not allow for neuroplasticity principles to be utilized adequately and ultimately, compromises the functional prognosis of each survivor(20)(16).

When looking at the opportunities for a stroke survivor to receive therapy services from the acute to subacute phases of recovery, they are limited. The use of therapeutic techniques in regaining negative impairments during the acute phase is lost especially in the more severe cases and neuroplasticity techniques are attempted only after discharge from hospital.

2.4 Principles of neuroplasticity

The brain has the ability to adapt, even after it has fully developed. This occurs frequently in adulthood as learning of new skills and new experiences still takes place which requires adaptability of the brain. This is the premise of neuroplasticity in relation to stroke rehabilitation. If neurons have the ability to adapt to external and internal factors in order to equip the person in optimal functioning, stroke rehabilitation should implement principles which facilitate this process to improve functional independence of stroke survivors(16)(24)(25)(26).

Neuroplasticity principles have been suggested in order to guide rehabilitation and facilitate the process in order for the patient to re-develop their motor control to achieve independence in functional tasks.

“Use it or lose it”(16) implies that the affected limb should be encouraged as early in the rehabilitation process as possible. Neurons which form neural circuits require consistent stimulation in order to remain intact. Decreased stimulation to these circuits result in degradation and loss of the once functional area. With regards to stroke survivors, there is decreased stimulation of circuits related to the affected limbs and this places the limbs at further loss of function. This degradation is usually supported by learned non-use of the affected limb as patients begin using their non-affected limbs in a compensatory method to perform daily tasks. Learned non-use takes the opportunity of using the affected limb and continuing with stimulation of the required neuronal circuits(16)(24)(25).

“Use it and improve it”(16) encourages the idea that neuronal circuits which are at risk of degrading can improve if provided with the appropriate skill training. The training received by the stroke survivor needs to follow specific principles which ensure that neuroplasticity does occur, and tasks should be mentally and physically challenging and should allow for elements of problem solving. This would include other neuroplasticity principles such as ensuring that the task engaged in by survivors have a specific goal which they are well aware of, the task has sufficient opportunities for repetition so that the movement and skill can be practiced and

further refined. The task has to be intense and to elicit neuronal adaptation. The task and movement should be meaningful to the survivor as their motivation to want to improve and adapt would influence the adaptability and learning of new skills. The movement has to be transferred into various tasks as practice of the functional task with the desired movement or technique is necessary(16)(24)(25).

Repetition(16) as a neuroplasticity principle discusses the importance of repeating a specific task or movement in order to provide long-lasting cortical re-organisation changes. This will allow for the use of the practiced movement of task outside of therapy, which links to the principle of transference whereby the learned movement or skill is performed in a variety of settings. Ultimately, stroke rehabilitation techniques may elicit a desired movement. However, this principle is stating that once the movement is achieved, it needs to be repeated over time to ensure that it becomes a permanent neural change. This can then be further built on and can form the basis to a functional movement which can be performed over various environments and circumstances(16)(24)(25).

Along with repetition, intensity(16) also plays a significant role in ensuring long-lasting neuroplasticity. Studies have shown that an increase in intensity has an increase in the number of synapse formations. Intensity can be considered in terms of physical and mental impairments. Stroke rehabilitation and motor control theories require a sufficient amount of mental functioning as rehabilitation is goal focused, requires appropriate cognitive and physical endurance as well as the ability to follow instructions, plan and correct errors using physical and verbal feedback. Therefore, a task can be considered intense even when it challenges cognitive components. This allows for neuroplasticity to occur and could be the basis to more effective motor improvements(16)(24)(25).

Occupational therapy makes use of client-centred approaches when considering a treatment plan for a patient. It also centres around purposeful and meaningful tasks to the patient as this is linked to a patient's motivation and drive to engage in a task(1). If a stroke survivor does not consider a movement or engagement in a task meaningful, the chances of them participating in an active and goal-directed manner would be decreased and so would the cortical reorganisation changes. However, if they participate in a task which they find beneficial and really perform with intensity and a goal in mind, there would be a larger change in synapse formation and cortical reorganisation. Salience is a neuroplasticity principle which highlights the importance of goal-directed and motivational-based tasks during rehabilitation to ensure appropriate neuroplasticity to occur(16)(24)(25).

Neuroplasticity is closely related to prognostic factors in stroke rehabilitation. Prognosis of the stroke survivor is the realistic expectation of the stroke survivor to regain function in

impairments based on medical and functional factors affecting the recovery of function in the person. The rehabilitation therapist will decide whether to use intervention that will improve function in impairments, or rather compensate for the impairments and focus on improvement in functioning in areas of occupation. It is however important to remember that neuroplasticity principles can be applied to stroke survivors with a fair to good prognosis as it requires mental, psychosocial and motor components to work together in order for adaptation to occur. A severe stroke would indicate that there is a larger degree of damaged neuronal matter and so there would be more dysfunction which would need to be rehabilitated. Thus, it is noteworthy to consider the prognostic indicators for stroke rehabilitation and how this would assist in the choice of approach(16)(24)(25)(27).

2.5 Prognostic factors of stroke

The state of the stroke survivor on admission is essential to record as this will assist in establishing a realistic prognosis. Determining a survivor's functional prognosis can be challenging as each case is unique and numerous factors contribute to the survivor's current and future states. However, it has been identified as a need that specific prognostic factors be determined which can assist therapists in making appropriate and objective treatment decisions. The ability to decide on a treatment approach early in the recovery process is vital as it facilitates the implementation of neuroplasticity and motor leaning techniques as soon as possible or makes use of compensatory techniques and does not prolong the survivor's coping cycle and acceptance phase of what has occurred. Either approach, when implemented timeously will allow for the survivor, family members and therapist to work on the same goal together while addressing other psychosocial impairments which may develop, such as depression(16)(25)(12).

The following factors have been suggested for consideration when determining the functional prognosis of a stroke survivor: urinary and bowel incontinence, the presence of perceptual impairments, previous strokes and patients with advanced age. These factors have been shown to have a poor functional prognosis in survivors who presented with more than one factor on admission. These can be used as a guideline with clinicians as these signs in survivors will indicate that the rehabilitative approach will need to be considered from early stages of the recovery process(28).

Other prognostic factors which can be considered are: the support given to the survivor at home and in the community post discharge, accessibility to medical care, the survivor's motivation and compliancy as well as the survivor's response to neuroplasticity techniques

and principles. These factors are especially challenging within the South African context and can affect functional prognosis later in the rehabilitation process(23)(12)(29).

Along these general prognostic factors, there have been specific prognostic indicators of the recovery of the affected upper limb and hand. It has been shown that it is possible to predict severe motor impairment of the affected upper limb and hand one month post stroke. This was done through determining the severity of the stroke, assessing the affected upper limb and hand's grip strength, finger extension and shoulder abduction. However, the challenge remains for those survivors who present with severe motor impairment immediately after the stroke as these prognostic indicators were less accurate versus the accuracy obtained in stroke survivors who had less severe motor impairments(30).

2.6 Motor impairments after stroke

As previously discussed, the focus on improving motor control for inpatient stroke survivors with the challenge of their short hospital stay is of a high priority. When considering the neuroplasticity principles which are used in stroke rehabilitation, encouraging motor control as early as possible after the stroke is required(16). The use of the affected limb from early stages and repetition of purposeful movements are also important principles which should be considered(16). The focus on motor control with inpatient stroke survivors who have some movement after the stroke is being performed however, a concern is patients with minimal or no voluntary movement after the stroke. These stroke survivors usually display a more severe stroke and the importance of efficient rehabilitation of the affected limb is required so that a realistic prognosis can be made before the patient is discharged. This will allow the therapist to use the remaining time to choose an appropriate treatment approach and educate the patient and family on a realistic functional prognosis and home programme(23)(12)(29).

As seen in rehabilitation literature, hemiplegia and hemiparesis are deficits most commonly diagnosed after neurological insult due to stroke(3)(4)(5)(6)(7). This can affect the upper and lower limb, trunk, facial and oral sensorimotor functions (8). Due to the lack of movement after stroke being so common, it is the intervention area that rehabilitation therapists are seeking the most information on, to ensure their management of stroke survivors are effective, efficient and evidence based. Leaders in stroke rehabilitation have been researching the cause of hemiplegia and paresis to rehabilitate these impairments more effectively. Recent studies have identified negative impairments of stroke as the factors which have been lost or are absent due to the stroke. This can include muscle weakness and loss of motor control(3)(4)(5)(6)(7).

With evolving research into stroke, it has been identified that the negative impairments are the areas where stroke rehabilitation should focus on as opposed to the positive impairments, which include spasticity and hyperreflexia (31). Previously, it was thought that the main focus of stroke management was to minimise spasticity and normalise reflexes in order to regain normal movement to the stroke survivor. However, it has been shown that spasticity is not a factor which can be controlled long-term. No therapeutic or pharmaceutical modality is able to reduce spasticity consistently or permanently. Furthermore, the reduction of spasticity does not guarantee the return of isolated and controlled movement of the affected side. However, it is important to clarify that an attempt to minimise spasticity will not improve motor control and movement of a survivor, but the techniques used will prevent the development of secondary impairments such as muscle shortening, neural tension and myofascial stiffness. Effective results have occurred when a shift in rehabilitative focus was made to improving motor control and muscle strength in stroke survivors with spasticity still present. This is effective as it is consistent with principles of neuroplasticity(16)(31), which will be discussed next.

The Fugl-Meyer Assessment (FMA) (motor function of the upper limb domain) is an assessment tool based on the Brunnstrom stages of motor recovery. It is a sensitive tool used to measure small motor changes and considering initial, partial and full movements(32)(33). This assessment tool also assesses movements which are commonly used and is broken down into the smaller movements of each area which is required to achieve the full movement(32)(33). For example, the stroke survivor would be asked to touch their ear however the therapist would be looking at smaller movements of the shoulder, scapular, elbow, forearm and wrist. It is a suitable tool to use with acute stroke survivors who have little or no movement. The assessment consists of five domains namely: motor function, sensory function, balance, joint range of motion and joint pain. Each domain is scored on a 3-point ordinal scale with 0 being scored if the movement cannot be performed and two being scored if the movement is performed fully(32)(33). The entire assessment takes about 30 minutes to administer however specific domains can be administered independently. The assessment has a whole received an excellent intra-rater and interrater reliability score of P<0,001 for all. The motor domain received a good construct validity score by a variety of studies(32)(33).

2.7 Sensory impairments after stroke

Absent or diminished sensation within the stroke population is commonly seen and can be indicative of a more severe stroke. This can often lead to unsafe use of the affected upper limb where the limb is placed in awkward positions after a transition and can lead to pain and

further musculoskeletal and orthopaedic injury of the affected limb. Survivors also report that the limb feels heavier and this can lead to despondency in attempting to regain motor functioning. Severe sensory fallout can also lead to decreased awareness of the affected limb and make rehabilitation of the upper limb challenging(11)(14)(34).

There are a variety of assessments available for the assessment of sensation however, these are not always easy to administer on stroke survivors as psychosocial, cognitive, speech and language factors further complicate the findings. Stroke survivors are not always able to verbalise their thoughts, understanding of basic language can be affected and the comprehension of diminished sensation is sometimes poor(34).

Mental impairments can hinder the results of the test and can affect treatment options too(4)(8)(35)(36)(37). Sensory re-education can be challenging as it requires daily practice and intact cognitive skills in order to sustain an appropriate attention span to process the sensory feedback to the brain. The therapist has to start by improving the patient's awareness of the affected limb and then work on returning normal sensory modalities back with the use of vision and in the absence of vision(4)(8)(35)(36)(37). Treatment of this factor is also challenging as the degree of sensory loss varies between patients and is further complicated by the presence of cognitive and psychosocial impairments. Survivors can present with absent sensation which can be accompanied by a hemineglect. Rehabilitation in cases like these have to start with addressing the hemineglect and perceptual issues first before moving onto the sensory impairments thus making the rehabilitative process much longer. (4)(8)(35)(36)(37).

Hemineglect is diagnosed in stroke survivors who have difficulty with processing stimuli to the affected limbs which are contralateral to the site of injury. This results in decreased awareness of the affected limb and the general space on the contralateral side. This has a negative effect on survivors' functional ability and places the affected limbs in a vulnerable position as they are at risk of injury due to the decreased awareness by the survivor. Hemineglect also has dysfunctional consequences of activities of daily living as the affected side is not involved and taken into account when performing in a task resulting in only the unaffected side being addressed. For example, the person would only comb their hair which lies in the unaffected side. There are a variety of treatment techniques used to improve the awareness of the affected side(4)(8)(35)(36)(37).

Mirror therapy has been shown to be effective in improving awareness of the affected side. If addressed within the acute phase of recovery hemineglect does not have to continue into the subacute stages and further hinder the emergence of motor control improvement(14).

Mirror therapy has been shown to be effective in both the treatment of hemineglect as well as sensory impairments however, usually this has been performed with survivors who have a fair amount of intact cognitive and psychosocial skills(14). The severe cases of sensory fallout and hemineglect usually have lower cognitive and psychosocial skills available especially during the acute stages of recovery which means that mirror therapy is not an obvious option at this stage(14). Inpatient therapy at this stage would prioritise the cognitive and psychosocial factors which would be addressed in hospital. This is a necessary approach as these impairments do make it difficult to try and improve motor control however, with the pressure of only 6-10 days before discharge, motor control and sensory factors need to be addressed almost simultaneously to the cognitive and psychosocial impairments. However, this can be challenging and frustrating as one factor affects the other(4)(8)(20)(35)(36)(37).

2.8 Mental impairments after stroke

The evaluation of mental impairments after stroke is very complex due to the variety of complications seen(4)(8)(10)(35)(36)(37). Each stroke is unique, and the mental functioning of each survivor varies according to the type of stroke, severity of the injury and premorbid mental functioning(3)(5). Furthermore, the term “mental impairments” is an umbrella term and there is not a specific group of functions which fall under this term as it varies between therapists. Mental impairments can be a primary result of the stroke as areas of the brain may have been directly affected by the stroke however, it can also be secondary to the stroke as a result of loss of function. Mental impairments are not unique to stroke survivors and so it can be a result of post-stroke depression. It is also important to consider the person’s mental ability before the stroke as this also varies and it cannot be assumed that everyone has the same mental capacity(4)(8)(10)(35)(36)(37).

For purposes of this study, mental impairments will include components and factors which are used in the VdTMoCA. This includes: attention span, level of communication (motivation to communicate rather than no communication due to the stroke), orientation to person, place and time, awareness of environment and people, intention of effort (effort can range from no interaction with materials, to destructive interaction with materials to incidental action of a task which results in an unplanned end product), ability to engage in a routine (follow a routine, plan their own routine), making decisions, following instructions (demonstrative, verbal, written). There are many other factors considered and this is well described in the VdTMoCA, along with the APOM. However, when looking at the use of the VdTMoCA holistically, it looks at how a person functions in their environment, how much assistance and structure is required

to ensure productivity and how the person goes about creating and performing in tasks (it can be incidental, explorative, experimental, purposeful).

It would be more useful to evaluate the effect of mental impairments on the stroke survivors' level of functioning in occupational performance areas, i.e. tasks required for functioning in everyday life. A person's occupational performance can be assessed using Vona du Toit's Model of Creative Ability (VdTMoCA) (11). Her model describes different functional characteristics over a span of ten levels of action and motivation(1)(2)(38)(39). Du Toit postulated that a person's occupational performance is affected by their level of motivation, and thus motivation and action are intrinsically connected(1)(2)(38)(39). Stroke recovery can be challenging on an emotional level as patients have to accept the sudden loss of function due to the multiple impairments which are associated with stroke. This recovery process can be considered psychical and Du Toit considered that this process consisted of different levels of motivation and action, which led to the development of the VdTMoCA. Motivation can be defined as the "inner force that initiates or directs all behaviour and results in the creation of a tangible or intangible product". The actions observed by a person can be considered governed by their motivation and it can be considered that an observation of action can assist in determining the strength of motivation(1)(2)(38)(39).

A person's level of action is affected by environmental difficulties, general well-being and inherent qualities, including the cognitive deficits which are often present after a stroke(39). Furthermore, a patient's dependency on others in areas of occupation can impact on motivation, cause depression and negatively impact compliancy to treatment. These factors will all have negative consequences on the person's motor functioning(23)(39).

According to this model, a person who is considered to be on one of the lower levels of creative ability would present with a multitude of difficulties which would hinder their engagement in functional tasks. A person's process skills which include their attention, knowledge and skills surrounding basic concepts and their task concept would be unconsolidated and poorly developed.

Task concept is a term specific to creative ability. It is made up of the different components which make up a task such as initiating a task, executing a task, completing a task and evaluating a task. People placed on the lower levels of creative ability usually have an absent or developing/unconsolidated task concept which means that any engagement in familiar and unfamiliar tasks would be problematic. In order for a basic task to be completed, the components which make up task concept, would be worked through automatically in a person who has a consolidated task concept. However, in a person whose task concept is unconsolidated/developing certain components would be challenging such as initiating the

task (they may need to be encouraged or guided through the first few steps), following instructions (they may miss a step or have difficulty following the next step), knowing when the task is complete (they may be hesitant or unsure if they are undone or unaware of the end product) and evaluating a task (detecting their mistakes and correcting it, giving realistic feedback on their performance). This has implications on physical rehabilitation when considering theories of motor control and neuroplasticity. Therapy focuses on engaging patients in activities in order to provide an opportunity to practice desired movements and improve endurance. However, a stroke survivor who is placed on a lower level of the VdTMoCA may have difficulty performing a simple task such as washing or dressing because their task concept is still developing as well as other mental components. Thus, they appear unmotivated and perform poorly but this is because the activity, handling and environment is not appropriate to facilitate task engagement.Therefore, choosing an appropriate task for therapy is as important as the motor components the task would elicit. Furthermore, MT hs been shown to be successful in regaining motor function of the affected upper limb in stroke survivors. If VdTMoCA principles are implemented in MT sessions, it should allow for MT to be effective with survivors who are usually excluded.(1)(2)(38)(39).

The VdTMoCA's lower levels of action present with low motivation, unconsolidated task concept, short attention span and decreased engagement in areas of occupation. This improves the higher the level (39). When an occupational therapist therefore measures a stroke survivor's level of VdTMoCA, they would be able to ascertain whether their mental abilities are sufficient to cope with the demands of MT, to ensure that the intervention would be suitable to be effective in the return of motor functioning of the limb. MT can be adapted from one step tasks to more complex tasks which can be adjusted according to the various levels of creative ability. The amount of time can also be adjusted according to the varying attention span, motivation and emotional expression(1)(2)(38)(39).

The Activity Participation Outcome Measure (APOM) was developed as a measurable way in which creative ability can be assessed using an 18-point scale. The measure consists of nine domains which can be administered individually if required. Overall, it takes 30-45 minutes to perform. The evaluator requires training on the tool. It has a 0.98 interrater and intra-rater reliability score and a good content validity of 0.93(38).

2.9 Mirror therapy in stroke rehabilitation

Mirror therapy was introduced in the 1900s by Ramachandran for the treatment of phantom limb pain. Its effectiveness has consequently been studied intensively in conditions such as pain syndromes and stroke(15). It has been successfully used to treat the hemiparesis of the

affected upper limb post stroke as well as in addressing sensory and visuo-spatial neglect(15)(6)(7).

The stroke survivor's hemiparetic upper limb is placed inside a box with a mirror facing the patient's midline. As the stroke survivor looks into the mirror, the patient perceives the image of the unaffected limb as the affected limb. When movement is performed with the unaffected limb, the brain interprets the hemiparetic limb as moving, when it is actually stationary. The survivor in essence is "visualising" or "imagining" that their hemiparetic limb is moving(14). The visualisation stimulates the firing of motor neurons to the hemiparetic limb, and movements become apparent in the hemiparetic limb as the survivor moves the unaffected limb. These movements are a mirror image of the unaffected limb (which is performing the movement) (14). The improvement of the hemiparetic limb's movement has been theorised to be due to the following reasons: 1) The primary motor cortex becomes excited on the ipsilateral side during movement, due to viewing the movement in the mirror. Therefore, because the brain perceives the hemiparetic limb as moving, the primary motor cortex excites the motor neurons. 2) Due to the effects of cortical reorganisation, the brain is recruiting neurons to innervate the hemiparetic limb, as it perceives the limb as being used. 3) Bilateral activation of the inferior parietal area, the supplementary motor area in the premotor cortex, occurs and therefore firing of neurons to the ipsilateral side is stimulated 4) Central adaptations occur in networks controlling both the unaffected and hemiparetic limbs when the unaffected side moves (16).

There are several MT protocols available, and most include repetitive tasks which are appropriate to perform with a mirror reflection, such as squeezing a ball, squeezing water out of a sponge, rotating a dowel stick, and often simply moving each joint in the hand and wrist. However, all protocols have a list of factors which would make a patient eligible for receiving this treatment technique. This includes: intact cognitive skills which include sufficient attention span of atleast 10-15 minutes, working memory and the ability to follow instructions(14). Other factors include: sufficient trunk control, the absence of severe visual impairments and a typical moving non-affected upper limb and hand. The specific protocol used in this study has suggested these patient characteristics to guide who is eligible for mirror therapy(14). These characteristics are in alignment with other protocols(6)(7)(40). However, this specific protocol mentions the uncertainty and contradicting evidence which has led to the suggestion of these specific characteristics and has highlighted the unclarity of specific guidelines for which groups of patients mirror therapy will benefit. It leads to uncertainty of when it would be appropriate to begin mirror therapy as often acute stroke survivors present with cognitive impairments and decreased motor control(6)(7)(14)(40).

When considering the treatment options available to a severely affected stroke survivor in the acute phase of recovery, it is limited. Furthermore, these techniques do not facilitate neuroplasticity to occur as often it is passive movements and compensatory activities which facilitate the development of learned non-use(41).

The greatest challenge is a combination of cognitive impairments and severe motor loss as often, cognitive skills are required in the rehabilitation process for learning. Stroke survivors are required to relearn how to make the connection with the motor cortex in order to elicit voluntary movement(4)(35)(41). The presence of limited attention span, visuospatial impairments and poor following of instructions can delay the patient's ability to learn compensatory techniques in performing daily tasks or relearn methods of motor control(4)(12)(35)(41). This often leads to a poor prognosis. However, if treatment was focused on improving or stimulating cognitive and perceptual skills in the acute phase, as well as motor control, this may lead to an improved motor ability later in the rehabilitative process(4)(12)(35)(41).

Mirror Therapy has been shown to be effective in the improvement of motor control and sensory re-education(14). It can be used to assist the patient with motor imagery techniques and activation of motor neurons which are required to regain voluntary movement within the affected limb(6)(7)(14)(40). The occupational therapist can target a specific area of the upper limb ranging from the shoulder to the hand and focus on functional movements which the survivor requires. Once a functional movement is initiated, the movement can be practiced in functional tasks without the mirror. Therefore, mirror therapy can be used to assist in regaining the initial movement or to correct a specific movement after which the movement should be repeated and practiced in other tasks which are purposeful to the survivor(6)(7)(14)(40). The transference of the movement to purposeful tasks is also a neuroplasticity principle and is important in ensuring that the movement is maintained once the survivor is discharged from hospital and attends therapy as outpatient(16). The stroke survivor would be more likely to repeat the movement if it includes a functional use that simply practice a movement as part of an exercise program. This would also promote functional use of the affected upper limb and delay the learned non-use phenomenon from developing in the early stages of rehabilitation(6)(7)(14)(40).

MT has been shown to be effective in returning motor control to the affected limb with intense therapy however, there is no research exploring clear patient characteristics for stroke survivors(6)(7)(14)(40). This limits the tool in its use and creates uncertainty of when it is appropriate to use amongst therapists. A clear indication of its effectiveness on the spectrum

of cognitive and motor impairments post stroke and the intensity required for results to be achieved is necessary for further use and advancement of this tool in stroke rehabilitation.

2.10 Conclusion to Literature Review

In conclusion, MT has been shown to be an effective treatment tool in stroke rehabilitation in terms of motor, sensory and visuospatial impairments(6)(7)(14)(40). However, the appropriate recovery stage of introducing it and which stroke survivors are eligible is unclear(6)(7)(14)(40). It has been used mostly within the subacute and chronic stages of recovery in stroke survivors who have sufficient cognitive skills. However, it has been unexplored if it is of benefit in lower cognitive functioning survivors and its effectiveness in the acute stages of recovery(6)(7)(14)(40). South Africa requires low cost and fast-effective treatment techniques due to the high levels of stroke within the population, the burden of care and limited financial resources for longer hospital stays and access to further rehabilitative services on an outpatient basis(3)(11)(20). Hence, effective treatment in the acute stages of recovery can lead to a better functional prognosis for our stroke survivors(3)(11)(20).

Studies have been performed using MT in the acute, sub-acute and chronic stages of stroke rehabilitation with success in returning motor control to the affected limb(6)(7)(14)(40). However, survivors were only included if they had sufficient cognitive abilities(6)(7)(14)(40). The presence of cognitive impairments within stroke survivors is high and sometimes not recognised or considered by medical professionals during the rehabilitative process. Furthermore, the presence of psychosocial impairments such as post-stroke depression and general low moods as part of the coping cycle is a reality(4)(10)(8)(35)(36)(37). It is common to find a stroke survivor with moderate to severe cognitive fallout to present with frustration and low moods at some point in the acute and subacute stage of recovery, which also has an effect on their progress in therapy(4)(10)(8)(35)(36)(37). Motivation and self-esteem along with cognitive impairments can really hinder a survivor's progress and affect their functional prognosis. These issues need to be addressed at some stage within the rehabilitative process in order to provide the survivor with the best chance at recovery(4)(10)(8)(35)(36)(37). It is understandable why survivors with low cognitive abilities have been excluded from mirror therapy however, it is worth exploring the effectiveness of this treatment technique within this group of survivors as their treatment options are limited due to lacking research on cognitive rehabilitation(4)(10)(8)(35)(36)(37).

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction to research methodology

The research methodology will provide detailed information about the study design, sample and the steps taken in order to perform the research study. It will discuss what was initially planned and the changes made during data collection.

3.2 Study design

A basic, descriptive, interventional, quantitative design was used and included pre-test and post-test assessments to determine which group of participants, Self-differentiation or Self-presentation, would benefit the most from MT.

3.3 Study population

The study population consisted of stroke survivors with motor dysfunctions, who fell within the VdTMoCA levels of Self-differentiation and Self-presentation (details describing the characteristics of these levels can be found in table 3.5.2 on page 25) admitted to Sebokeng hospital, in Gauteng.

3.4 Study sample

The study sample consisted of a total population sample. According to hospital statistics, an average of 35 stroke survivors are admitted to Sebokeng hospital over a period of six months, who fall within the VdTMoCA levels of Self-differentiation, Self-presentation and Passive participation.

Data was collected over a 6 month period, all stroke admissions were screened and within that time 13 participants met the inclusion criteria. All of the participants were inpatients at Sebokeng Hospital who were admitted with their first stroke incident. Of the total participants, 54% were female and 46% were male. They were all seen within the first week of their stroke. All participants spoke Sesotho as their first language and had some basic understanding of English as a second language. These participants had minimal motor abilities and scored between 0-20% on the Fugl-Meyer Assessment. 23% of participants presented with motor and

sensory impairments, 77% had intact sensation and motor impairments. All participants presented with varying degrees of mental impairments.

3.5 Inclusion and exclusion criteria

The following inclusion and exclusion criteria were applied to select the sample for the study.

Table 3.5.1: Inclusion and exclusion criteria for sample selection

Inclusion criteria:	**Exclusion criteria:**
Stroke patients admitted to Sebokeng hospital.	Patients who presented with receptive aphasia, as confirmed by the speech and language therapist which is confirmed through the use of their standardised assessments and clinical reasoning.
Patients levelled on the VdTMoCA: Self-differentiation and Self-presentation, as determined by the thorough assessment of the researcher and scores of 32 - 96 on the APOM.	Patients with diagnosed premorbid chronic conditions, which could decrease motor improvement, such a neuropathies and arthritis confirmed through collateral information and medical records.
Maximum percentage on the Fugl-Meyer Assessment (Appendix A) of: Arm: 0-20% Hand: 0-8% Wrist: 0-20%	

3.5.1 Planned sample selection

Initially, it was planned that all stroke survivors who were admitted with a stroke diagnosis would be screened. survivorss who fell within the self-differentiation, self-presentation and passive participation levels of the VdTMoCA would be included in the study. The survivors also had to present with motor abilities of 0-20% of the arm and wrist and 0-8% of the hand according to the Fugl-Meyer Assessment. Participants were planned to be gathered from both Sebokeng and Kopanong Hospital based on a referral and screening system.

3.5.2 Final sample selection

In order to gather as big a sample size as possible, the researcher gained permission from both Kopanong and Sebokeng Hospitals. The researcher had visited the medical wards and notified nurses, doctors, physiotherapists and occupational therapists of her study. She had requested that the therapists inform her of any referrals which they received during the week

and she had screened the wards every Monday afternoon for any patients who were not referred.

Unfortunately, there were no stroke survivors, admitted to Kopanong Hospital in the first two months of the study as the hospital was referring stroke survivors to Sebokeng Hospital. The researcher had requested that the therapists inform her when the situation had changed and she focused her time on screening the four medical wards at Sebokeng Hospital on a Monday and Wednesday. She was notified a month later that Kopanong survivors were being referred to the therapy department late and patients were discharged on the day the referral was received. Stroke survivors were discharged on the morning of the third day and inpatient therapy was not being performed.

The researcher continued to focus her time on Sebokeng Hospital and was able to see two to three participants during some weeks, depending on admissions.

All survivors who met the inclusion criteria were included in the study along with standard treatment issued to all survivors. Survivors were evaluated, placed on a level of the VdTMoCA and included if they were on the appropriate levels. The researcher used the guidelines, according to the VdTMoCA to assess the participants appropriately, and as part of their usual and regular occupational therapy management. Survivors who also met the motor requirements were included in the study. As initially planned, a third level of VdTMoCA was included however, survivors who were placed on the passive participation level had motor abilities higher than the inclusion scores required for this study. Thus, the third level was excluded from the study. Once the survivors were placed on a level, the sample was divided into two groups. The two levels of survivors used in this study can be summarised as follows:

Table 3.5.2: Description of levels of Vona du Toit Model of Creative Ability(1)

Level of motivation (Level of action)	**Characteristics of level**
Group A: Self-differentiation (Incidental constructive action)	The person is establishing and maintaining self-awareness as a separate entity from the environment. They are also achieving control over their bodies and learning the basic skills to use their body to interact with the environment. Action is unplanned and often unintentional, and they often have an immediate recognisable end-product.
Group B: Self-presentation (Constructive Explorative action)	The person intentionally investigates materials, objects and others in the environment. Exploration of the properties of materials and objects helps the person understand how he fits into his world and environment. As they repeat actions, they become more confident and develop feeling of competence.

3.6 Data collection tools

3.6.1 Activity Participation Outcome Measure(38):

This measure is based on the VdTMoCA and was used to record the survivor's level of participation based on their motivation and action in tasks. This tool has good intra-rater-reliability of 0.98 and an internal consistency of 0.92. It requires training and purchasing of the recording tool, the researcher has received training and is able to use the tool. It requires assessment and observation using functional tasks with the participant and takes 30-45 minutes to administer(38). The functional tasks used for assessment was individualised to the appropriateness for each participant and many factors needed to be considered. These factors included: the level of motivation of VdTMoCA the participant was on which determined the number of steps the activity had as well as the type of instructions given and assistance provided(1)(38). Other factors include: culturally appropriate tasks and tasks which the participant was exposed to pre-morbidly. These tasks include washing of themselves (which can be applicable to all levels), dressing and feeding. These tasks are general daily tasks which every person has been exposed to and it was graded according to the participant's ability(1)(38).

This measure was used to group the participants according to the two groups. It was used as a pre-test assessment and as a post-test assessment at the end of MT intervention, before discharge. There are nine participation domains, namely: 1) Process skills 2) Communication/Interaction skills 3) Life skills 4) Role performance 5) Balanced lifestyle 6) Motivation 7) Self-esteem 8) Affect(38). An 18-point scale is used for the first six levels of VdTMoCA. The tool can also be administered using independent subsections therefore decreasing the time required for administration(38). The researcher performed an appropriate assessment for each stroke survivor and recorded results in domains applicable for each individual. The tool was used to record the participant's level of VdTMoCA before MT began and after the last session of MT.

- The participant on the level of Self-differentiation received a score of 4, 5, or 6 for each specific component, thus a total score of 32 – 48.
- The participant on the level of Self-presentation received a score of 7, 8, or 9 for each specific component, thus a total score of 56 – 72.

3.6.2 Fugl-Meyer Assessment of motor function:

The Fugl-Meyer Assessment (32)(42) (Appendix A) is used to assess a variety of factors including motor ability, joint range, pain and sensation of the hemiparetic side post stroke.

Studies have shown that it has a good test-retest reliability of 0.97, intra and inter-reliability overall 0.98-0.99, an internal consistency of 0.94-0.98 (across four administrations) (32)(42). It is a sensitive assessment and is used to interpret smaller changes of movement of the hemiparetic limb. The assessment does not require any additional training and is accessible on various websites for free download. The assessment can be broken down into subsections, therefore decreasing the time of administration from 35 minutes to approximately 20 minutes(32)(42).

The assessment was performed as a pre-test assessment to determine the initial score for each participant. It was also used as a post-test assessment to determine if there is a change post treatment, thus after each day of MT(32)(42). The assessment consists of four sections, namely: 1) Upper limb 2) Wrist 3) Hand and 4) Coordination. Each section consists of several movements, and the participant's ability to perform the movement is scored as zero, one or two, where zero is the poorest performance and two is the best performance(32)(42). The upper limb maximum score is thirty-six, the wrist has a maximum score of ten, the hand has a maximum score of fourteen, and coordination has a maximum of six. The participant's scores were converted to a percentage for each section as well as a total for the whole assessment(32)(42).

3.7 Research Procedure:

1) The protocol was approved by the Faculty Graduate Studies Committee.
2) Ethical clearance (number: M161011) for the study was obtained for the Human Ethics Research committee at the University of the Witwatersrand (HREC).
3) Permission was obtained from the CEO of Kopanong and Sebokeng hospitals. An information letter (Appendix B) was be given, and permission was granted (Appendix C).
4) The researcher screened the medical wards at both hospitals and received referrals from both therapy departments at the hospital of all stroke survivors admitted.
5) The researcher performed a pilot study on three stroke survivors at the research settings to ensure that the measurement tools were adequate and that the MT protocol(14) was sufficient. The treatment principles for each group of participants was used as described by the VdTMoCA (Appendix D) (1). Feedback from the pilot study was used to make adjustments to the MT protocol(14) as well as allowed the researcher to practice the use of APOM(38).

6) There were changes required after the pilot study which included: before beginning the MT protocol, focus was placed on improving left-right discrimination and motor imagery of the affected limb. This is required before use of the mirror can commence.
7) The researcher then commenced the main study and data was collected from Sebokeng Hospital over six months.
8) MT was issued along with other treatment usually offered by the hospital. Participants on this level received passive movement and positioning as treatment from Occupational Therapy. Participants were treated for as long as their inpatient stay, which ranged from 1-4 days. Participants received a minimum of 20 minutes of therapy daily, this was either split into shorter sessions or one session depending on their level of VdTMoCA and mental abilities to sustain their attention and engage in the task.

3.8 Data collection

The following table was used for each participant across the three levels of VdTMoCA. The number of participant rows was equal to the sample size, but one row is provided for the purpose of the example:

Table 3.8.1: Data collection table

Participant:	**APOM Score:**	**Fugl-Meyer Score:**			
		Pre-Test	Day 1	Day 2	Day 3
1					

3.9 Data analysis:

Data from all tests performed was processed using StatSoft ® STATISTICA 12. Microsoft Excel ® used for descriptive statistics. The following statistical tests were used in the analysis of the data:

- To determine whether there were any significant differences at baseline between the two groups, the Fischer's Exact Test was used.
- To determine the improvement in APOM scores within each group, the Wilcoxon sign rank test was used to calculate the p-value.
- To determine the difference in number of MT sessions between the two groups, the Mann Whitney U-test was used to calculate the p-value.
- To calculate the effect sizes of MT within each group for APOM and Fugl-Meyer scores, the Cohen's d Test was used.

- To determine the difference between the differences in improvement in APOM scores between the two groups, the Mann Whitney U-test was used to calculate the p-value.
- To determine the correlation between APOM scores and FM scores, the Pearson Correlation Coefficient was used to calculate the r-value.

3.10 Ethical considerations:

- Ethical clearance for the study was obtained for the Human Ethics Research Committee at the University of the Witwatersrand (HREC) (Number: M161011).
- Stroke patients admitted to Sebokeng Hospital were invited to participate in the study by the researcher who gave them an information letter which was interpreted into the language of preference by a staff or family member (Appendix F).
- Participants provided informed consent before participating in the study through the informed consent form (Appendix G).
- Participants were informed that participation is entirely voluntary and that they may withdraw from the study at any time without any negative effect, and their therapy will continue as per protocol if they do not wish to participate in the study.
- Confidentiality was emphasized. The researcher did not make use of any names or identities in the study, and all participants received a participant code.
- All necessary therapy continued with the participants who were part of the study. Beneficence of all participants was ensured and participants received the standard care offered by the hospital staff.
- The data collection forms will be stored in a locked archive at the researcher's practice for six years, and thereafter it will be destroyed.

CHAPTER 4: RESULTS

4.1 Introduction to the results

The results of the study will be presented. The demographics of the study participants will be presented first, followed by various tables showing the effects of MT in mental and physical impairments in the self-differentiation group and the self-presentation group, when calculating the p-value. This will be followed by calculations of the effect size comparing the effectiveness of MT on mental impairments (APOM) and motor impairments (Fugl-Meyer Assessment). Furthermore, results of MT between both groups will be compared and lastly a table showing the correlation of APOM scores and the Fugl-Meyer results will be presented. The sample consisted of 13 participants all of whom were inpatients at Sebokeng Hospital recovering from a stroke.

4.2 Sample demographics

From the total participants, 54% were female and 46% were male. 38% of the total participants presented with a left hemiplegia and 62% with a right hemiplegia. All participants were treated within the first week of their stroke and every participant had received four MT treatment sessions while in Sebokeng Hospital.

Participants were all from the Vereeniging area, specifically Sedibeng district, and made use of the public health services available. Their primary diagnosis was stroke and they received inpatient occupational therapy and physiotherapy offered by Sebokeng Hospital atleast 1-2 times while in hospital. Regular therapy mostly focused on passive movements and positioning of these patients in their beds and issuing of an assistive mobility device on discharge. MT was issued to all participants within the first week of their stroke incidents.

Table 4.2.1: Sample demographics

Demographic factor	**Self-differentiation**	**Self-presentation**	**p-value**
Number of subjects	7	6	1
Gender (male:female)	4:3	2:4	0.59
Side of hemiplegia (left:right)	2:5	3:3	0.59
Number of MT sessions (average)	4.00	4.17	1.00

4.3 Results of the Self-differentiation group

There is a change in all domains of the APOM scores after participants received MT. As can be seen, the p-value is significant in all APOM domains with a score of 0.016.

Table 4.3.1: APOM scores for the Self-differentiation group

APOM domain	Pre-test		Post-test		p-value
	Mean	Std deviation	Mean	Std deviation	
Process skills	5.14	1.22	8.29	1.38	0.016*
Communication skills	5.29	1.38	8.14	1.35	0.016*
Life skills	4.57	1.13	7.00	1.15	0.016*
Role performance	4.43	0.98	7.29	0.95	0.016*
Balanced life style	4.29	0.95	7.14	0.69	0.016*
Motivation	4.71	1.11	8.00	1.53	0.016*
Self esteem	4.71	1.11	7.86	1.21	0.016*
Affect	4.71	1.25	7.86	1.21	0.016*
APOM average	7.70	1.02	7.70	1.02	0.018*

The upper limb, wrist and hand showed insignificant change after the use of MT over four sessions with the upper limb being the most insignificant.

Table 4.3.2: Fugl-Meyer scores for the Self-differentiation group

Fugl-Meyer section	Pre-test		Post-test		p-value
	Mean	Std deviation	Mean	Std deviation	
Upper limb	13.49	2.50	17.46	5.49	0.125
Wrist	0.00	0.00	2.86	7.56	1
Hand	0.00	0.00	7.14	5.83	0.063
Total	10.00	0.00	15.00	7.07	0.063

Table 4.3.3: Strength of effect size

Indication of strength of effect size	
Small size (0.00 – 0.20)	
Moderate size (0.21 – 0.50)	*
Large size (0.51 – 0.80)	**
Very large size (> 0.80)	***

Table 4.3.4: Interpretation of effect sizes

Effect size of post-test	Percentage of Pre-test group who would be below average score in post-test group	Rank of score in pre-test group of 25 who would be equivalent to the average score in post-test group	Probability that score from post-test group will be higher than score from pre-test, if both chosen at random
0.4	66%	9th	0.61
0.5	69%	8th	0.64
0.6	73%	7th	0.66
0.7	76%	6th	0.69
0.8	79%	6th	0.71
0.9	82%	5th	0.74
1.0	84%	4th	0.76
1.2	88%	3rd	0.80
1.4	92%	2nd	0.84
1.6	95%	1st	0.87
1.8	96%	1st	0.90
2.0	98%	1st (or 1st out of 44)	0.92
2.5	99%	1st (or 1st out of 160)	0.96
3.0	99.9%	1st (or 1st out of 740)	0.98

In the table below, the effect sizes of each domain of the APOM was calculated to determine if the improvement in mental impairments was clinically significant (43). As indicated in the table, all domains of the APOM within the self-differentiation group had a very large size and was clinically significant.

Table 4.3.5: Effect size of improvement in APOM scores in the Self-differentiation group

APOM domain	Mean Pre-test	Mean Post-test	Std. deviation pre-test	Std. deviation post-test	Effect size
Process skills	4,73	7,70	1,06	1,02	2,85***
Communication skills	5,14	8,29	1,21	1,38	2,42***
Life skills	5,29	8,14	1,38	1,35	2,10***
Role performance	4,57	7,00	1,13	1,15	2,12***
Balanced life style	4,43	7,29	0,98	0,95	2,97***
Motivation	4,29	7,14	0,95	0,69	3,48***
Self esteem	4,71	8,00	1,11	1,53	2,49***
Affect	4,71	7,86	1,11	1,21	2,70***
APOM average	4,71	7,86	1,25	1,21	2,55***

In the table below the effect sizes were calculated for each section of the Fugl-Meyer assessment, indicating whether the improvement in upper limb motor function was clinically significant. As shown in the table below the upper limb and hand have a very large effect size and the wrist has a large effect size. This indicates that all three sections have a clinical significant change after participants in the self-differentiation group received MT. the lowest effect size belongs to the life skills domain with 2,10 which indicates that 98% of the post-test scores have improved from the pre-test group. The highest effect size is the motivation domain with 3,48, which indicates that 99.9% of post-test scores have improved from pre-test scores.

Table 4.3.6: Effect size of improvement in Fugl-Meyer scores in the Self-differentiation group

Fugl-Meyer section	Mean Pre-test	Mean Post-test	Std. deviation pre-test	Std. deviation post-test	Effect size
Upper limb	13,49	17,46	2,50	5,49	0,99***
Wrist	0,00	2,86	0,00	7,56	0,76**
Hand	0,00	7,14	0,00	5,83	2,45***
Total	8,10	12,62	1,50	4,99	1,40***

All effect sizes are very large and represent a strong clinical significance of improvement in motor function after receiving MT, except for the wrist which was found to have a large size and still a strong clinical significance. The wrist has an effect size of 0,76 showing that 76% of post-test scores have improved from the pre-test scores. The hand has an effect size of 2,45 which indicates that 98% of post-test scores have improved from the pre-test scores.

4.4 Results of the Self-presentation group

In table 4.4.1 below, process skills, motivation, self-esteem and affect were shown to have a significant improvement after participants received MT with a score of p=0.031.

Table 4.4.1: APOM scores for the Self-presentation group

APOM domain	Pre-test		Post-test		p-value
	Mean	Std deviation	Mean	Std deviation	
Process skills	8.17	1.17	10.50	0.55	0.031*
Communication skills	11.50	2.43	12.50	1.87	1
Life skills	8.17	1.47	9.83	0.75	0.063
Role performance	8.50	1.87	10.00	1.41	0.063
Balanced life style	7.83	1.47	9.50	1.05	0.063
Motivation	7.67	0.82	10.67	1.03	0.031*
Self esteem	7.67	1.86	11.00	1.26	0.031*
Affect	8.17	1.33	10.17	1.17	0.031*
APOM average	8.46	1.31	10.52	0.81	0.028*

The upper limb and hand showed an insignificant improvement after MT with a consistent score of p=0.063 as seen below.

Table 4.4.2: Fugl-Meyer scores for the Self-presentation group

Fugl-Meyer section	Pre-test		Post-test		p-value
	Mean	Std deviation	Mean	Std deviation	
Upper limb	16.67	4.30	24.54	5.39	0.063
Wrist	0.00	0.00	15.00	28.11	1
Hand	2.38	5.83	16.67	17.30	0.063
Total	10.56	2.02	21.11	10.52	0.063

In the table below, the effect sizes of each domain of the APOM was calculated to determine if the improvement in mental impairments was clinically significant. As indicated in the table, all domains of the APOM within the self-presentation group had a very large size and was clinically significant, except the life skills domain which had a moderate effect size and moderate clinical significance.

Table 4.4.3: Effect size of improvement in APOM scores in the Self-presentation group

APOM domain	Mean Pre-test	Mean Post-test	Std. deviation pre-test	Std. deviation post-test	Effect size
Process skills	8,46	10,52	1,31	0,81	1,95***
Communication skills	8,17	10,50	1,17	0,55	2,72***
Life skills	11,50	12,50	2,43	1,87	0,47*
Role performance	8,17	9,83	1,47	0,75	1,50***
Balanced life style	8,50	10,00	1,87	1,41	0,91***
Motivation	7,83	9,50	1,47	1,05	1,32***
Self esteem	7,67	10,67	0,82	1,03	3,24***
Affect	7,67	11,00	1,86	1,26	2,13***
APOM average	8,17	10,17	1,33	1,17	1,60***

In the table below, the effect sizes were calculated for each section of the Fugl-Meyer assessment, indicating whether the improvement in upper limb motor function was clinically significant. As shown in the table above, the upper limb, wrist and hand have a very large effect size. This indicates that all three sections have a clinical significant change after participants in the self-presentation group received MT. The life skills domain has the lowest effect size of 0,47 which indicates that 66% of post-test scores have improved from the pre-test scores. The highest effect size, which is the self esteem domain, is 3,24 which indicates a 99,9% improvement of post-test scores from pre-test scores.

Table 4.4.4: Effect size of improvement in Fugl-Meyer scores in the Self-presentation group

Fugl-Meyer section	Mean Pre-test	Mean Post-test	Std. deviation pre-test	Std. deviation post-test	Effect size
Upper limb	16,67	24,54	4,30	5,39	1,62***
Wrist	0,00	15,00	0,00	28,11	1,07***
Hand	2,38	16,67	5,83	17,30	1,24***
Total	10,56	21,11	2,02	10,52	1,68***

All Fugl-Meyer sections have a very large effect size showing a strong clinical significance in improvement of motor recovery after receiving MT. The effect size range from 1,07-1,68, all showing an 84% improvement in post-test scores from the pre-test scores.

4.5 Comparison between degree of improvement in the two groups

In the table below, the difference between the pre-test average and post-test average scores were calculated for each section of the Fugl-Meyer Assessment, and it was calculated whether there is a significant difference in the improvement when comparing the two groups.

Table 4.5.1: Comparison of improvement in Fugl-Meyer scores between the two groups

Fugl-Meyer section	Self-differentiation Mean difference (Post-test – pre-test)	Lower quartile	Upper quartile	Std. deviation	Self-presentation Mean difference (Post-test – pre-test)	Lower quartile	Upper quartile	Std. deviation	p-value
Upper limb	3.57	0.00	5.56	5.00	0.93	0.00	2.78	1.43	0.390
Wrist	2.86	0.00	0.00	7.56	15.00	0.00	20.00	28.11	0.438
Hand	7.14	0.00	14.29	5.83	14.29	7.14	14.29	11.95	0.230
Total	4.52	0.00	8.33	4.88	10.56	5.00	10.00	10.26	0.171

There was no significant improvement between the two groups with regards to the upper limb and hand after receiving MT.

In the table below, the difference between the pre-test average and post-test average scores were calculated for each domain of the APOM, and it was calculated whether there is a significant difference in the improvement when comparing the two groups.

Table 4.5.2: Comparison of improvement in APOM scores between the two groups

APOM domain	Self-differentiation Mean difference (Post-test – pre-test)	Lower quartile	Upper quartile	Std. deviation	Self-presentation Mean difference (Post-test – pre-test)	Lower quartile	Upper quartile	Std. deviation	p-value
Process skills	3.14	3.00	4.00	1.21	2.33	2.00	3.00	1.03	0.208
Communicati	2.86	2.00	3.00	0.69	1.00	0.00	2.00	1.26	0.021
Life skills	2.43	1.00	3.00	1.13	1.67	1.00	3.00	1.21	0.301
Role	2.86	3.00	3.00	0.38	1.50	1.00	2.00	1.05	0.015
Balanced life	2.86	2.00	4.00	0.90	1.67	2.00	2.00	0.82	0.034
Motivation	3.29	3.00	4.00	0.76	3.00	2.00	4.00	0.89	0.594
Self esteem	3.14	3.00	3.00	0.38	3.33	2.00	5.00	1.51	1.000
Affect	3.14	3.00	4.00	0.69	2.00	2.00	2.00	0.63	0.019
APOM	2.96	2.75	3.38	0.38	2.06	1.38	3.00	0.84	0.115

Communication (p=0.021), role performance (p=0.015), balanced lifestyle (p=0.034) and affect (p=0.019) were shown to have the most significant change between the two groups.

4.6 Correlation between level of VdTMoCA score on the APOM and upper limb function improvement according to the Fugl-Meyer Assessment

The pre-test APOM scores were correlated with the improvement in Fugl-Meyer scores (difference between pre and post-test scores) of the total sample to determine whether there is an association between the initial APOM score and the amount of improvement in upper limb functioning after MT. The strength of correlation was determined by using the following scale:

Table 4.6.1: Strength of correlation

Indication of strength of correlation	
Poorly correlated (0.00 – 0.30)	
Moderately correlated (0.31 – 0.50)	*
Strongly correlated (0.51 – 0,80)	**
Very strongly correlated (0.81 – 1)	***

Life skills had a moderate correlation with the improvement in wrist function(r=0.36). Motivation had a moderate correlation with the improvement in wrist function (r=0.33) and hand function (r=0.37). Self-esteem was moderately correlated with wrist function (r=0.32) and

hand function (r=0.30). As shown in the table, all other domains were poorly correlated with the improvement in upper limb and hand function.

Table 4.6.2: Correlation of pre-test APOM score and improvement in Fugl-Meyer scores of total sample

	Upper limb	Wrist	Hand	Total
Process skills	0.23	0.24	0.28	0.28
Communication skills	0.10	0.21	0.17	0.18
Life skills	0.08	0.36*	0.27	0.26
Role performance	0.15	0.27	0.25	0.25
Balanced life style	0.04	0.27	0.19	0.18
Motivation	0.24	0.33*	0.37*	0.34*
Self esteem	0.18	0.32*	0.31*	0.30*
Affect	0.12	0.26	0.26	0.23

4.7 Conclusion to results chapter

The use of MT over only four sessions with inpatient stroke survivors presenting with severe mental and physical impairments has been shown to be clinically significant in improving voluntary movement of the hemiplegic upper limb, wrist and hand in both the self-differentiation and self-presentation groups. There has been a significant improvement as well as a clinical significance in mental components of the same participants.

The significance was seen throughout all APOM domains in the self-differentiation group whereas only certain components had a significant change in the self-presentation group.

Overall, there was a moderate correlation between specific APOM domains, such as life skills, motivation and self-esteem in the improvement of voluntary movement of the hemiplegic wrist and hand. A discussion of these results will be presented in the next chapter.

CHAPTER 5: DISCUSSION

5.1 Introduction to discussion

The following chapter will discuss the sample demographics and significant difference which MT has on acute stroke survivors' mental and motor impairments. It will discuss the use of MT within the South African context and its appropriateness to the occupational therapy profession. Furthermore, the limitations of the study will be discussed and the basis for future recommendations will be explored.

5.2 Sample demographics

The aim of the study was to determine the effectiveness of MT in upper limb motor function of stroke survivors with mental impairments on two different levels of the Vona du Toit's Model of Creative Ability. The participants all reside in the same geographical area, which is Vereeniging in the Sedibeng district, and were admitted to Sebokeng hospital, which is a public facility. All the participants received standard occupational and physiotherapy, as per the protocol at the hospital. The two levels of VdTMoCA included were self-differentiation and self-presentation, and there were seven and six participants in these groups respectively. The total sample was thus thirteen and all participants received the MT intervention within the first week of their stroke incidents. In the self-differentiation group, there were four males and three females, two of them had left hemiplegia and five had right hemiplegia. In the self-presentation group, there were two males and four females, and there was an equal number of subjects with left and right sided strokes, i.e three, in this group. There was no significant difference between the two groups in terms of number of participants ($p=1$), gender ($p=0.59$), and side of hemiplegia ($p=0.59$). Both groups received four MT sessions (4.00 and 4.17 respectively) and there was no significant difference between the two groups in terms of number of sessions received ($p=1$), as shown in table 4.2.1.

It can therefore be noted that apart from the different levels of VdTMoCA, the two groups were similar in terms of their demographic details and MT intervention received.

5.3 Self-differentiation and self-presentation groups improvement in function after mirror therapy

5.3.1 Improvement in mental impairments

The results of this study for improvement in upper limb motor function in the self-differentiation group have shown a significant difference (p-value= 0.016) over all APOM domains after participants received MT, as shown in table 4.3.1.

Participants in the self-presentation group had higher mental functioning than the self-differentiation group on their baseline assessment, as expected according to VdTMoCA. However, their mental abilities were still severe enough to consider them excluded from the current MT protocols(6)(7)(14)(40). The results of this study had shown a significant p-value of 0.013 in four domains namely, process skills, motivation, self-esteem and affect, as shown in table 4.4.1.

This study has shown that MT has an effect on stroke survivors with mental impairments and the tool can therefore be considered with this population. Despite the physical benefits having an insignificant p-value for both groups, as shown in tables 4.3.2 and 4.4.2, studies have shown a strong link between cognitive improvement and motor control improvement. Thus, the results of this study show a large effect size and therefore clinical significant motor improvement within both groups after receiving MT, as seen in tables 4.3.5 and 4.4.5. It can thus be hypothesized that longer use of the tool with this population would have cognitive improvement effects initially, and motor control improvement thereafter(4)(10)(8)(35)(36)(37).

This study has highlighted that MT had an effect on mental impairments such as processing skills which include components such as: attention span, processing speed, basic concepts and problem solving. It also included domains such as self-esteem and motivation. Interestingly, all domains had the same significant p-value (0.016) as seen in table 4.3.1. These domains included communication, role balance, balanced lifestyle and affect. Role balance and balanced lifestyle was considered within the hospital setting. Participants were initially observed to take on a passive patient role within the wards and would not initiate any tasks, would rely on nurses to perform all tasks for them and slept the reminder of the time. Often, these participants had limited speech, or would say very little and had a limited affect. After receiving MT, it was noted that participants would eagerly wait for their next session, which was usually later in the day or the following day. They began assisting with organising space for the mirror box, assisting with in-bed mobility such as rolling and sitting up, either over the edge of the bed or in long sitting. Participants would spontaneously smile and laugh when they had made a good connection and response within MT and experienced the

sensation of the affected limb moving. Participants began asking questions about the stroke and their recovery and taking an active role in trying to understand what had happened to them and hoping for an improvement in the future.

Research has shown that stroke survivors are at risk of developing post stroke depression at any point in the recovery and rehabilitative processes. Often survivors do present with low mood in the acute stages as they have been informed about their injury and they are seeking further information. Due to a variety of factors, survivors take on the sick role and do not play an active part in their recovery while in hospital. This could be due to still feeling unwell from the stroke, dealing with the diagnosis of a stroke, and mental impairments which leave them feeling confused, frustrated and overwhelmed(4)(10)(8)(35)(36)(37).

MT creates an environment where the patient feels they are in control. They begin believing that the affected limb can work again, and they begin to take on an active role in their recovery process. These elements are some of the principles required for neuroplasticity to occur and the earlier they develop these skills, the better(6)(7)(14)(16)(24)(25)(40).

Currently, within the occupational therapy profession, there is very limited guidance regarding the treatment or stimulation of mental impairments post stroke, especially on an acute level. Research has shown that spontaneous recovery can occur however, research is lacking and contradictive as to which specific mental impairments have the potential to improve, which impairments are mostly seen to undergo spontaneous recovery and which impairments have a poor prognosis of improvement(4)(10)(8)(35)(36)(37).

In previous studies, MT has been used mainly to address physical, sensory and visuospatial impairments in specifically stroke survivors(6)(7)(14)(40). Furthermore, survivors were only considered suitable for MT if they had sufficient mental abilities(6)(7)(14)(40). There has not been a study where a change in mental ability was measured after receiving MT. Due to the study sample and context, intervention time was short, and the sample size was small. However, this was to be expected when aiming to perform a study on acute stroke survivors who are still inpatients within the hospital. Furthermore, specifically stroke survivors with significant mental impairments. This study however, could be the basis to a larger study where acute stroke survivors receive MT for an extended period of time (5-6 weeks) as recommended in current protocols, as inpatients and outpatients(6)(7)(14)(40). The study could also be extended to including chronic stroke survivors with mental impairments and poor motor control, as MT studies have been shown to be effective even in the chronic stroke population.

For the occupational therapy profession, this study has indicated the worthiness of MT within the stroke population and its use can be expanded to a wider population. Occupational

therapists have limited resources to address mental impairments during the acute, inpatient phase. Furthermore, there is pressure to improve the physical components which require, to an extent, also addressing the mental components(3)(11)(20)(23). This scenario can be overwhelming, and a debate is often raised regarding what components to begin with and what is the best for the patient. The current study thus shows potential for an intervention tool which could be effective in improving mental impairments and can thereafter be used to address the physical components. This tool promotes neuroplasticity in terms of cortical reorganisation, maintaining the motor and sensory cortices and homunculi of the affected limbs(6)(7)(14)(16)(24)(25)(40). This is important when beginning motor control techniques as these factors can be considered a pre-requisite. This also assists therapists in delaying learned non-use as patients are being treated and made aware that the affected limb will be included in tasks with any movement present. The improvement in motivation, processing skills and self-esteem are the building blocks to a good functional prognosis. If this can be addressed as early as possible, as stroke survivors are afforded an opportunity at recovery(16)(24)(25)(31).

5.3.2 Improvement in upper limb function

Participants in both groups had shown an insignificant p-value, as shown in tables 4.3.2 and 4.4.2. However, there were significant effect sizes which showed clinical significance in motor improvements within both groups, in all three domains of the Fugl-Meyer Assessment, as shown in tables 4.3.5 and 4.4.5.

According to the available literature, the following factors have been suggested for consideration when determining the functional prognosis of a stroke survivor: urinary and bowel incontinence, the presence of perceptual impairments, previous strokes and patients with advanced age. These factors have been shown to have a poor functional prognosis in patients who presented with more than one factor on admission. Other prognostic factors which can be considered are: the support received from the patient at home and in the community post discharge, accessibility to medical care, the survivor's motivation and compliancy as well as the survivor's response to neuroplasticity techniques and principles(23)(12)(29).

These can be used as a guideline with clinicians as these signs in survivors will indicate that the rehabilitative approach will need to be considered from early stages of the recovery process(28). Stroke survivors who are placed on the self-differentiation and self-presentation levels of VdTMoCA would be considered having poor prognostic indicators as they present with mental impairments, low motivation and poor response to neuroplasticity techniques as treatment techniques are limited with these groups(23)(12)(29). This would indicate to

clinicians that a rehabilitative approach, using compensatory and adapted techniques of recovery should be implemented.

However, the use of MT with these two groups of participants has taken on a therapeutic approach, which would not be considered as literature states otherwise. MT makes use of a number of neuroplasticity techniques and the results of this study have shown that this tool has a positive effect on mental improvements as well as motor impairments after stroke. Therefore, a change in prognostic factors within the acute phase of stroke recovery would indicate that these participants would fall within the group of survivors who have a fair functional prognosis, as is according to literature. With an improvement in motor function, these survivors have improved from no movement to movement of the affected upper limb and hand which would be considered as a better functional prognosis, which includes movements such finger flexion and extension(30). If only four sessions of MT can have such an impact on improving mental and motor impairments within the more severe range of stroke survivors, this would place a larger amount of the stroke population within the therapeutic phase of treatment where improving the affected limbs will be of priority. This information within the South African context is of much value, as often due to lack of resources and the multifaceted health challenges, many stroke survivors face a poor functional prognosis(23)(12)(29). However, MT is a tool which is showing to be effective in improving these impairments in a group of stroke survivors which has been considered to be incapable of this improvement for a variety of reasons, possibly one being a lack of effective tools. Due to the combination of VdTMoCA and MT, along with all their treatment principles, mental impairments and physical impairments are being addressed simultaneously which resonates with neuroplasticity principles and therefore an improvement in these areas.

This study is unique to other MT studies previously performed within the stroke population as the standardised protocol used was adapted using VdTMoCA principles. Occupational therapists are equipped with the ability to adapt any tasks according to the requirements of the patient, and this includes physical, mental and psychosocial components. Specifically looking at the self-differentiation and self-presentation groups of VdTMoCA, MT was adapted according to their attention spans, task concept, processing speed, ability to follow instructions, motivation, self-esteem and engagement with the environment and others in the environment. When considering the self-differentiation group, which is the group which presents with more severe mental impairments, the following changes were made. Participants had two to three MT sessions of an average of ten minutes long(1). They were given the opportunity to engage in the task in an incidental manner with guidance from the researcher in reinforcing the idea that both upper limbs and hands work(1). As expected, participants did not show much reaction to the feedback given however, it was interesting to

see how intrigued they were in the idea of looking into the mirror and copying movements as well as experiencing passive movements with the guidance of the researcher. Participants paid full attention and sustained it for five to ten minutes, which was longer than engagement in any other functional task (which they perceived more as a basic need rather than an interesting task)(1). There was no pressure placed on participants in this group to follow specific instructions or adapt according to feedback but only to interact with the mirror and believe that both upper limbs and hands worked. Participants responded well and an improvement in mental impairments was noted, which included an improved attention span, developing a task concept, following instructions to name a few, which had then placed them on the next level of VdTMoCA which is self-presentation.

When working with the participants in the self-presentation group, they are expected to engage in a task in an explorative manner(1). Patients on this level are generally considered to be more willing to interact with objects and require guidance in order to perform the task correctly(1). They are able to correct errors with feedback and have some elements of task concept. Participants on this level coped with a maximum of 20-minute sessions of MT in the day(1). They were able to copy movements in the mirror and even continue independently with these movements under supervision. These participants were also keen on seeing their affected upper limb and hand after MT to see if it worked as well as what they had seen in the mirror. The idea that it was not working was confusing and sometimes upsetting however, when some movement was seen thereafter or a change in sensation was felt, participants responded well.

General activity requirements when using VdTMoCA is that: activities have a variety of materials and tools, there is a definite end product and instructions should be available(1). The use of the mirror box, sensory materials such as the hedgehog ball, different brushed and feathers was used to make the illusion more intense as well as address sensory impairments. Verbal instructions with demonstrations, bilateral passive movements and manual guidance was provided and the end product or result was the achievement of experiencing the illusion and improving motor and sensory impairments.

As current literature states, MT has a positive result on motor improvement within the stroke population when using it over a five to six week period and with the recommended patient criteria(6)(7)(14)(40). However, this study has shown that it can be effective in two new ways, which have not been previously considered. Firstly, MT is effective in improving mental impairments within the stroke population and secondly it can be extended to use with patients who have more severe mental impairments, who are usually excluded from receiving MT. This

has the potential to address a larger number of the stroke population and improving mental and motor impairments.

The South African stroke survivor population has expanded to include a younger group of patients who are the main breadwinners of their families. This adds to the dynamic of stroke rehabilitation as there is an added pressure of return to work along with the usual functional activities(3)(11)(20). Therefore, the need for an effective treatment technique which can be used in various stages of rehabilitation, and with a wider group of stroke survivors at a cost-effective price is a serious requirement, and MT meets these criteria. Mirror boxes can be made from any re-usable material and the training is not expensive. Often the technique is taught by senior staff and supervisors and a standardised protocol, specific to occupational therapy which includes VdTMoCA would make this learning process even easier. This study has shown an improvement within four sessions, which indicates its effectiveness with the more severe stroke impairments. It stimulates neuroplasticity principles and VdTMoCA principles within the acute stages therefore changing patient's functional prognosis from poor to fair. It focuses on negative impairments of stroke rehabilitation which is in line with recent stroke literature and research findings.

MT is in line with neuroplasticity principles which is indicative of long-lasting and effective rehabilitation in mental and physical impairments. "Use it or lose it" is implemented as MT focuses on the use of the affected upper limb and hand and stimulates neural circuits with the activation and stimulation of mirror neurons. This further delays the development of learned non-use and keeps the prestrike motor and sensory homunculi intact as opposed to the homunculi changing as a result of learned non-use of the affected upper limb and hand(16)(24)(25).

"Use it and improve it" is implemented in MT as there is specific training performed on the affected upper limb and hand which is separate to simply encouraging functional use of the affected limb. MT focuses on specific movements which are required for efficient functional involvement of the affected upper limb and hand. This includes basic movements such as wrist flexion and extension, forearm pronation and supination, finger flexion and extension. It can then be upgraded to including objects used in functional tasks such as cups, spoons, brushes (which all require different grasps and pinches)(16)(24)(25).

MT protocols require that movements are repeated before a new movement is introduced as this further reinforces the neural circuitry stimulation and contributes towards cortical reorganisation and neuroplasticity. Repetition is an important neuroplasticity principle and MT protocols have incorporated it well into therapy(16)(24)(25).

MT is repetitive, and this may not necessarily be considered intense however, when considering a survivor on a low level of VdTMoCA with little or no motor control, sustaining concentration to maintain the illusion of a functional hand and upper limb can be challenging. Furthermore, gaining partial movements in a severely affected upper limb and hand and repeating the movement to ensure it is consistent is intense. This study has shown that as the results over only four sessions have been positive.

Participants on both self-differentiation and self-presentation levels of VdTMoCA responded well to receiving MT and looked forward to the next session. Often, participants on the self-presentation level would provide feedback at the beginning of the next session of how they practiced motor imagery techniques and the movements gained in previous sessions. They took on an active role in sessions and began initiating MT and practicing movements which were important to them. This would indicate that, when considering VdTMoCA and MT principles, salience is a neuroplasticity principle which is also incorporated into this treatment tool. Salience emerged after a few sessions in both groups, as even the self-differentiation participants found it easier to engage in the task after the first or second session. Salience was well observed within the self-presentation group as they made MT sessions their own and began forming their own goals, as well as continuing with repetition of movements outside of MT sessions(16)(24)(25).

As research has indicated there are numerous challenges to stroke rehabilitation within the South African context. Due to this, medical professionals are very reliant on the use of prognostic indicators in determining the length of hospital stay, admission to rehabilitation facilities and the treatment approach used in therapy. Inpatient stroke survivors are often discharged as soon as they are stable and this can include anything from two to ten days(3)(11)(20). Within that time, occupational therapists are expected to prepare the survivor for returning home or to a rehabilitation facility. The context of South Africa, is one in which majority of the population have some form of family responsibility and a stroke cannot get in the way of that(3)(11)(20). This often leads to survivors quickly developing compensatory techniques which enable them to return to their responsibilities sooner. However, the quality and efficiency when performing these tasks often suffer and little function is returned to the affected limb(3)(11)(20). MT provides therapists with an effective and low-cost tool which can be used on acute inpatient survivors whom have varying levels of mental impairments. The use of this tool has shown to be effective within four sessions, in which an improvement in mental and physical impairments are seen. The use of neuroplasticity techniques is also implemented to ensure that the changes seen are long term. These long-term effects allow for delayed loss to the sensory and motor homunculi, and development of learned non-use. It further provides better prognostic indicators to the survivor and can be carried over into the

home environment for the survivor to continue with. Currently, it is the most ideal tool for this context(16)(24)(25)(26).

5.4 Comparison between degree of improvement in the two groups

One of the objectives of this study was to determine at which level of VdTMoCA (Self-differentiation or Self-presentation), the use of MT would be the most effective in the treatment of upper limb motor function in stroke survivors (determined by the Fugl-Meyer Assessment). There was no significant difference in the amount of improvement between the two groups as displayed in table 4.5.1.

We would expect the participants in self-differentiation group to not improve as much as the participants in the self-presentation group, due to the link of the level of cognitive impairments of patients in this group with poor prognostic indicators. However, this study has shown that MT adapted using VdTMoCA principles makes a difference and patients on this level should not be excluded in the therapeutic approach of stroke rehabilitation. The results show an improvement in both groups motor and mental impairments are indicative that MT can be effective if it is adapted to the survivor's level of functioning. Therefore, occupational therapists are able to adapt MT sessions accordingly to be most effective to the survivor when including VdTMoCA principles to address the mental impairments.

The lowest level of the VdTMoCA is the tone level and usually stroke survivors placed on this level are medically unstable, with varying levels of low consciousness. They often require special medical care and do not always require occupational therapy rehabilitative services until stable. Therefore, self-differentiation and self-presentation levels can be considered the lowest levels of VdTMoCA which could be considered for rehabilitative services. The participants were all inpatients at Sebokeng Hospital receiving standard therapy services. Thus, there were no external factors which could be cause for the changes established in motor and mental functioning. Furthermore, it was noted that all participants displayed some kind of improvement within the four sessions, either mental, physical or both. Participants were also assessed before and after each session to ensure that changes seen were within sessions, which reinforces the effectiveness of this tool.

5.5 Correlation between level of VdTMoCA score on the APOM and upper limb function improvement according to the Fugl-Meyer Assessment

Self-esteem and motivation were the two domains from the APOM which had a moderate correlation with improvement of the affected upper limb after participants received MT, as

shown in table 4.6.2. When referring back to neuroplasticity principles, patients' motivation is one of the components which are considered important for neuroplasticity to occur(16)(24)(25). According to the APOM tool, motivation consists of the patient showing: active involvement, motives and drives, shows interest, goal directed behaviour and locus of control. Self-esteem consists of: commitment to a task, using feedback, self-worth, attitude towards self, self-assurance, awareness of qualities and social presence(1)(2)(38)(39).

Participants' ability to commit to the MT tasks and use feedback of the therapist and mirror are also important factors in any neuro-rehabilitative techniques(31). There is contradicting evidence regarding psychosocial and cognitive impairments after stroke and spontaneous recovery as opposed to therapeutic techniques. However, stroke survivors are at a high risk of developing post stroke depression and it could be considered normal for survivors to experience periods of low moods as a result of the loss they are experiencing(6)(7)(14)(16)(24)(25)(40). Therefore, it is interesting that MT had a positive effect and correlation on these components. The active involvement of the survivor and the training using an illusion of a well-functioning hand could be possible contributions to this finding. However, further research with a larger sample size and over a longer period of time would be required. It would be interesting to see if the mental improvements have a long term effect as found with the motor improvements(4)(12)(35)(41).

An improvement in these components in acute survivors with significant mental impairments is of high importance to stroke rehabilitation, especially occupational therapy, as mental impairments are within occupational therapy scope of practice. Occupational therapists are ideally situated to make use of this tool in a more holistic manner as the core principles of occupational therapy is a holistic patient approach where a variety of multiple systems have an effect on one another as in the dynamical systems theory. Therefore, if the tool can be used to improve motor functioning by improving mental impairments in severely affected strokes, occupational therapists would be the most equipped to handle this. With the use of the VdTMoCA, occupational therapists will be able to adapt the approach of MT, the activity analysis included in MT, the appropriate time for each session and how to best provide instructions and feedback in order to ensure that this is an effective tool to be used with varying mental impairments, as was performed in this study.

5.6 Limitations of study

The study findings and conclusions were limited by the following factors:

The sample size was limited to 13 participants. This was expected in the study as the MT protocol was administered by the researcher alone due to a lack of funding and lack of therapists trained in the use of APOM and MT within the public hospital used. The data collection period was set at a specific length and all participants who were applicable for the study were included within that time. Furthermore, statistics from the hospitals had shown an acute inpatient admission of seven to ten survivors per month with severe physical impairments and it was expected not all these survivors would present with the lower levels of VdTMoCA required for the study. The exclusion criteria of the study thus limited the number of patients used during the data collection period.

Of the total participants, 62% presented with a right stroke which research has shown to present with more cognitive and visuospatial impairments. However, there has been no studies showing that MT cannot be used with this group of strokes. Due to the small sample size, data was not analysed for each affected side subgroups and therefore conclusions cannot be made based on the side of the lesion.

The intervention time for MT was four sessions per participant, over a two to four day period, which is realistic to the South African context. The pressures of short inpatient stay and therapists lacking appropriate time and resources to be effective in this short time span. However, the results have shown sufficient improvement within that short time span and so lays the basis for furthermore intense research with the population of stroke survivors.

5.7 Conclusion to discussion chapter

This discussion has highlighted that MT is effective in the acute stroke survivor who presents with more severe mental impairments as well as motor impairments. This specific group of stroke survivors have not been considered for MT in the past, however, within only four sessions, an improvement in mental impairments, as according to the APOM tool, has been noticed. The results have also shown a clinical significance in the improvement in motor impairments in both groups after MT was administered. Within the South African context, the pressure on therapists to make a meaningful difference on inpatient stroke survivors is high as survivors are being discharged under the supervision of community clinics, rehabilitation hospitals or outpatient therapy within both the private and public sectors(3)(11)(20). Survivors who are not immediately transferred to rehabilitation hospitals are at high risk of developing

learned non-use of the affected upper limb, purely as a means of survival(23)(12)(29). Often survivors have their own social pressures which include work, taking care of families and running households. With few treatment sessions and the urgency to return to independence in daily living as soon as possible, learned non-use and compensatory techniques could triumph(3)(11)(20)(23)(12)(29). However, if the survivor has an idea from as early as an inpatient, that the affected limb has the potential of recovery and neuroplasticity techniques are implemented from this early stage, there is a possibility of limiting learned non-use and reducing stroke impairments.

CHAPTER 6: CONCLUSION

6.1 Conclusions to objectives

This study has shown that the use of MT has not been explored to its full capacity and that a larger number of the stroke population could benefit from the benefits of this technique. Furthermore, this study has reinforced the benefits of VdTMoCA treatment principles when attempting to engage a stroke survivor with mental impairments in any task. This study had three objectives which will be discussed and concluded in this chapter.

The first objective was to determine the improvement in upper limb motor function (determined by the Fugl-Meyer Assessment) in stroke survivors on two levels of VdTMoCA (Self-differentiation and Self-presentation) after the implementation of MT. Generally, stroke survivors placed on these two levels of the VdTMoCA present with impaired cognitive skills, motivation and self-esteem. This would therefore exclude them from MT as recommended in MT protocols. When considering survivors in these two groups within the acute phase of recovery, literature has indicated that an effective treatment modality is lacking and often due to the severe mental impairments along with physical impairments and social contexts, these survivors are considered to have a poor prognosis. These further leads therapists to incorporate a rehabilitative approach in the few days of the survivor's hospital stay where compensatory techniques are taught. This reinforces learned non-use and the functional prognosis of the affected upper limb is further worsened as no neuroplasticity techniques are attempted to alleviate impairments of the affected limb(3)(11)(20)(23)(12)(29). This current study has shown an improvement in upper limb motor function in stroke survivors on both levels of the VdTMoCA included in the study. Large to very large effect sizes were found and both groups displayed improvement in all three sections of the Fugl-Meyer Assessment, as shown in tables 4.3.5 and 4.4.5. Over and above the initial objective of the study, results had also shown an improvement in mental impairments, according to the APOM after participants received MT, as shown in tables 4.3.1, 4.3.4, 4.4.1 and 4.4.4.

The second objective of the study was to determine at which level of VdTMoCA (Self-differentiation or Self-presentation) the use of MT would be the most effective in the treatment of upper limb motor function in stroke survivors (determined by the Fugl-Meyer Assessment). It was expected that the self-presentation group would perform better than the self-differentiation group due to the differences in mental abilities. It was shown however that there was no significant difference between the two groups in the improvements seen, as shown in table 4.5.1 (p-value = 0.17). This could be as a result of adapting the MT task appropriately to

the needs of each group in terms of VdTMoCA principles, which enabled participants to engage in an appropriately structured and guided manner which facilitated neuroplasticity techniques through MT.

The third objective of the study was to determine whether there is an association between the level of VdTMoCA scores on the APOM, according to levels of Self-differentiation and Self-presentation, and improvement in scores for upper limb motor function in stroke survivors (determined by the Fugl-Meyer Assessment) after implementing MT. The results of the study, as shown in table 4.6.2, displayed that life skills had a moderate correlation with the improvement in wrist function(r=0.36). Motivation had a moderate correlation with the improvement in wrist function (r=0.33) and hand function (r=0.37). Self-esteem was moderately correlated with wrist function (r=0.32) and hand function (r=0.30). Motivation and salience (which can be seen in life skills) are important neuroplasticity principles to consider. This study has reinforced that these factors do play an essential role in stroke rehabilitation and appear to be significant especially when treating this group of stroke survivors.

It can be concluded that MT is effective in improving mental and physical impairments in stroke survivors who present with more severe mental impairments. MT can be used over shorter sessions while patients are acute and are still inpatients at hospital. Stroke survivors who are usually considered to have a poor functional prognosis should have an opportunity to participate in tasks which meet neuroplasticity principles, as this study has shown that they are capable of improving their mental and motor abilities within only four sessions of MT. This will allow for a fair to good functional prognosis and lay down the foundation for more effective therapy as survivors approach the sub-acute phase of recovery. If survivors receive effective therapy from early acute phases, this may have a positive impact on return to work for the younger stroke population as well as empower older patients who still have family and community responsibilities. This may lessen the burden of care within communities and decrease the high number of stroke disability in chronic stroke survivors(3)(11)(20)(23)(12)(29).

6.2 Recommendations for future research

As this study has shown improvement in mental and motor impairments within the self-differentiation and self-presentation groups of VdTMoCA after receiving MT while in hospital. It is recommended that further studies are performed with these groups of stroke survivors within the sub-acute and chronic phases. The study should also be performed over a longer time period of five to six weeks and with a larger sample size.

This research has also laid the foundation for more specific research into MT and use of VdTMoCA principles with the stroke population and it would be relevant to ascertain whether

survivors with right sided strokes respond differently to MT than those with left sided strokes. As the results of this study indicate that MT can be expanded in its uses, a standardised MT protocol implementing VdTMoCA principles needs to be established within the occupational therapy profession.

6.3 Recommendations for clinical practice

This study has indicated that MT is an effective tool within stroke rehabilitation within survivors placed on the self-differentiation and self-presentation levels of the VdTMoCA. It would be recommended to be used with acute inpatient stroke survivors in conjunction with standard hospital protocol with regards to occupational therapy treatment. It could be expanded to sub-acute and chronic survivors as current literature supports the use of MT in these phases of treatment.

REFERENCES

1. de Witt P. Chapter 1: Creative ability: a model for psychosocial occupational therapy. In: Occupational Therapy In Psychiatry and Mental Health, 4th Edition. 2005. p. 1–6.

2. Du Toit V. Patient Volition and Action in Occupational Therapy. 2nd ed. Johannesburg: Vona and Marie du Toit Foundation; 1991.

3. Bryer A, Connor MD, Haug P, Cheyip B, Staub H, Tipping B, et al. South African guideline for management of ischaemic Stroke and transient ischaemic attack 2010: a guideline from the South African Stroke Society(SASS) and the SASS Writing Committee. SAMJ South African Med J [Internet]. 2010;100(11):750–78. Available from: http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S0256-95742010001100022&lng=en&nrm=iso&tlng=en

4. Mercier L, Audet T, Hébert R, Rochette a, Dubois MF. Impact of motor, cognitive, and perceptual disorders on ability to perform activities of daily living after stroke. Stroke. 2001;32(11):2602–8.

5. Sacco RL, Kasner SE, Broderick JP, Caplan LR, Connors JJ, Culebras A, et al. An updated definition of stroke for the 21st century: A statement for healthcare professionals from the American heart association/American stroke association. Stroke. 2013;44(7):2064–89.

6. Manuscript A, Shimodozono M, Noma T, Nomoto Y, Hisamatsu N, Kamada K, et al. Mirror therapy for patients with severe arm paresis after stroke - a randomized controlled trial. Clin Rehabil [Internet]. 2012;44(4):146–54. Available from: http://dx.doi.org/10.1016/j.apmr.2012.07.022%5Cnhttp://nnr.sagepub.com/cgi/doi/10.1177/1545968312465896

7. Lee MM, Cho H-Y, Song CH. The Mirror Therapy Program Enhances Upper-Limb Motor Recovery and Motor Function in Acute Stroke Patients. Am J Phys Med Rehabil [Internet]. 2012;91(8):689–700. Available from: http://www.ncbi.nlm.nih.gov/pubmed/22469877

8. Brown T, Mapleston J, Nairn A, Molloy A. Relationship of Cognitive and Perceptual Abilities to Functional Independence in Adults Who Have Had a Stroke. Occup Ther Int. 2013;20(1):11–22.

9. Al-Qazzaz NK, Ali SH, Ahmad SA, Islam S, Mohamad K. Cognitive impairment and memory dysfunction after a stroke diagnosis: A post-stroke memory assessment. Neuropsychiatr Dis Treat. 2014;10:1677–91.

10. Cumming TB, Marshall RS, Lazar RM. Stroke, cognitive deficits, and rehabilitation: Still an incomplete picture. Int J Stroke. 2013;8(1):38–45.

11. Cawood J, Visagie S, Mji G. Impact of post-stroke impairments on activities and participation as experienced by stroke survivors in a Western Cape setting. South African J Occup Ther. 2016;46(2):10–5.

12. Hendricks HT, Van Limbeek J, Geurts AC, Zwarts MJ. Motor recovery after stroke: A systematic review of the literature. Arch Phys Med Rehabil. 2002;83(11):1629–37.

13. Wasserman S, Villiers L De, Bryer A. Community-based care of stroke patients in a rural African setting. SAMJ South African Med … [Internet]. 2009;99(8):579–83. Available from: http://www.scielo.org.za/scielo.php?pid=S0256-95742009000800015&script=sci_arttext

14. Genius J, Roß S, Uhr S, Braun S, Rothgangel A, Verlag P. Practical Protocol for Stroke Rehabilitation. 2013;

15. Ezendam D, Bongers RM, Jannink MJ. Systematic review of the effectiveness of mirror therapy in upper extremity function. Disabil Rehabil. 2009;31(26):2135–49.

16. Kleim J a, Jones T a. Principles of experience-dependent neural plasticity: implications for rehabilitation after brain damage. J Speech Lang Hear Res [Internet]. 2008;51(1):S225-39. Available from: http://jslhr.pubs.asha.org/article.aspx?articleid=1773394

17. Krishnamurthi R V., Feigin VL, Forouzanfar MH, Mensah GA, Connor M, Bennett DA, et al. Global and regional burden of first-ever ischaemic and haemorrhagic stroke during 1990-2010: Findings from the Global Burden of Disease Study 2010. Lancet Glob Heal [Internet]. 2013;1(5):e259–81. Available from: http://dx.doi.org/10.1016/S2214-109X(13)70089-5

18. Giroud M, Jacquin A, Béjot Y. The worldwide landscape of stroke in the 21st century. Lancet. 2014;383(9913):195–7.

19. Hankey GJ. The global and regional burden of stroke. Lancet Glob Heal [Internet]. 2013;1(5):e239–40. Available from: http://dx.doi.org/10.1016/S2214-109X(13)70095-0

20. L. de V, M. B, M. F. Stroke outcomes in a socio-economically disadvantaged urban community. South African Med J [Internet]. 2011;101(5):345–8. Available from: http://www.samj.org.za/index.php/samj/article/view/4588/3209%5Cnhttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emed10&NEWS=N&AN=2011290306

21. Meijer R, Ihnenfeldt DS, de Groot IJM, van Limbeek J, Vermeulen M, de Haan RJ.

Prognostic factors for ambulation and activities of daily living in the subacute phase after stroke. A systematic review of the literature. Clin Rehabil. 2003;17(2):119–29.

22. Jongbloed L. Prediction of function after stroke: a critical review. Stroke. 1986;17(4):765–76.

23. Kagee A, Le Roux M, Dick J. Treatment adherence among primary care patients in a historically disadvantaged community in South Africa: a qualitative study. J Health Psychol. 2007;12(3):444–60.

24. Hallett M. Plasticity of the human motor cortex and recovery from stroke. Brain Res Brain Res Rev [Internet]. 2001;36(2–3):169–74. Available from: http://www.ncbi.nlm.nih.gov/pubmed/11690613

25. Chen, Haiwen; Epstein, Jane; Stern E. Neural Plasticity After Acquired Brain Injury: Evidence from Functional Neuroimaging. Am Acad Phys Med Rehabil. 2010;2(12s):306–11.

26. Pekna M, Pekny M, Nilsson M. Modulation of neural plasticity as a basis for stroke rehabilitation. Stroke. 2012;43(10):2819–28.

27. Sabari J. Chapter 23: Optimizing Motor Skill Using Task-Related Training. In: Occupational Therapy for Physical Dysfunction, sixth edition. 2008. p. 618–40.

28. Kwakkel, Gert; Kollen, BJ; Wagenaar R. Therapy Impact on Functional in Stroke Rehabilitation. Physiotherapy. 1999;85(7):377–80.

29. Gillen R, Tennen H, McKee TE, Gernert-Dott P, Affleck G. Depressive symptoms and history of depression predict rehabilitation efficiency in stroke patients. Arch Phys Med Rehabil. 2001;82(12):1645–9.

30. Snickars J, Persson HC, Sunnerhagen KS. Early clinical predictors of motor function in the upper extremity one month post-stroke. J Rehabil Med. 2017;49(3):216–22.

31. Ada, Louise and Canning C. Chapter 5: Changing the way we view the contribution of motor impairments to physical disability after stroke. In: Science-Based Rehabilitation: Theories into Practice. 2005. p. 87–103.

32. Gladstone DJ, Danells CJ, Black SE. The fugl-meyer assessment of motor recovery after stroke: a critical review of its measurement properties. Neurorehabil Neural Repair. 2002;16(3):232–40.

33. Carr JH, Shepherd RB, Nordholm L, Lynne D. Investigation of a new motor assessment scale for stroke patients. Phys Ther. 1985;65(2):175–80.

34. Lincoln NB, Jackson J, Adams S. Reliability and Revision of the Nottingham Sensory Assessment for Stroke Patients Reliability and Revision of the Nottingham Sensory Assessment for Stroke Patients. Physiotherapy. 1998;84(8):358–65.

35. Hachinski V, Iadecola C, Petersen RC, Breteler MM, Nyenhuis DL, Black SE, et al. National Institute of Neurological Disorders and Stroke-Canadian Stroke Network vascular cognitive impairment harmonization standards. Stroke. 2006;37(9):2220–41.

36. Leśniak M, Bak T, Czepiel W, Seniów J, Członkowska A. Frequency and prognostic value of cognitive disorders in stroke patients. Dement Geriatr Cogn Disord. 2008;26(4):356–63.

37. Haghgoo HA, Pazuki ES, Hosseini AS, Rassa M. Depression, Activities of Daily Living and Quality of Life in Patients with Stroke. J Neurol Sci. 2013;328:87–91.

38. Daleen C. Development of an outcome measure for occupational therapists in mental health care settings [Internet]. University of Pretoria; 2011. Available from: http://hdl.handle.net/2263/28019

39. Crouch, Rosemary; Alers V. Occupational Therapy in Psychiatry and Mental Health, fourth edition. 2005. 3-20 p.

40. Dohle C, Püllen J, Nakaten A, Küst J, Rietz C, Karbe H. Mirror Therapy Promotes Recovery From Severe. Neurorehabil Neural Repair. 2009;23(Cd):209–17.

41. Kleim, Jeffrey a; Jones T. Principles of Experience-Dependent Neural Plasticity: Implications for Rehabilitation After Brain Damage. J Speech Lang Hear Res. 2008;51:225–39.

42. Rehabilitation Measures Database [Internet]. [cited 2016 Aug 10]. Available from: http://www.rehabmeasures.org/Lists/RehabMeasures/DispForm.aspx?ID=908

43. Robert C. It's the Effect Size, Stupid. What effect size is and why it is important. Paper presented at the Annual Conference of the British Educational Research Association, University of Exeter, England, 12-14 September 2002

APPENDICES

Appendix A: Fugl-Meyer assessment form

FMA-UE PROTOCOL

Rehabilitation Medicine, University of Gothenburg

FUGL-MEYER ASSESSMENT
UPPER EXTREMITY (FMA-UE)
Assessment of sensorimotor function

ID:
Date:
Examiner:

Fugl-Meyer AR, Jaasko L, Leyman I, Olsson S, Steglind S: The post-stroke hemiplegic patient. A method for evaluation of physical performance. Scand J Rehabil Med 1975, 7:13-31.

A. UPPER EXTREMITY, sitting position					
I. Reflex activity			**none**	**can be elicited**	
Flexors: biceps and finger flexors (at least one) **Extensors**: triceps			0 0	2 2	
Subtotal I (max 4)					
II. Volitional movement within synergies, without gravitational help			**none**	**partial**	**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). **Extensor synergy:** Hand from ipsilateral ear to the contralateral knee	Shoulder Elbow Forearm	retraction elevation abduction (90°) external rotation flexion supination	0 0 0 0 0 0	1 1 1 1 1 1	2 2 2 2 2 2
	Shoulder Elbow Forearm	adduction/internal rotation extension pronation	0 0 0	1 1 1	2 2 2
Subtotal II (max 18)					
III. Volitional movement mixing synergies, without compensation			**none**	**partial**	**full**
Hand to lumbar spine hand on lap	cannot perform or hand in front of ant-sup iliac spine hand behind ant-sup iliac spine (without compensation) hand to lumbar spine (without compensation)		0	1	2
Shoulder flexion 0°- 90° elbow at 0° pronation-supination 0°	immediate abduction or elbow flexion abduction or elbow flexion during movement flexion 90°, no shoulder abduction or elbow flexion		0	1	2
Pronation-supination elbow at 90° shoulder at 0°	no pronation/supination, starting position impossible limited pronation/supination, maintains starting position full pronation/supination, maintains starting position		0	1	2
Subtotal III (max 6)					
IV. Volitional movement with little or no synergy			**none**	**partial**	**full**
Shoulder abduction 0 - 90° elbow at 0° forearm pronated	immediate supination or elbow flexion supination or elbow flexion during movement abduction 90°, maintains extension and pronation		0	1	2
Shoulder flexion 90° - 180° elbow at 0° pronation-supination 0°	immediate abduction or elbow flexion abduction or elbow flexion during movement flexion 180°, no shoulder abduction or elbow flexion		0	1	2
Pronation/supination elbow at 0° shoulder at 30°- 90° flexion	no pronation/supination, starting position impossible limited pronation/supination, maintains start position full pronation/supination, maintains starting position		0	1	2
Subtotal IV (max 6)					
V. Normal reflex activity assessed only if full score of 6 points is achieved in part IV; compare with the unaffected side			**0 (IV), hyper**	**lively**	**normal**
biceps, triceps, finger flexors	2 of 3 reflexes markedly hyperactive or 0 points in part IV 1 reflex markedly hyperactive or at least 2 reflexes lively maximum of 1 reflex lively, none hyperactive		0	1	2
Subtotal V (max 2)					
Total A (max 36)					

Approved by Fugl-Meyer AR 2010 1 Updated 2015-03-11

B. WRIST support may be provided at the elbow to take or hold the starting position, no support at wrist, check the passive range of motion prior testing		none	partial	full
Stability at 15° dorsiflexion elbow at 90°, forearm pronated shoulder at 0°	less than 15° active dorsiflexion dorsiflexion 15°, no resistance tolerated maintains dorsiflexion against resistance	0	1	2
Repeated dorsifexion / volar flexion elbow at 90°, forearm pronated shoulder at 0°, slight finger flexion	cannot perform volitionally limited active range of motion full active range of motion, smoothly	0	1	2
Stability at 15° dorsiflexion elbow at 0°, forearm pronated slight shoulder flexion/abduction	less than 15° active dorsiflexion dorsiflexion 15°, no resistance tolerated maintains dorsiflexion against resistance	0	1	2
Repeated dorsifexion / volar flexion elbow at 0°, forearm pronated slight shoulder flexion/abduction	cannot perform volitionally limited active range of motion full active range of motion, smoothly	0	1	2
Circumduction elbow at 90°, forearm pronated shoulder at 0°	cannot perform volitionally jerky movement or incomplete complete and smooth circumduction	0	1	2
	Total B (max 10)			

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		none	partial	full
Mass flexion from full active or passive extension		0	1	2
Mass extension from full active or passive flexion		0	1	2
GRASP				
a. Hook grasp flexion in PIP and DIP (digits II-V), extension in MCP II-V	cannot be performed can hold position but weak maintains position against resistance	0	1	2
b. Thumb adduction 1-st CMC, MCP, IP at 0°, scrap of paper between thumb and 2-nd MCP joint	cannot be performed can hold paper but not against tug can hold paper against a tug	0	1	2
c. Pincer grasp, opposition pulpa of the thumb against the pulpa of 2-nd finger, pencil, tug upward	cannot be performed can hold pencil but not against tug can hold pencil against a tug	0	1	2
d. Cylinder grasp cylinder shaped object (small can) tug upward, opposition of thumb and fingers	cannot be performed can hold cylinder but not against tug can hold cylinder against a tug	0	1	2
e. Spherical grasp fingers in abduction/flexion, thumb opposed, tennis ball, tug away	cannot be performed can hold ball but not against tug can hold ball against a tug	0	1	2
	Total C (max 14)			

D. COORDINATION/SPEED, sitting, after one trial with both arms, eyes closed, tip of the index finger from knee to nose, 5 times as fast as possible		marked	slight	none
Tremor	at least 1 completed movement	0	1	2
Dysmetria at least 1 completed movement	pronounced or unsystematic slight and systematic no dysmetria	0	1	2
		≥ 6s	**2 - 5s**	**< 2s**
Time start and end with the hand on the knee	at least 6 seconds slower than unaffected side 2-5 seconds slower than unaffected side less than 2 seconds difference	0	1	2
	Total D (max 6)			

		TOTAL A-D (max 66)		
H. SENSATION, upper extremity eyes closed, compared with the unaffected side		**anesthesia**	**hypoesthesia or dysesthesia**	**normal**
Light touch	upper arm, forearm palmary surface of the hand	0 0	1 1	2 2
		less than 3/4 correct or absence	**3/4 correct or considerable difference**	**correct 100%, little or no difference**
Position small alterations in the position	shoulder elbow wrist thumb (IP-joint)	0 0 0 0	1 1 1 1	2 2 2 2
			Total H (max12)	

J. PASSIVE JOINT MOTION, upper extremity, sitting position, compare with the unaffected side				**J. JOINT PAIN** during passive motion, upper extremity		
	only few degrees (less than 10° in shoulder)	decreased	normal	pronounced pain during movement or very marked pain at the end of the movement	some pain	no pain
Shoulder Flexion (0° - 180°) Abduction (0°-90°) External rotation Internal rotation	0 0 0 0	1 1 1 1	2 2 2 2	0 0 0 0	1 1 1 1	2 2 2 2
Elbow Flexion Extension	0 0	1 1	2 2	0 0	1 1	2 2
Forearm Pronation Supination	0 0	1 1	2 2	0 0	1 1	2 2
Wrist Flexion Extension	0 0	1 1	2 2	0 0	1 1	2 2
Fingers Flexion Extension	0 0	1 1	2 2	0 0	1 1	2 2
Total (max 24)				**Total** (max 24)		

A. UPPER EXTREMITY	/36
B. WRIST	/10
C. HAND	/14
D. COORDINATION / SPEED	/ 6
TOTAL A-D (motor function)	/66

H. SENSATION	/12
J. PASSIVE JOINT MOTION	/24
J. JOINT PAIN	/24

Department of Occupational Therapy

WITS UNIVERSITY

7 York Road, Parktown, 2193 South Africa • e-mail: Leilane.Mackay@wits.ac.za • Tel: (+27)11 717 3701 • Fax: (+27)11 717 3709

Appendix B: Information letter to CEO of hospitals

Dear Sir,

My name is Bhavna Bahgoo, and I'm a postgraduate student at Wits currently completing a Masters degree in Occupational Therapy. Part of the degree requirements is a research study. The title of my research study is: Implementation of mirror therapy for upper limb motor function in stroke survivors on three levels of creative ability.

INTRODUCTION:

Stroke patients fulfilling the inclusion criteria at your facility will be invited to participate in this research study. This letter of information is to help you decide if you would agree for out-patients at your facility to take part in this research study. Before you agree, it is important that you understand what it involves. If you have any questions regarding areas that are not fully explained in this letter, please do not hesitate to contact the researcher.

The purpose of this study is to see which stroke patients, at varying levels of mental impairments, will improve the most using mirror therapy. Mirror therapy is a technique where patients look in a mirror and move their unaffected arm. When they see the reflection of their arm moving, the brain perceives that the hemiparetic arm is moving, which then makes the motor neurons fire. The hemiparetic limb then improves in movement.

The study will be carried as part of the patients' normal rehabilitation. The patients will be assessed before the start of mirror therapy, and then after each session, to see how much they have improved.

WHAT IS THE DURATION OF THIS STUDY AND WHAT DOES IT ENTAIL?

Approximately 35 participants will be included in the study. The initial assessment will last for approximately 1 hour, and each session of mirror therapy will be adjusted according to the participant's abilities.

HAS THIS STUDY RECEIVED ETHICAL APPROVAL?

This study protocol has been submitted to the Faculty of Health Sciences Research Ethics Committee of the University of Witwatersrand and the ethical clearance has been obtained.

WHAT ARE YOUR RIGHTS OF YOUR PATIENTS IN THIS STUDY?

The results of the study will only be used for investigation in this study and participants will remain anonymous. Participation is totally voluntary, and participants have the right to withdraw from the study at any time, without stating any reason for doing so, and without any penalty. Withdrawal from this study will not affect patients' access to therapy in any way. The researcher may withdraw participants from the study if it is considered to be in their best interest.

SOURCE OF ADDITIONAL INFORMATION

For the duration of this study, participants will be under the care me, Ms. Bhavna Bahgoo. If at any time you have any questions, please do not hesitate to contact me. The telephone number is 072 636 3976, through which you can reach me.

CONFIDENTIALITY

All information obtained during the course of this study is strictly confidential. Data that may be reported in scientific journals will not include any information which identifies your patients in this study. Any information uncovered regarding test results or state of health as a result of participation in this study will be held in strict confidence. Patients will be informed of any finding of importance to their health or continued participation in this study, but this information will not be disclosed to any third party in addition to those listed above without their permission.

CONTACT DETAILS

For further information/reporting of study related events please contact the Wits Occupational Therapy Department on 011 717 3701. Please contact the Chairman of the ethics committee, Prof P Cleaton-Jones at peter.cleaton-jones1@wits.ac.za or 011 717 1234 if you have any complaints or problems.

Thank you

Kind regards

Ms Bhavna Bahgoo

Occupational therapist

Appendix C: Permission to conduct research from hospital CEO

GAUTENG PROVINCE
REPUBLIC OF SOUTH AFRICA

KOPANONG HOSPITAL
Private Bag X031, Vereeniging, 1930

OFFICE OF THE CHIEF EXECUTIVE OFFICER

Enquiries: Bhavna Bahgoo

Tel. No : 016 428-7115

Fax no: 016 428-1148

15 November 2016

CEO: Sebokeng Hospital

Dr. Z Ngcwabe

Moshoeshoe Street

Sebokeng

1983

RE: REQUEST TO CONDUCT POSTGRADUATE RESEARCH AT THE HOSPITAL

To Whom It May Concern,

This letter serves to request permission for the use of stroke inpatients within Sebokeng Hospital as participants in the research project: **Implementation of mirror therapy for upper limb motor function in stroke survivors on three levels of creative ability.** The research will be conducted by the registered M.Sc (OT) student Bhavna Bahgoo (456908) over a period of 6 months, beginning in January 2017.

Mrs M Madolo

Allied Manager

Dr. Z Ngcwabe

CEO: Sebokeng Hospital

GAUTENG PROVINCE

KOPANONG HOSPITAL
Private Bag X031, Vereeniging, 1930

OFFICE OF THE CHIEF EXECUTIVE OFFICER

Enquiries: Bhavna Bahgoo

Tel. No : 016 428-7115

Fax no: 016 428-1148

9 November 2016

CEO: Kopanong Hospital

Dr. A.M Kgomojoo

2 Casino Road

Duncanville

Vereeniging

1908

RE: REQUEST TO CONDUCT POSTGRADUATE RESEARCH AT THE HOSPITAL

To Whom It May Concern,

This letter serves to request permission for the use of stroke inpatients within Kopanong Hospital as participants in the research project: **Implementation of mirror therapy for upper limb motor function in stroke survivors on three levels of creative ability.** The research will be conducted by the registered M.Sc (OT) student Bhavna Bahgoo (456908) over a period of 6 months, beginning in December 2016.

2016/12/2

Dr. Sayi

Clinical Manager

05/12/2016

Dr. A.M Kgomojoo

CEO: Kopanong Hospital

NB! But please note that we need to be provided with the research outcome results.

Appendix D: VdTMoCA treatment principles

	Handling principles	Presentation principles	Structuring principles	Activity requirements
Self-differentiation: Incidental constructive action	Therapist does all planning of activities. Verbalise all actions. Ensure full attention during sensory input.	Speak in a clear, raised voice. Clear, simple, step-by-step instructions Repeat instructions frequently. Present one material at a time. Verbalise texture, form, shape and size of object.	No external stimuli. Short session of a maximum of 5 minutes. Well organised area, before patient arrives. Demonstrate movement repeatedly.	Concrete and simple movements. Interaction should give immediate gratification.
Self-presentation (Explorative)	Support and encourage due to poor self-confidence. Include elements of the person's interests and opinions. Patient can have some choice in activities.	Instructions should make patient aware of process and steps to complete task.	Area where person feels safe and secure. Therapist must be constantly supporting and supervising. Sessions approximately 5 - 10 minutes long. Reduce level of distractions. Demonstration used with discretion.	Concrete and simple activities. Emphasis on involvement and not end-product. Use fail proof activities to boost self-esteem. Each step in activity can have 4 to 7 tasks. Use new and unfamiliar tasks.
Passive participation (Experimental)	Make patient aware of norms and expectations. They may need encouragement from time to time.	Patient should be involved in all step of the activity. Therapist gives input regarding their performance with concrete advice on how to improve. Present activity as a whole but ensure that patient grasps what is required. Instructions can be verbal, written or diagrammatic.	Activities can be performed during the full day and does not require full supervision of therapist. Sessions will be a minimum of 10 minutes. Patient can be involved in preparing the area, cleaning up and packing away.	Activity should require some elements of accuracy. Use tools that require safety. Give opportunities to recognise and correct errors. Activities should allow for experimentation, be concrete and stimulate their interests.

Appendix E: Ethical clearance

R14/49 Miss Bhavna Nerisha Bahgoo

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M161011

NAME: (Principal Investigator)	Miss Bhavna Nerisha Bahgoo
DEPARTMENT:	School of Therapeutic Sciences Occupational Therapy Kopanong and Sebokeng Hospitals
PROJECT TITLE:	Implementing of Mirror Therapy for Upper Limb Motor Function in Stroke Survivors on Three Levels of Creative Ability
DATE CONSIDERED:	28/10/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Juliana Freeme
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	06/02/2017

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in October and will therefore be due in the month of October each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature Date

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

Department of Occupational Therapy

WITS UNIVERSITY

7 York Road, Parktown, 2193 • e-mail: Leilane.Mackay@wits.ac.za • Tel: (+27)11 717 3701 • Fax: (+27)11 717 3709
South Africa

Appendix F: Patient information letter

Hello,

My name is Bhavna Bahgoo, and I'm a postgraduate student at Wits currently completing a Masters degree in Occupational Therapy. Part of the degree requirements is a research study. The title of my research study is: Implementation of mirror therapy for upper limb motor function in stroke survivors on three levels of creative ability.

INTRODUCTION:

You are invited to participate in this research study because you have had a stroke. This letter of information is to help you decide if you would agree to take part in this research study. Before you agree, it is important that you understand what it involves. If you have any questions regarding areas that are not fully explained in this letter, please do not hesitate to contact the researcher. If you have difficulty understanding the language of the researcher, please tell her so she can get the help of a staff member of family member to translate for you.

The purpose of this study is to see which stroke patients, at varying levels of mental impairments, will improve the most using mirror therapy. Mirror therapy is a technique where patients look in a mirror and move their unaffected arm. When they see the reflection of their arm moving, the brain perceives that the hemiparetic arm is moving, which then makes the motor neurons fire. The hemiparetic limb then improves in movement.

The study will be carried as part of your normal rehabilitation. You will be assessed before the start of mirror therapy, and then after each session, to see how much you have improved.

WHAT IS THE DURATION OF THIS STUDY AND WHAT DOES IT ENTAIL?

The initial assessment will last for approximately 1 hour, and each session of mirror therapy will be a minimum of 10 minutes and a maximum of 30 minutes. You will receive the mirror therapy with all your usual rehabilitation.

HAS THIS STUDY RECEIVED ETHICAL APPROVAL?

This study protocol has been submitted to the Faculty of Health Sciences Research Ethics Committee of the University of Witwatersrand and the ethical clearance has been obtained.

WHAT ARE YOUR RIGHTS OF YOUR PATIENTS IN THIS STUDY?

Your participation in this study is entirely voluntary and you can refuse to participate or stop at any time without stating any reason. Your withdrawal will not affect your access to other medical care/treatment. The investigator retains the right to withdraw you from the study if it is considered to be in your best interest. If you do not participate in the study, your therapy will continue as per usual, and will not be affected in any way.

SOURCE OF ADDITIONAL INFORMATION

For the duration of this study, you will be under my care, Ms. Bhavna Bahgoo. If at any time you have any questions, please do not hesitate to contact me. The telephone number is 072 636 3976, through which you can reach me.

CONFIDENTIALITY

All information obtained during the course of this study is strictly confidential. Data that may be reported in scientific journals will not include any information which identifies your patients in this study. Any information uncovered regarding test results or state of health as a result of participation in this study will be held in strict confidence. You will be informed of any finding of importance to your health or continued participation in this study but this information will not be disclosed to any third party in addition to the ones mentioned above without your written permission.

CONTACT DETAILS

For further information/reporting of study related events please contact the Wits Occupational Therapy Department on 011 717 3701. Please contact the Chairman of the ethics committee, Prof P Cleaton-Jones at peter.cleaton-jones1@wits.ac.za or 011 717 1234 if you have any complaints or problems.

Thank you

Kind regards

Ms Bhavna Bahgoo

Occupational therapist

072 636 3976

Appendix G: Informed consent from patients

I hereby confirm that I have been informed by the investigator, Ms Bhavna Bahgoo about the nature, conduct, benefits and risks of the study.

I have also received, read and understood the above written information (Patient information letter) regarding the study.

I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.

I may, at any stage, without prejudice, withdraw my consent and participation in the study. I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.

Participant's name: _____ (please print)

Participant's signature: _____

Date: _____

I, Bhavna Bahgoo herewith confirm that the above-mentioned patient has been informed fully about the nature, conduct and risks of the above study.

Investigator's name: _____ (please print)

Investigator's signature: _____

Date: _____

Witness's name: _____ (please print)

Witness's signature: _____

Date: _____

VERBAL PATIENT INFORMED CONSENT

(Applicable for patients who cannot write due to their dominant hand being affected due to the stroke or cannot read due to language barriers or illiteracy.)

I, the undersigned, Bhavna Bahgoo, have read and explained fully to the patient and/or his/her relative, the patient information leaflet which has indicated the nature and purpose of the study in which I have asked the patient to participate. The explanation I have given has mentioned both the possible risks and benefits of the study and the alternative treatments available for his/her illness. The patient indicated that he/she understands that he/she will be free to withdraw from the study at any time for any reason and without jeopardizing his/her subsequent injury attributable to the treatment used in the study, to which he/she agrees.

I hereby certify that the patient has agreed to participate in this study.

Patients name: _____
(please print)

Date: _____

Patient's Thumbprint:

(Note left or right thumb) _____

Right thumb ☐ OR Left thumb ☐

Investigator's name: _____ (please print)

Investigator's signature: _____

Date: _____

Witness's name: _____ (please print)

Witness's signature: _____

Date: _____

(Witness – sign that he/she has witnessed the process of informed consent)

Turnitin Originality Report

MSc Research Report-Final by Bhavna Bahgoo

From Final Report/Dissertation/Thesis Scan Part 1 (Moodle TT) (2018 Postgraduate Research (Moodle TT))

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