EXPLORING THE IMPACT OF ATTENTION TRAINING ON ATTENTION DIFFICULTIES OF OLDER ADULTS

A Thesis submitted by

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ABSTRACT

Background

Attention – a central constituent of cognitive ability was researched. Attention difficulties affect different cognitive abilities. The Scaffolding Theory of Ageing and Cognition (STAC) supported the implementation of cognitive training (specifically Attention Training used in this study) that aimed to provide scaffolding against age-related attentional decline expected in older adults aged between 60 and 80 years.

Aim

The main aim of this study was to investigate changes in attention ability resulting from participants' engagement in a structured attention training program.

Method

The two studies in this research investigated attention in a community of Healthy Older Adults (HOA) and in the elderly with Mild Cognitive Impairment (MCI), aged between 60 and 80 years. The intervention assessed in this study was Attention Training against a control condition namely -Relaxation Training. Sixty-three HOA's participating in Study 1, were randomly allocated to the Intervention group (34 participants) and Active Control group (29 participants). Of the 29 Active-Control group participants, 24 completed the intervention training after completing their Relaxation Training. All trainings were delivered in small face- to- face groups of eight participants maximum, undergoing, ten, 2- hour weekly sessions. Study 2 comprised of four participants with MCI, from the Memory Clinic, receiving face-to- face attention training only. The MCI sample only received the Attention Training (Intervention) as the sample size was too small to qualify for a randomized control trial (RCT). All participants were tested before participation in the Attention or Relaxation Training (time 1) and after completion of both training programs (Attention Training for the intervention group and Relaxation Training for the active control group-time 2), followed by the completion of the Attention Training (time 3) by the Partial Crossover group (which was formed from the interested participants of the Active Control group), with the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) and the Test of Everyday Attention (TEA). From the RBANS, the overall RBANS index score measuring overall cognitive abilities and the Attention index score, and from the TEA, Map Search subtest (MS,

in 1 minute) measuring visual selective attention, Visual Elevator subtest (VE1) measuring switching attention and Lottery subtest measuring sustained attention, were assessed.

Results

Study 1 hypothesized that (a) Intervention (Attention Training) would influence increases in attention and general cognition among HOA's of the Intervention group in comparison to HOA's of the Active Control group; and (b) improvement in attention and general cognition were expected from post- Relaxation Training to post- Attention Training (intervention) for the Partial Crossover group. (a) Analysis with 2x2 repeated ANOVA indicated statistically significant differences between the two groups for Attention index score (RBANS) and Map Search test (MS1 score of the TEA) measuring visual selective attention. In particular, both groups combined, performed better post- training for Attention index score (RBANS) but for visual selective attention both groups individually performed worse post- training with poorer performance noted in the Intervention group than the Active Control group. For (b) For the Partial Crossover group, a one-way repeated ANOVA indicated a statistically significant increment for the RBANS total index scores from time 1 (before participation in the Relaxation Training) to time 3 (after completion of the Attention Training) and also for the Attention index scores (RBANS) from time 1 (before participation in the Relaxation Training) to time 2 (after completion of the Relaxation Training), and contrastingly a statistically significant decrement in the visual selective attention measure of the TEA from time 1 (before participation in the Relaxation Training) to time 2 (after completion of the Relaxation Training) and time 1 (before participation in the Relaxation Training) to time 3 (after completion of the Attention Training).

Study 2 hypothesized that intervention will lead to improvements in attention and general cognition among participants with MCI post intervention. Results indicated a reliable change (increase) from time 1 to time 2 in 1 out of 4 participants with MCI for switching attention and a reliable change (decrement) from time 1 to time 2 for sustained attention in 2 out of 4 participants with MCI, as measured by the TEA.

Implications and conclusions

Different training programs are required for different groups of participants (healthy older adults and MCI). The positive impact of socialisation was evident from the overall findings of this research. The need for multidomain and multicomponent interventions are implicated as opposed to training in a single cognitive domain. The

need for developing psychometrically sound cognitive assessment tools for the elderly aged 89 years and above, was also implicated because currently, it is rare to find any comprehensive psychometric assessments that measure cognition in the elderly above the age of 89 years.

CERTIFICATION OF THESIS

I Mousumi Singh declare that the PhD Thesis entitled Exploring The Impact Of Attention Training On Attention Difficulties Of Older Adults is not more than 100,000 words in length including quotes and exclusive of tables, figures, appendices, bibliography, references, and footnotes. The thesis contains no material that has been submitted previously, in whole or in part, for the award of any other academic degree or diploma. Except where otherwise indicated, this thesis is my own work.

Date: 14 July 2022

Endorsed By:

Professor Bob Knight
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Student and supervisors' signatures of endorsement are held at the University.

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CHAPTER 1: INTRODUCTION

The World Population Prospects data (Department of Economic and Social Affairs Population Division, 2015) predicted a phenomenal rate of growth in the ageing population (60 years and above) from 1.4 billion (2030) to 2.1 billion by 2050. This projected increase in the elderly population dictated the urgency of research supporting clinical services focused on normal and pathological ageing. An important determinant of successful ageing and quality of life in late adulthood is cognitive ability (Zając-Lamparska, 2020).

Cognition is defined as "the mental action or process of acquiring knowledge and understanding through thought, experience and the senses" (Oxford University Press). Cognitive ageing is described as a process of gradual, longitudinal changes in cognitive functioning associated with the ageing process (Cognitive Aging, 2020). Cognitive ageing is often difficult to distinguish from changes linked to illness in the elderly population. Operationalization of the cognitive changes in the elderly requires an in depth understanding of the following aspects of the change process: whether these changes are universal or partial, whether certain functions are affected earlier, which cognitive domains are most susceptible to impairments as a result of ageing, what changes occur in these domains, how these cognitive changes affect performance of cognitive tasks, daily physical and social functioning and whether these cognitive changes allow accurate and reliable differentiation of normal (normative) from pathological cognitive ageing (Massaldjieva, 2018). Cognitive ageing is not monolithic; age-related decline is seen in varied domains including processing speed, working memory, cognitive control, visuospatial processing, and verbal memory, whereas stability with age has been found in vocabulary, semantic memory, and autobiographical memory (Faust et al., 2020).

A well-documented characteristic of ageing is cognitive decline (Zając-Lamparska, 2020) that exists on a spectrum with healthy ageing on one end and pathological ageing on the other. The DSM-5-TR (American Psychiatric Association, 2022) in a subsection entitled neurocognitive disorders (NCDs) discussed mild and major NCDs: Mild Cognitive Impairment (MCI) is regarded as mild neurocognitive disorder (mNCD) as opposed to dementia, a major neurocognitive disorder. MCI in older adults refers to a "modest cognitive decline from a previous level of performance in one or more cognitive domains" and "the

cognitive deficits do not interfere with capacity for independence in everyday activities" and is not explained by "delirium" or "any other mental disorders" (American Psychiatric Association, DSM-5-TR, 2022, p. 680). The current study investigated cognitive ageing, in particular, the attention domain in participants at one end of the spectrum (namely healthy older adults) and participants with MCI – where pathological ageing begins according to DSM-5-TR criteria. Understanding of the factors that influence cognitive decline, which are the changes observed with age in brain volume and activity, will allow its monitoring and that will help establish the optimal period for interventions intended to minimize or slow down the pace of cognitive decline.

Cognitive changes and decline with age are broad topics with many nuances which are nearly impossible to capture adequately, in a single paper. Therefore, this research focuses on one of the key cognitive domains, attention, a central constituent of cognitive ability. Attention is not a unitary function but is composed of several different processes. Through attention, information is selected, hence if attention is impaired, the brain will not receive information needed for further processing, be it language, memory or any other cognitive faculty. If attention is compromised, the information received will not be processed accurately in the brain and this may possibly lead to reduced and faulty understanding. Hence, attention problems can impact on other cognitive abilities such as thought processes, social judgement, self-awareness and communication (Malia & Brannagan, 2007). Impairment in attention ability with age is impacted by numerous factors and generalisations on attentional decline with age can be misleading.

Sohlberg and Mateer's (1987, 2001a) clinical model of attention discusses five types of attention used in everyday life, which are organised in a hierarchy because the outcome of each attention level is dependent on the workings of its previous level. Therefore, it is difficult to separate the terms "types" and "levels" in the explanation of attention, and thus the terms have often been used interchangeably. The types of attention described in Sohlberg and Mateer (2001) model of attention are focused attention, selective attention, sustained attention, alternating attention or switching attention and divided attention. Their model of attention was deemed most suitable for the current research as it allowed the systematic evaluation of change in the varied types of attentional skills used in everyday life in response to the interventions that were employed. However, the current study discusses only four attentional types as the assessment tool, namely the

Test of Everyday Attention (TEA), systematically measures only four types of attention namely, visual selective, sustained, divided and alternating or switching attention. The reasons for the choice of this tool in this research are elaborated in the literature review in Chapter 2.

A basic knowledge of the deficits in the varied types of attention in the ageing population was necessary to determine whether these deficits are a normal or pathological part of aging. Furthermore, this knowledge allowed the researcher to compare the trends in changes in attention types seen in the research sample with the changes identified in the broader population, as cited in the literature.

The ability to **focus attention**, which requires dual task performance or blocking out distraction, decreases with age (Cohen-Mansfield et al., 2015). Deficits in **selective attention**, or the ability to focus on goal-directed, task-relevant information while ignoring other irrelevant information, was found to exist in varied domains including feature-selection, object-based attention, temporal attention, spatial search, and some imagery abilities. Regardless of the scarcity of research investigating **sustained attention** deficit in the elderly, which is the ability to maintain vigilance over time, it was established that the onset of this decline due to ageing was evident years later than other forms of attentional deficits (Zanto & Gazzaley, 2017). Both **divided attention**, or the ability to perform two or more tasks or attend to two or more sources of information or processes concurrently and **switching attention**, or the ability to switch between tasks that require a global shift in the cognitive set, were noted to decline with age (Zanto & Gazzaley, 2017). Decline in attention in older people with MCI has been poorly researched. For people with MCI, attention has often been measured in the context of dual task conditions (Borges et al., 2018; Klotzbier & Schott, 2017; Toosizadeh et al., 2019) where significant deficits were noted.

As, attention acts as a mechanism for information selection in the environment, attention difficulties are likely to influence slowed processing of information and motor speed (Lester et al., 2018). Clinical observations from working in a rehabilitation outpatient setting with the elderly population referred for various medical issues (stroke, pain, chronic medical conditions, neurological diseases such as Parkinson's disease, Spinal Cord injuries, Huntington's disease, Multiple Sclerosis) and also in a Memory Clinic led the author to conclude that changes in cognition, in particular slowed cognitive processing speed as part of normal ageing, was further complicated by sensory deficits (hearing problems

despite the use of hearing aids, difficulty reading despite the use of appropriate visual aids), physical challenges (such as dry eyes, muscle tension, fatigue, stiffness in joints, and experience of pain), and the presence of various chronic medical conditions and the possible side effects of the medications used. During individual and group therapy sessions, the author noted that elderly clients often expressed difficulties around new learning (significant frustration and stress were experienced in relation to new learning or changing one's habits) that shaped their attitudes and beliefs around self-efficacy, and their pre conceived views and opinion formed over time were also noted to influence their mental state (including but not limited to possible anxiety and hypervigilance) and affected their learning outcomes. Such psychological factors, sensory and physical challenges brought about by age were likely to affect their cognitive outcomes (Xu et al., 2012). The impact of such factors (psychological, sensory and physical) was found to be more pronounced in the elderly with MCI than healthy older adults (Chen et al., 2018; Yang et al., 2020)

It is acknowledged that ageing can also be related to positive processes that allow for compensation and adaptation to this decline both at the cognitive and neural level (Zając-Lamparska, 2020) which is achieved by the re-wiring of the brain - allowing for the formation of new pathways and neural connections resulting in the improvement of cognitive functioning. The Scaffolding Theory of Ageing and Cognition (STAC) proposes plasticity as a central mechanism by which detrimental effects of ageing may be minimised (Park & Reuter-Lorenz, 2009). Scaffolding is a normal and adaptive process present throughout the lifespan. STAC states that structural or neural changes and functional degradation of the brain is inevitable as a result of ageing, but the level of cognition in an individual is the combination of this negative structural and functional degradation in the brain, and "compensatory scaffolding" taking place in the individual. Compensatory scaffolding involves the formation of additional circuitry or the use of remaining circuitry differently with age that compensates for declining structures whose function has become noisy, inefficient, or both. Cognitive Reserve is "the adaptability of cognitive processes that helps to explain differential susceptibility of cognitive abilities or day-to-day function to brain aging, pathology, or insult" (Stern et al., 2020). Links have been demonstrated between compensatory mechanisms and concepts of cognitive reserve and neural efficiency (Gonzalez-Burgos et al., 2020).

Cognitive training is one of the several types of intervention that can trigger and influence scaffolding (Reuter-Lorenz & Park, 2014). This initiated the

investigation of changes in attention ability resulting from participants' engagement in a structured attention training program. Cognitive training includes carefully guided, frequently repeated, and highly standardized sequence of exercises that address specific deficits or domain impairments. Such training is often delivered through manualised program and is not unique to each person's specific neuropsychological profile of strengths and weaknesses. Cognitive training assumes that repeated exposure and practice may potentially improve performance in the desired cognitive domain and this practice will eventually generalise beyond the immediate training context. Such cognitive training that strengthens neuroplasticity and cognitive reserve is believed to eventually reduce the risk of acquiring a neurodegenerative disorder (Matthews et al., 2016). Moreover, some studies have found increased synaptic strength and synaptogenesis in people undergoing cognitive training (McPhee et al., 2016).

Therefore, as research unfolds in the future, neuroplasticity-based treatments may become an increasingly important part of best treatment practices. The authors of the STAC model theoretically differentiated the aims of the cognitive training in the elderly depending on the nature of their neural activity. For, individuals displaying significant deterioration or deactivation of the neural networks engaged in the given task execution, the aim of the cognitive training was to trigger additional activity of a compensatory nature, whereas for individuals already performing cognitive tasks by relying on compensatory patterns of brain activity, the cognitive training was aimed at improving primary network efficiency and reducing compensatory engagement, thus its aim was more of a restorative nature (Zając-Lamparska, 2020). Attention training provided in this current research would influence the two research samples (healthy older adults and older adults with MCI) differently due to the difference in the nature of the neural activities in the above two samples as explained by STAC authors.

This thesis is divided into several sections: Chapter Two is divided into 3 parts: Part 1 reviews the literature on cognitive ageing. The concept of cognitive reserve is explained and pathological cognitive decline with age, emphasizing the evolution, conceptual development and measurement of Mild Cognitive Impairment (MCI), and the correlation between varied factors (other than cognition) including subjective cognitive decline and functional decline in formulating the diagnosis of MCI, is explored. Part 2 reviews attention in normal ageing and in the MCI population. Lastly Part 3 discusses the importance of cognitive intervention

supported by the Scaffolding Theory of Ageing and Cognition, Reuter-Lorenz and Park (2014), provides a comparative analysis of the two common modes of training namely computerised cognitive training versus face- to- face cognitive training in both the healthy older adults as well as the MCI population with preferential emphasis on face- to- face cognitive training. This part also reviews the available literature on attention training in healthy ageing and MCI. Chapter 3 focuses on the assessment and intervention relevant to both empirical studies, details the rationale for the selection of outcome measures and provides support for the selection of the intervention approaches for both the Attention Training and Relaxation Training programs. Chapter 4 reports the study with healthy older adults and Chapter 5 discusses the study with the MCI sample. Chapter 6 discusses the limitations of the current research and implications for future research in attention.

CHAPTER 2: LITERATURE REVIEW

Ageing is the sequential or progressive changes occurring in late adulthood which is mapped as the stage of maturity and wisdom according to Erikson (1959) stages of psychosocial development (Erikson as cited in Knight, 2017). Ageing includes physical, psychological, cognitive, and social changes: it is an individual but variable process affected by environmental and lifestyle factors. The growth in the ageing population in Australia is consistent with the global trends: an estimated number of 3.8 million Australians, aged 65 and over in 2017, is expected to increase over the coming years to a projected 8.8 million older Australians by 2057, and 12.8 million by 2097 (Australian Institute of Health and Welfare, 2020). This rapid growth in the ageing population over the coming years poses several challenges that will require appropriate management. From the time of birth to death, human brains are continuously changing. Changes bring about alterations in the brain function, such that with maturation comes growth and with ageing deterioration (Heilman & Nadeau, 2019). Noting Doidge's (2015) saying, "neuroplasticity exists from cradle to grave" makes one truly believe that challenges and deterioration that come with aging can be transformed into opportunities and growth, with the right interventions.

The World Health Organisation (WHO) report highlighting the concept of ***functional ability*** defined as "the health-related attributes that enable people to be and to do what they have reason to value" (WHO, 2015) provided a framework for healthy ageing. Maintenance of functional ability requires accurate mapping of cognitive decline.

PART 1

2.1. Cognitive Ageing

Cognition among physical, social and emotional factors, is regarded as the strongest predictor for independent activities of daily living (IADLs) including managing finances, taking medications, and preparing meals. Some aspects of cognition such as implicit memory, vocabulary and storage of general knowledge remain relatively intact as people age, whilst other aspects of cognition such as speed of information processing reaction time, working memory capacity, short-term memory, executive control, verbal fluency and visuo-constructional abilities have been shown to decline with age. Three life span models of cognitive ageing namely the Processing Speed theory, (Salthouse, 1996); the Inhibitory Deficits Hypothesis

by Hasher and Zacks (1988, as cited in Thomas & Gutchess, 2020); and Self-Initiated Processing Deficits theory by Craik and Byrd (1982, as cited in Thomas & Gutchess, 2020) were explored as they focused on attention as a component of cognitive ageing and decline.

2.1.1. Processing Speed Theory

This theory postulated that speed of processing is central to the age-related variance on almost any kind of cognitive task, ranging from memory to reasoning (Birren & Fisher, 1995; Salthouse, 1996). Two key assumptions of this theory are the limited time mechanism and the simultaneity mechanism that contribute to age-related cognitive decline. The limited time mechanism assumed that diminished processing or reduced speed of processing was due to the execution of many processing operations at any given amount of time whereas the simultaneity mechanism assumed that a reduced speed of processing resulted in the availability of limited information required for simultaneous processing. It further explained as people aged, they spent more time on executing early operations associated with a particular cognitive task, thus limiting the time available for later processing. Age-related differences in attention over and above other age-related differences in other cognitive domains such as memory and reasoning, were explained by these two important mechanisms according to Salthouse (1996).

2.1.2. Inhibitory Deficit Hypothesis

Inhibitory deficits hypothesis was another way to explain decline in cognition due to age. According to Hasher and Zacks (1988, as cited in Thomas & Gutchess, 2020) inhibitory deficit framework, efficient (fast and accurate) mental operations required the ability to use information that is most relevant to one's goals. Three proposed functions of inhibition were: controlling access to attention's focus, erasing irrelevant information from attention, and working memory, and suppressing competing but inappropriate responses. Experimentally, researchers have demonstrated that older adults have difficulties inhibiting irrelevant information from the focus of attention that in turn affected the smooth operation of higher cognitive processes, such as reasoning, decision-making, problem-solving, and language understanding. Again, attention was found to be the central cause of inhibitory deficits required for fluent operation of higher order cognition in the elderly.

2.1.3. Self-Initiated Processing Deficits

The speed of processing and inhibitory deficit models were domain-general theories, which postulated that all age-related changes in cognition could be explained by changes in an ability that is shared by the various types of tasks for which age-related impairment is demonstrated. Research has also demonstrated that ageing may not affect all areas of cognitive functioning, whilst some areas may be affected, others are spared. Some areas of cognitive functioning, such as memory and executive control, have been well researched whilst others, such as attention has received insignificant consideration in the ageing literature.

According to the "self-initiated processing" theory by Craik and Byrd (1982, as cited in Thomas & Gutchess, 2020) older adults face difficulties in initiating effective encoding "strategies" which enable facilitation of memory for the associative details of an experience. Such deficits diminish the kinds of self-initiated activities that maybe required for efficient task completion at encoding, thus making it increasingly difficult for older adults to generate elaborate and distinctive memory traces (encoding deficit). Moreover, if they fail to devote significant cognitive resources to search and retrieval, then memory trace will not be retrieved. Thus, diminished utilisation of effective processes at either encoding or retrieval, impair memory accuracy. However, in recent times DeCaro and Thomas (2020) demonstrated that the deficits in self-initiated processing or strategic regulation of learning and remembering could be task dependent. This knowledge is particularly important when designing cognitive training tasks that aim to improve encoding, learning and memory in the elderly.

Cognitive changes brought about by neurodegeneration exists in a continuum that transitions from normal functioning to Mild Cognitive Impairment (MCI), and finally to dementia, however separating the three (normal cognitive ageing from MCI and dementia) is not a straightforward process. The following paragraphs will discuss cognitive decline in particular the Mild Cognitive Impairment in the elderly.

2.2 Evolution and Conceptual Development of Mild Cognitive Impairment (MCI)

Mild cognitive changes in older adults were first defined by Kral (1962) who proposed "benign" versus "malignant" senescent memory loss differentiated on whether this cognitive change remained stable or progressed to dementia (Bermejo-Pareja et al., 2021). In 1982, two clinical staging systems, still in use today, were published, that allowed clinicians to establish clinical parameters between healthy ageing and dementia. These were the Clinical Dementia Rating (CDR) and the

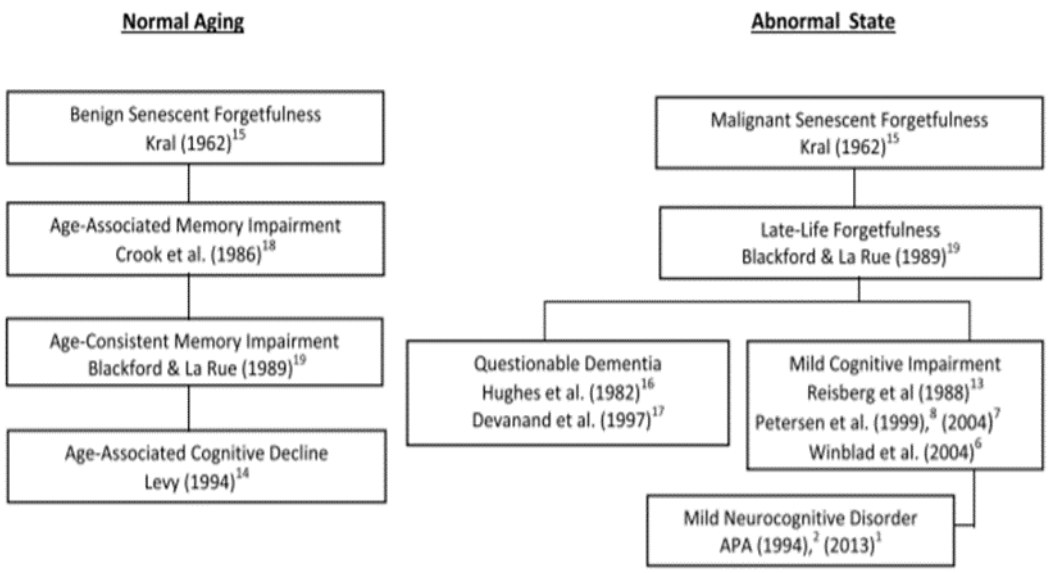
Global Deterioration Scale for ageing and dementia (GDS), with CDR being the most validated scale. On the GDS, that measured cognitive and functional decline was measured on a scale of 1 (cognitively normal) to 7 (severe dementia), with cognitive decline (synonymous to current MCI terminology) given a GDS score of 3 (Flicker et al., 1991) whereas the CDR system referred to the MCI stage as "Questionable dementia" and categorised individuals at this predementia stages with a rating of 0.5. Since then, many concepts such as – Age Associated Memory Impairment - AAMI introduced by Crook et al., 1986; Ageing Associated Cognitive Decline AACD by American Psychiatric Association (1993) and in the research criteria for ICD-10 (World Health Organization, 1992) cited in Levy (1994)); Age-Related Cognitive Decline-ARCD; DSM-IV as cited in Stephan et al. (2010), Mild Cognitive Disorder-MCD (Bermejo-Pareja et al., 2021); and Cognitive Impairment No Dementia-CIND; (Palmer et al., 2000; Tuokko et al., 2003), with slightly differing criteria were introduced to explain cognitive decline constructs in the elderly. AAMI and AACD mainly reflected normal aging in comparison to ARCD and MCD that explained abnormal decline.

Coined for the first time in 1997, the term MCI by Petersen, (Petersen et al., 1999) was defined in the light of memory complaints, not considering decline in other cognitive domains and its related impact on everyday functioning (Subramanyam & Singh, 2016). This led to extensive debates and consequent formulations of various diagnostic guidelines, eventuating in the concept of MCI defined as a spectrum that included impairment in both memory and non-memory cognitive domains. It was described as a syndrome defined by clinical, cognitive and functional criteria (Sperling et al., 2011). In the DSM-5-TR, (American Psychiatric Association, 2022) neurocognitive changes in old age are explained in a subsection entitled Neurocognitive Disorders (NCDs). DSM-5-TR differentiated between Major Neurocognitive Disorders (Major NCDs) with dementia and other related disorders categorised under this group, and Mild Neurocognitive Disorder (mNCDs) which is medically referred to as Prodromal Disease or Mild Cognitive Impairment (Dementia Australia, 2022). mNCDs is defined as "modest cognitive decline from a previous level of performance in one or more cognitive domains (complex attention, executive function, learning and memory, language, perceptual-motor, or social cognition)" and "the cognitive deficits do not interfere with capacity for independence in everyday activities (i.e., complex instrumental activities of daily living such as paying bills and managing medications are preserved) but greater

effort, compensatory strategies, or accommodation may be required and the cognitive deficits do not occur exclusively in the context of delirium, and are not better explained by another mental disorder" (APA, 2022, p 680). This definition of Mild Neurocognitive Disorder closely resembled the criteria of MCI obtained from the 2004 Stockholm Key Symposium and the revised criteria for MCI by National Institute on Ageing and Alzheimer's Association (Albert et al., 2011). Below is a pictorial presentation of the how MCI fits between normal aging and abnormal state and the evolution of the concept of MCI.

Figure 1

Evolution and Concept of MCI



Note. Normal Cognitive Aging versus Dementia "Boundary conditions and terms to describe the grey zone between normal cognitive aging and dementia". Modified and reprinted, with permission, from Geriatric Neuropsychology: Assessment and Intervention (Stokin et al., 2015).

The revised criteria of MCI included degenerative and cerebral vascular disorders (commonly associated aetiology) as well as traumatic, metabolic, and other pathologies with cognitive deficits that led to the determination of a heterogenous clinical phenotype considering the combination of two axes in four clinical subtypes: (A) amnesic (aMCI) versus non-amnesic (na-MCI); and (B) single domain versus multiple cognitive domains or amnesic + multiple domain (aMD), which assisted in defining the clinical diagnosis and course of cognitive decline in the elderly. The common consensus among the varied systems describing neurocognitive disorders in

the elderly, consider NCD along a continuum or spectrum; and mNCD (that included MCI) being represented between 1 and 2 standard deviations (SD) below the mean of normal controls (Bermejo-Pareja et al., 2021). This objective criterion (1 and 2 SD below the mean of normal controls) for ascertaining MCI status over and above a diagnosis given by the Geriatrician in the Memory Clinic, assisted in the recruitment and monitoring of this sample by utilising a standardised validated measurement tool of general cognition (the Repeatable Battery for the Assessment of Neuropsychological Status- RBANS), in the current study.

The term MCI was preferred in the current study, over the term mNCD delineated by the DSM 5-TR, for a variety of reasons: the understanding of mNCD was derived almost exclusively from research in MCI (Sachs-Ericsson & Blazer, 2015). Therefore, MCI is one of the many mNCDs. The diagnosis of mNCD represented a heterogeneous category, encompassing multiple possible aetiologies (e.g., prodromal AD, and acquired stable cognitive deficits associated with traumatic brain injury (TBI), as such mNCD encompassed a more diverse group of entities including mild acquired impairments in younger individuals and impairments that may be transient, static, or even reversible whereas MCI is one of the mNCD and refers to the pathological cognitive decline seen as a result of aging which is the focus of the current study. Moreover, the diagnosis of mNCD does not differentiate between amnesic MCI (aMCI) and non-amnesic MCI (naMCI) (Sachs-Ericsson & Blazer, 2015), consequently not paying much heed to the aetiology of the disease, whereas MCI can be subdivided to reflect various aetiologies. It is particularly important to track the trajectory of this disease and understand the factors that aid in the disease progression or reversion. Such understanding helps formulate interventions that can aid in this process. Though such detailed differentiation between different types of MCI is not required for the current study, an understanding of such is helpful to predict relevant areas of cognitive decline other than memory, and to test whether interventions (such as attention training used in the current study) will be at all useful in the management of MCI in the future.

2.2.1. Prevalence and Conversion of MCI to Dementia

The prevalence of MCI in older adults aged 65 years and above was predicted to be around 3 to 22%, depending on the demographics of the population studied. Its true prevalence has been difficult to ascertain due to variability in "cut-off" scores for determining MCI in different studies (Sanford, 2017). MCI prevalence and incidence differ depending on the age of the population (higher in older samples);

(Sachdev et al., 2015), the origin of the studied cases (higher in clinical settings than in population surveys), and the type of diagnosis (algorithmic vs. clinical judgments) (Bermejo-Pareja et al., 2021). Sachdev et al. (2015) developed an international consortium – Cohort Studies of Memory in an International Consortium (COSMIC), which was able to harmonise the collated data from cohort studies of cognitive ageing internationally to reliably estimate MCI prevalence across different geographical and ethnocultural regions (three studies in USA, four in Europe, two in Asia, and two in Australia). From their data obtained, the average age (60-89 years) and sex standardised prevalence was 5.8 (5.4–6.2) %. A recent forecast estimated that 15 million people will be living with MCI by 2060, an increase from approximately 6.08 million in 2017 (Brookmeyer et al., 2018). People with MCI have a greater risk of developing dementia, ranging from 2.5 to nearly 9 times higher than cognitively normal individuals (Bermejo-Pareja et al., 2021). Dementia is the loss of cognitive functioning to an extent that interferes with the individual's daily life and activities, in the following years (National Institute on Aging, 2021).

According to the Department of Economic and Social Affairs Population Division (2015) the number of people diagnosed with dementia worldwide is currently estimated at 50 million and this is predicted to almost triple by 2050 (WHO, 2017). Although MCI diagnosis determines a higher risk of incident dementia, an understanding of how great this risk is, whether this risk depends on the MCI clinical phenotype and the protective factors ameliorating this risk, are essential to mitigate the risk of conversion from MCI to dementia. An estimated annual conversion rate from MCI to dementia was found to be 10% in clinical settings, 5% in community surveys, and 1%–2% of the cognitively normal people (Bermejo-Pareja et al., 2021; Bradfield & Ames, 2020; Michaud et al., 2017). Studies have also found that a limited number of MCI cases in population-based cohorts develop dementia (Bermejo-Pareja et al., 2021) whereas a minor proportion reverts to normality at follow-up (8% in clinical studies, until 25% in community surveys), which could be unstable in some cases changing again to MCI or dementia (Canevelli et al., 2016; Ganguli et al., 2019; Pandya et al., 2016; Xue et al., 2019). Studies have also found that the MCI evolution-to-dementia risk is greater in the first years of diagnosis and decreases afterward (Bermejo-Pareja et al., 2021). This necessitates early detection of MCI. Since MCI has a greater probability to convert to dementia in the first years of diagnosis and MCI has the potential to revert to normal cognition in the elderly, though the latter cannot be stated with confidence

yet, due to lack of longitudinal studies, research around what factors may help prevent the conversion of MCI to dementia should be investigated and the importance of early intervention for MCI population is clearly indicated. Moreover, as noted the progression of MCI to dementia is affected by many factors: there is rapid trajectory in some cases whereas in others, progression can be slow. As such intervention needs to monitor this trajectory of progression, targeting the factors affecting this progression.

According to Bermejo-Pareja et al. (2021) the risk of conversion from normal cognition to MCI are not much different from risk factors of conversion from MCI to dementia. The authors have identified age, severity of cognitive impairment, a Md-MCI subtype and functional dysfunction as strong risk factors whilst high education (Sachdev et al., 2015) and physical activity were considered as protective factors against conversion risk. The authors also highlighted that younger, educated people with higher general cognitive functioning, less IADL (independent activities of daily living) impairment, better health and absence of ApoE ε4 genotype, characterised those people with MCI who reverted back to normality. Sachdev et al. (2015) study found similar trends in the rise of MCI to that of dementia globally with increased age, but the global prevalence of dementia was found to be greater among women than among men which is in contradiction to Sachdev et al. (2015) study that found the opposite trend for gender in MCI. This trend of increase in cognitive impairment with advancing age was also noted in a study by Jacob et al. (2019). Sachdev et al. (2015) from their findings concluded that MCI should not be conceptualized solely as a pre-dementia syndrome, but as a distinct syndrome with some overlap with pre-dementia, which necessitated further exploration of the cognitive deficits experienced by people diagnosed with MCI.

2.2.2. Psychological and Cognitive Changes and MCI

2.2.2.1. Subjective Cognitive Complaints. Subjective cognitive complaints are self-reported symptoms of cognitive decline in daily life and are a core criterion in the diagnosis of MCI (Numbers et al., 2020). The authors reported that memory complaints strongly predicted a steeper rate of global cognitive decline over six years, when mood and personality factors were controlled. Moreover, self-reported memory complaints were found to be an indication of language deficits whereas informant-reported memory complaints were predictive of deficits in executive function and memory changes, over time.

Lee et al. (2020) conducted a study with 182 participants and a mean age of 78.4 years, recruited from a senior welfare centre in Seoul. It showed that participants with cognitive impairment had poorer perceived health status, more severe depression, and lower physical and cognitive activity levels than people who were cognitively intact. Moreover, cognitive function was associated with age, educational level, perceived health status, and cognitive activity whilst subjective cognitive decline (SCD) was not associated with age and educational level. The authors explained that cognitive impairment in turn can make it difficult for older adults to manage their health, apply problem-solving strategies, and make appropriate decision. Moreover, the authors found that those participants who experienced cognitive impairment had more cognition-related complaints than those without cognitive impairment.

Other studies, such as Sun et al. (2015), have shown that SCD in people with normal cognitive functioning was seen to be associated with an increased risk of positive pathophysiological biomarkers for Alzheimer's disease. Therefore, SCD was considered a helpful additional factor for identifying people who maybe at a high risk for cognitive decline. 25 to 50% of community-dwelling older adults reported subjective memory complaints and such prevalence was found to increase with advancing age (Brailean et al., 2019; Lee et al., 2020).

Studies have also noted faster decline in objective memory performance, language and executive function performance in people having more initial memory complaints (Brailean et al., 2019). On the contrary, comparatively lower perceived subjective cognitive performance to increased objective cognitive performance may reflect declining insight into cognitive performance among persons with cognitive dysfunctions. The presence of Anosognosia or lack of awareness of one's own health condition, among older adults with mild cognitive impairment (MCI) was suggested (Brailean et al., 2019). The authors analysed data (N = 11,391, older adults aged 50 years and above) from the English Longitudinal Study of Aging, over 4 waves (between 2002 to 2009; one baseline assessment followed by 3 follow-up assessments) and found small to moderate associations between cognitive performance and subjective memory complaints. According to the Conscious Awareness Model (CAM; Agnew & Morris., 1998). accurate metacognitive output is reliant on attention, memory and executive functioning systems. Moreover, poor awareness of deficits is correlated with depression, anxiety and more so with apathy together with cognitive impairments (Steward et al., 2020). The authors found that

inter and intra-patient variability influences Anosognosia or impaired awareness for different IADLs in the MCI population. People presenting with poor initial cognitive performance showed more initial subjective memory complaints. In particular, older adults with increased subjective memory complaints overtime experienced steeper decline in verbal fluency, processing speed and immediate recall, thus leading the authors to conclude that subjective cognitive complaints accompany objective cognitive decline. Sachdev et al. (2015) study also reported that the rate of subjective memory complaints increased with age, from 26.4% among 60–69-year-olds, to 30.7% among 70–79-year-olds ($\chi 2 = 33.95$, df = 1, $P < .001$), and 37.5% among 80–89 years ($\chi 2 = 67.58$, df = 1, $P < .001$ vs. 70–79 years). This trend was similar to the age trends noted in the MCI population.

So, it can be established that MCI diagnosis should not only be deduced through standardised psychometric assessments, but a combination of objective measures, supported by subjective cognitive complaints from both the client and significant others. Moreover, as early detection of MCI is emphasized for predicted better prognosis through early intervention, subjective cognitive complaints would play a significant part in early detection of MCI. If such is encouraged, the stigma around the cognitive decline with age can be adequately addressed which would have a flow-on effect on early detection and management. The following paragraphs discuss some aspects of neuropsychological deficits common in people with MCI and its relationship to attentional decline in this population.

2.2.2.2. Neuropsychological Deficits in MCI. The range of neuropsychological deficits in MCI can be varied due to the diversity in the manifestation of MCI. In Bharath et al.'s (2019) study of 7469 older adults, less than 1% were diagnosed with MCI. Deficits in more than one cognitive domain (such as memory, attention and executive functions) were identified. Moreover, neuropsychiatric symptoms identified, influenced their cognitive scores. The authors recommended culture fair neuropsychological assessment with the inclusion of indigenous assessment tools for assessment and evaluation of this diverse group. Another study by Andrejeva et al. (2016) examined 288 patients with MCI derived from a memory clinic and concluded that neuropsychological deficits in MCI refer to five dimensions of change – verbal memory, logical memory, executive functioning, language skills and figural memory and apraxia and the performance in these dimensions of change differed according to the MCI subtypes indicating the benefits of cognitive reserve and / or utility of compensatory strategies in varying degrees

among the subtypes of MCI. The authors reported that declarative memory deficits (that included verbal memory and logical memory) were found in 81.5% and 84.7 respectively and was therefore considered a hallmark of MCI. Executive dysfunctions are often apparent in MCI and when combined with deficits in delayed memory recall, may usually predict progression to Alzheimers' disease (AD). The authors reported that 64.5% of the patients with MCI were impaired on either the Trail Making Test (TMT A) and/or TMT B that were used as a measure for executive performance. The TMT B in combination with impaired verbal fluency has also been detected as an important preclinical sign. Changes in language skills prevalent in a lesser degree among MCIs was found in 48.4% of those investigated in the Andrejeva et al. (2016) study. The fact that executive functions may mitigate neuropsychological deficits through utilisation of cognitive reserve in MCI, underlines the importance of training programs and early intervention. Sachdev et al. (2015) study showed twice as much estimated prevalence of non-amnestic MCI (naMCI) to amnestic MCI (aMCI) (2:1). The authors were concerned that the examination of naMCI has been scarcer than aMCI and cautioned against possible bias of only focusing on memory complaints with this population. This higher prevalence of naMCI was also evidenced by less progression to dementia and higher rates of reversion to normal cognition upon follow-up, which may possibly indicate that this population may be a better target for early intervention than aMCI.

2.2.2.3. Language and MCI. Orange (2009) reported that from the few available studies describing the language or hearing profiles of individuals with MCI, it was found that individuals with MCI exhibit decreasing verbal fluency scores (letter and semantic categories), poor picture confrontation naming scores on nouns and they do not benefit from semantic cues. Maruta and Martins (2019) in their longitudinal 5- year study examined the predictive value of language complaints for cognitive and language decline in 402 participants of community-dwelling healthy older adults with a mean age of 70.4 years and a mean of 7.5 years of education. Apart from subjective questionnaires to capture the presence or absence of language complaints, the authors also performed a neuropsychological assessment tackling attention/processing speed, memory, executive functioning, and language at baseline. Out of 402 recruited participants, 275 (68.4%) participated in a follow-up evaluation 4.9 (±0.6) years later. The authors reported that participants with a language complaint performed significantly poorer than participants without a language complaint on semantic fluency 5 years later, but they had a similar rate of decline

overtime that was not associated with a follow-up outcome of cognitive decline and hence the authors concluded that language difficulties may represent a specific type of age-related cognitive complaint and recommended for longer follow-ups to understand the issue investigated in their study.

2.2.2.4. Decision Making and MCI. Decision making is a core component of independent living and autonomy and relies on several cognitive abilities, including semantic memory, episodic memory, and some aspects of executive functioning. People with MCI showed impairment in decision making tasks under uncertainty or risky situations and were found to have difficulty in making beneficial decisions in a complex situation, or when the decision making was dependent on different sources of information.

Participants with MCI also required several repetitions to improve their performance (de Siqueira et al., 2017). The authors suggested that as deficits in executive function may be present in the early course of Alzheimer's' disease (AD), it is always an important indicator of decline to keep in mind with people with MCI. With AD progression, deficits in executive functions are manifested through changes in abstract reasoning, difficulty concentrating and performing calculations, so monitoring of these areas of cognition in MCI is vital. The authors reported several limitations of their systematic study, including small sample size in the studies included, and lack of comparison between types of patients (healthy controls vs MCI vs AD), age, education level, premorbid intelligence, specific contexts that led to increased decision-making difficulty, which made identification of clear patterns of decision-making impairment difficult in their review. Addressing such limitations in future studies would assist in determining rehabilitation pathways.

2.2.2.5. Impact of Cognitive Changes on Independent Activities of Daily Living (IADLs). The cognitive domains most susceptible to decline with MCI have been highlighted above; this paper will now explore how decline associated with MCI impacts on certain complex IADLs. Overdorp et al. (2016) systematic study reviewing 20 articles examining the impact of cognitive and brain morphological changes on independent activities of daily living (IADL) concluded that the performance on neuropsychological tests for memory (62.5 % of studies that examined this function) and executive functioning (66.7 % of studies) were both associated with current IADL impairment and also predicted future decline in IADL; overall, 83.3 % of all studies (that explicitly reported the effect of cognition) demonstrated a sole effect of cognition on IADL. Though neuroimaging markers,

independent of cognitive function, were also associated with IADL, their impact was found to be of a lesser extent, which led the authors to conclude that cognitive functioning was a stronger predictor of IADL impairment than morphological changes in the brain. The authors emphasized that planning, sequencing, and monitoring (aspects of executive functioning) were prerequisites for successful IADL performance in complex life situations. In contrast, Mansbach and Mace (2019) did not find any association between cognition that was required for games, current events, and tracking mixed media, and independent living, although such activities have been proven to improve quality of life which indicated that training in complex cognitive operations would be the area of intervention.

Anosognosia has been well studied in Alzheimer's Dementia (AD) but research investigating the ability of people with MCI to recognise financial declines, has been limited. Level of self-awareness was found to vary across IADL domains in different subtypes of MCI (Steward, Bulla and Wadley., 2019). Gerstenecker et al.'s (2019) undertook a study with a small sample size (n= 65) of MCI participants amongst a total of 186 participants (64 cognitively normal and 59 mild AD) found some reduction of awareness of financial skills decline in their MCI participants and called for investigation and management of this issue as the MCI affected were increasingly vulnerable for financial missteps - a complex IADL skill.

In summary, decline in declarative memory was found to be the hallmark for MCI; decrease in executive functions, particularly memory recall as part of executive functioning, was predictive of MCI progression to dementia; language deficit as a characteristic of MCI was yet to be confirmed; decision making around complex life situations (or complex IADL matters) and decisions that were dependent on different sources of information, were seen to be compromised in MCI; people with MCI often complain of some degree of decline in their ability to handle daily tasks, stating that they are forgetful, less able to multitask, have trouble planning and organising − which can manifest in varied ways such as problems in remembering where they have placed objects of everyday use, forgetting new names, difficulty completing two tasks at a time, trouble remembering shopping items from memory, recalling conversations, or prioritizing tasks based on their level of importance. Thus, the ability to learn and retain new information and perform higher-order executive skills are diminished in MCI which leads to somewhat less efficient daily functioning. Minor inconveniences in daily functioning may be present but they are not sufficiently severe to constitute a major disability in functioning as seen in

Alzheimer's Dementia. Thus, subjective cognitive decline enables early detection of cognitive difficulties. Early detection of MCI is vital to facilitate planning of the support required to manage associated risks due to difficulty in complex decision making. naMCI as compared to aMCI was found to be a better target for predicted success with early intervention as it was found to have improved rates of reversion to normal cognition. Moreover, assessment of older adults' individual level of awareness into one's cognitive status and /decline is vital. Such assessment and monitoring will guide the nature and type of intervention required. Early detection of MCI is vital to facilitate planning of the support required to manage associated risks due to difficulty in complex decision making. naMCI as compared to aMCI was found to be a better target for predicted success with early intervention as it was found to have improved rates of reversion to normal cognition.

Despite the prevalence of cognitive decline in the elderly, human brain has the ability to compensate for these deficits which may possibly arrest or change the trajectory of further cognitive deterioration under the right environmental conditions.

2.3. The Concept of Cognitive Reserve and Role of Compensatory Scaffolding

Ageing brings about challenges and opportunities - the above paragraphs have detailed the cognitive challenges brought about by ageing. The opportunities brought about by ageing are related to positive processes that allow one to compensate for the decline and adapt to it, both at the cognitive and neural levels through phenomenon known as cognitive plasticity or cognitive neuroplasticity (Zając-Lamparska, 2020) which refers to adaptive changes in patterns of cognition related to brain activity. These changes may be spontaneous or influenced by external events. When it is spontaneous, compensation of losses is brought about by self-activating mechanisms as seen in compensatory brain activity of older adults (Zając-Lamparska, 2020). In the latter, the increase in the level of functioning is assisted by environmental influences such as cognitive interventions, including cognitive training (Zając-Lamparska, 2020).

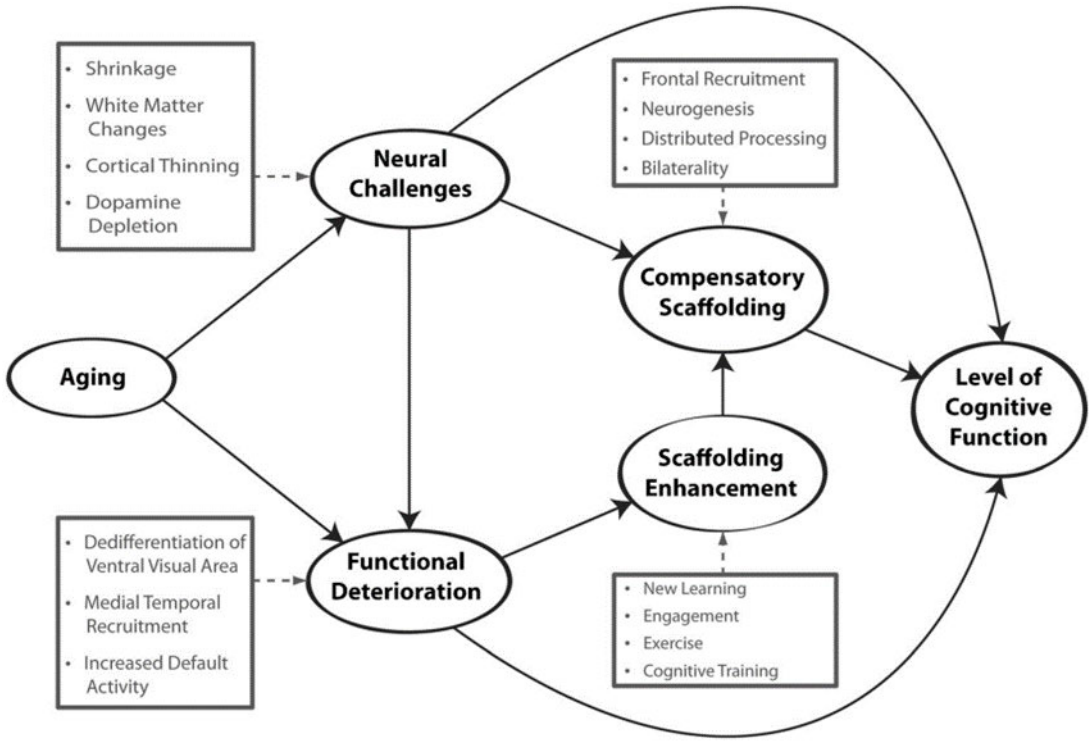
Cognitive reserve is defined as "the ability to optimize or maximize performance through differential recruitment of brain networks, which perhaps reflect the use of alternate cognitive strategies" (Stern, 2002, p. 451). Cognitive reserve is a theoretical construct that explains that the degree of individual differences in cognitive and functional impairment is not proportional to the amount of neuropathology present in the brain (Pettigrew & Soldan, 2019). Cognitive reserve is cultivated across one's lifespan through education (improving literacy

levels), occupational attainment, engagement in leisure activities, engagement in intellectual activities, varied social and physical activities as well as newly reported personality variables. As everyone's life experiences are unique, the amount of cognitive reserve acquired by an individual is also unique to the individual, hence it can be predicted that people with high cognitive reserve are considered to have better coping ability than people with low cognitive reserve against the same amount of brain damage (Stern et al., 2019). Different mechanisms were proposed to explain the cognitive reserve-performance link such as neural or cognitive compensation processes.

The Scaffolding Theory of Aging and Cognition (STAC) (Park & Reuter-Lorenz, 2009) explained how the ageing brain can compensate, recover, and rewire itself in the face of cognitive ageing - this compensatory scaffolding was synonymous with the development of cognitive reserve (Pettigrew & Soldan, 2019). STAC explained that the brain responded to neural insults or structural deficiencies by engaging in continuous functional reorganization and repairs. This homeostatic phenomena by the brain occurs throughout life as explained by the STAC model.

Figure 2

The Scaffolding Theory of Aging and Cognition

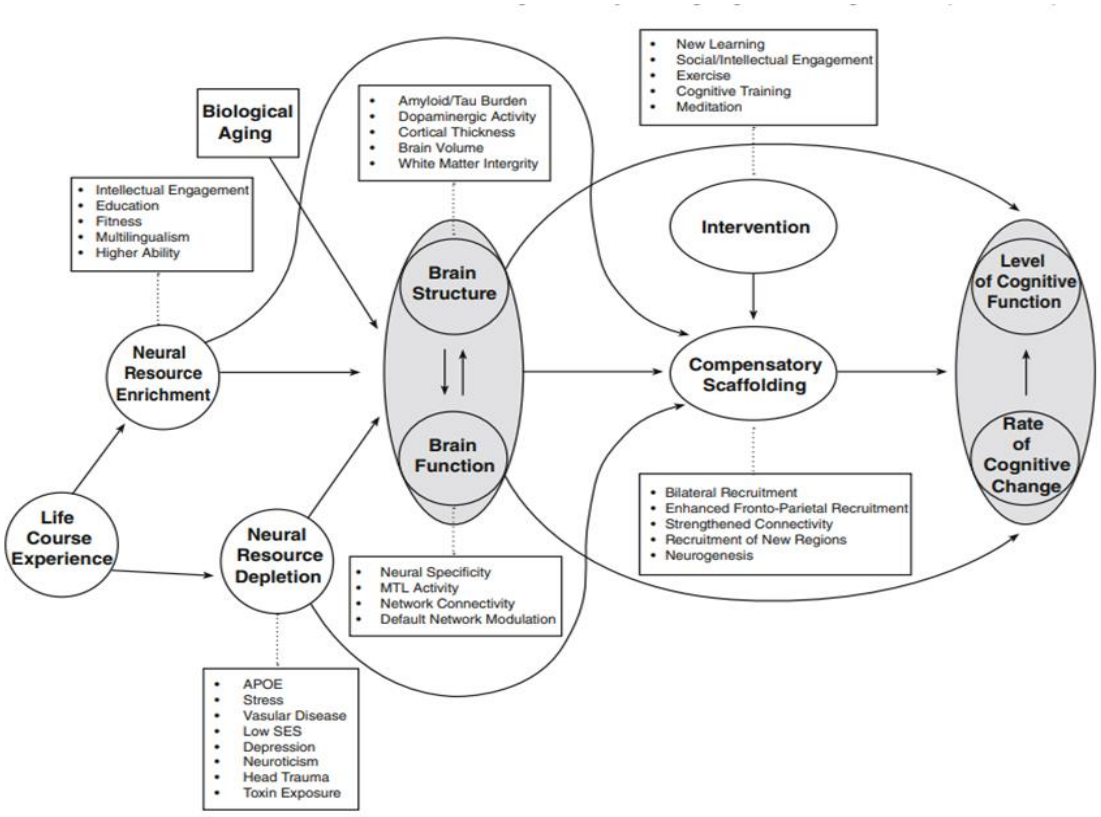


Note. From "How does it STAC up? Revisiting the Scaffolding Theory of Aging and Cognition" by P. A. Reuter-Lorenz & D. C. Park, 2009, Neuropsychology Review, 24, p. 357. Copyright 2009 by Springer.

The STAC model concluded that the level of cognition in an individual was the combination of negative structural and functional degradation in the brain resulting from ageing, and the "compensatory scaffolding" taking place simultaneously. Compensatory scaffolding involved the formation of additional circuitry, or the use of remaining circuitry differently, with age that compensated for declining structures whose function had become noisy, inefficient, or both. Though the basic hardware of cognition significantly deteriorated with age, knowledge and expertise are relatively protected from this age-related decline, which has the potential to enhance the level of compensatory scaffolding. The recognition of the influence of lifestyle, experience, genetics, and environment during aging and level of cognitive function led to the development of the revised STAC model (STAC-r). The STAC-r model (Reuter-Lorenz & Park, 2014) included the life-course variables, or the accumulation of experiences, and states experienced from birth to death. This revised model stated that both life experiences, through the varied developmental stages, and ageing, influence the structure and function of the brain and directly affected the development of compensatory scaffolding. STAC-r model introduced two new concepts namely Neural Resource Enrichment and Neural Resource Depletion. Neural Resource Enrichment factors enhanced brain structure or function. Some of these factors were engagement in leisure and cognitive activities in middle and late adulthood (Petkus & Gomez, 2021; Sauter et al., 2019; Stine-Morrow et al., 2014) as well as physical exercise (Erickson et al., 2012). STAC-r posited two pathways for this protective effect to occur: firstly, by enhancing and preserving brain structure and function (Chapman et al., 2015) and secondly through life course enrichment factors by increasing the capacity for compensatory scaffolding (Reuter-Lorenz & Park, 2014; Thomas & Gutchess, 2020). The second construct Neural Resource Depletion were negative influences on brain structure, neural function and cognition and may range from genetic factors to health and lifestyle choices (Queen et al., 2020; Silva et al., 2019).

Figure 3

The Revised Scaffolding Theory of Aging and Cognition



Note. From "How does it STAC up? Revisiting the Scaffolding Theory of Aging and Cognition" by P. A. Reuter-Lorenz & D. C. Park, 2009, Neuropsychology Review, 24, p. 360. Copyright 2009 by Springer.

Two approaches that describe the pattern of brain activity carrying compensatory potential for cognitive functioning of the elderly are: overactivation of pre-frontal regions with simultaneous decrease in activation in the occipital region known as the PASA pattern (Posterior-Anterior Shift in Aging) which is worth highlighting as it was first observed in tasks engaging attention and working memory (Zając-Lamparska, 2020). PASA mechanism relies on the compensation of automatic processes (for example, sensory processes or encoding) - processes involved in selective attention, through controlled processing based on internal command and top-down processing. The other approach is Hemispheric Asymmetry Reduction in Older Adults (HAROLD) that involves a reduction in hemispheric asymmetry which is the additional assignment of brain regions that are positioned to those regions normally recruited during a cognitive performance in

younger people (Zając-Lamparska, 2020). HAROLD pattern has been observed in studies of various cognitive functions including attention and its control and inhibitory processes. Compensatory brain activity occurs in some individuals and not everyone, and it may also appear during a particular cognitive activity−hence what sort of environment enables such compensation to take place has been the focus of recent research. Higher cognitive reserve is believed to be associated with the ability to recruit a compensatory network or in contrast the inability to recruit this network (Zając-Lamparska, 2020).

Enriched environment, cognitively stimulating activities. cognitive training and physical training are likely to increase one's cognitive reserve, providing resilience against cognitive decline and damage (Lambert et al., 2019; Yu & Wei, 2021). According to the STAC model, cognitive training can influence compensatory scaffolding; the authors of the model had theoretically determined that benefits of compensatory scaffolding could only be seen in individuals who display a significant deactivation or deterioration of the neural networks engaged in the given task execution, and the training should trigger additional activity of a compensatory nature (new scaffolds). But in individuals for whom cognitive tasks are already performed by them relying on compensatory patterns of brain activity, the training should lead to a decrease in compensatory engagement and an improvement of the primary network efficiency (the kind of restoration of brain activity characteristic of young individuals). However, there is no research to date that has tested these assumptions in a systematic manner.

PART 2

Attention has been described as a wide collection of processes, skills, and cognitive states (Sohlberg & Mateer, 2001). It is a vital component of learning and other cognitive processes thus occupying a central position in the recovery of function following cognitive changes that is worthy of further investigation.

2.4. Importance of Studying Attention

The above-mentioned research clearly demonstrated the importance of attention in several aspects of cognitive decline in the elderly, which further demands a thorough understanding of the varied aspects of attentional decline in the elderly. Attention is interpreted in various ways (Oberauer, 2019), so it is important to delineate at the outset which aspect of attention was explored in this study.

Attention is not a unitary entity and can be conceptualised along several dimensions. The first dimension is in its definition: one definition characterizes attention as a limited resource for information processing and another discusses it as a process or mechanism for selection of information to be processed with priority (Oberauer, 2019). A second dimension relates to what is attended to: on one hand whether it is the perceived environment or information which is not being currently perceived, such as attention to remembered episodes or concepts, distinguished from attention to things and events in the world around us, or attention to goals or task set. A third distinction relies on what we attend to: this is the distinction between controlled and automatic deployment of attention (Oberauer, 2019). Attentional networks allow the switch between different streams of information such as the switch between top-down (intentionally allocated) and bottom-up (stimulus-induced) information.

2.4.1. Attentional Changes in Normal Cognitive Ageing

Sohlberg and Mateer (2001b) proposed a clinical model of attention that easily identified attentional difficulties reported or observed in individuals with traumatic brain injury and provided a theoretically grounded method for assessment and treatment of attention problems. Sohlberg and Mateer (2001b) model of attention was best suited for this current study as it allowed the formulation and design of a specific attention training program that systematically measured the five types of attention (namely, focused attention, selective attention, sustained attention, alternating attention and divided attention) described in the model. Investigation into the decline in the different types of attention brought about by ageing was warranted before examining any intervention. The terms selective attention and visual selective attention; and alternating attention and switching attention have been used interchangeably by various authors (Bate et al., 2001; Chan et al., 2006; Robertson et al., 1994; Sohlberg & Mateer, 2001b) in varied contexts but it can be confirmed that the interchangeable terms referred to the same types of attention.

2.4.1.1. Focused Attention. Focused attention is the ability to respond discretely to specific visual, auditory or tactile stimuli (Sohlberg & Mateer, 2001b). In the conscious state people will have the ability to exercise focused attention adequately, focused attention is only disrupted in the early stages of emergence of coma (Sohlberg & Mateer, 2001b). Hence this type of attention was not relevant for the current study as the sample consisted of healthy older adults and people with MCI living in the community.

2.4.1.2. Selective Attention. Selective Attention is the ability to focus on goal-directed task-relevant information while ignoring other irrelevant information (Zanto & Gazzaley, 2017). Selective attention exists in varied modalities namely spatial, feature-based, object-based, intermodal, temporal and internal- aging affected these modes differently as elaborated below.

a) Spatial Selective Attention

Allocation of attention to one location while ignoring another is referred as spatial selective attention (Zanto & Gazzaley, 2017). Older adults were found to be slower and less accurate in detecting non-singleton targets when targets and distractors shared similar features. Older adults relied on top-down mechanisms to compensate for declines in bottom-up processes due to age-related declines in sensory and perceptual processes that in turn affected slowed and less accurate visual search. Age-based decline in filtering auditory distraction from distinct spatial locations, due to decline in attentional regulation has been documented (Zanto & Gazzaley, 2017). Lawrence et al. (2018), studied the relationship between the spatial spread of attention and healthy ageing and confirmed that older adults exhibited a relatively restricted spread of attention compared to their younger counterparts.

Visuo-spatial attention is the ability to focus on specific stimuli in a visual environment. Guilbert et al. (2019) showed that with increasing age, difficulty with reorienting attention into the left side of space increased, suggesting right attentional bias with ageing. This appeared to mimic unilateral spatial neglect. The authors concluded that age-related decline in spatial attention was more apparent with increased task difficulty.

In summary, several age-related deficits with spatial selective attention were noted: difficulty discriminating between targets and distractors sharing similar features, restricted spread of attention, right attentional bias, and sensory and perceptual difficulties bringing about a flow-on effect to other areas of cognitive functioning.

b) Feature-Based Selective Attention

Selective attention to features includes attention to elementary parts of a stimulus (colour or shape) or a tone in the auditory mode (Zanto & Gazzaley, 2017). In the visual mode, this has been measured through Stroop test, where older adults were found to be slower than younger adults, indicating a decline in interference

control. The auditory version of the Stroop task also showed similar age-related declines. Moreover, Zanto & Gazzaley found that age-related declines in feature-based selective attention may be attributed to reduced selectivity and processing speed delays. Inhibitory deficits in selective attention contributed by age appeared to be sensory-related such that older adults were disproportionately distracted when visual distractions accompanied an auditory task but not in the reverse situation (Zanto & Gazzaley, 2017). Some areas of age-related decline in feature-based selective attention included a decline in interference control with age, influencing reduced selectivity and processing speed delays and increased sensitivity to visual distractions.

c) Object-Based Selective Attention

The visual system processes objects holistically and not by individual parts or features (Zanto & Gazzaley, 2017). The authors reported that the decline in auditory object-based selective attention was partly due to deficits in bottom-up sensory processes in older adults as opposed to the visual object-based selective attention deficits in older adults, that were accounted by an ability to ignore distractions during a difficult task.

d) Temporal Selective Attention

Allocation of attention to specific points in time for optimization of behavioural performance, is referred as temporal selective attention. Zanto and Gazzaley (2017) reported that in comparison to younger adults, older adults did not effectively use temporal cues to allocate attentional processes in time for several types of tasks varying in complexity (from simple detection to more complex discrimination and go/no-go tasks) and they did not use temporal cues to improve performance during a delayed working memory task. Such was an indication of a decline in temporal based (anticipatory) attentional process in older adults that was seen to be present regardless of task difficulty. Moreover, the authors highlighted that the elderly showed greater inconsistency in judging a timed interval, were less precise in producing intervals, and required slower tapping rates during the production of modified movements.

In summary, a flow-on effect seen earlier in other forms of attention deficits was noted in temporal selective attention too, where older adults demonstrated difficulty in using temporal cues effectively, had difficulty judging a timed interval and were slow in processing−all of which are dependent on individual speed of fluid

reasoning, short-term memory, and reduction in attention resources due to deficient fronto-parietal neural network.

e) Internal Selective Attention

Internal selective attention includes the ability to focus attention on representations absent in the environment by refreshing working memory traces, recalling long-term memory, or through mental imagery. Zanto and Gazzaley (2017) explained that ageing differentially affected varied aspects of imagery processing, with older adults showing a decline in active imagery processing (as seen during completion of a jigsaw puzzle) but not passive imagery processing (required during composition of visual mental images). These age-related declines in mental imagery (active imagery processing) have been attributed to the shrinkage of the prefrontal cortex and loss of neural selectivity for imagined items in fronto-posterior networks. Moreover, this decline has been noted to be enhanced with task difficulty.

In summary, due to general slowing of information processing and declines in bottom-up sensory processes, age-related changes in selective attention in areas such as spatial, feature-based, object-based temporal, and internal selective attention were noted, with specific difficulties in filtering auditory distraction from distinct spatial location, right attentional bias, decline in interference control and selectivity, and in active image processing. Among other areas of functioning, a notable area of concern with older adults was the increased risk of falls attributed to difficulties in selective attention (Fernandez et al., 2019).

2.4.1.3. Sustained Attention. Sustained attention is the ability to maintain vigilance over time. Filley and Cullum (1994) reported that sustained attention was seen to be retained in adults aged 50 -69 years and deficits were only evident in adults aged 70 years and above. Decline in sustained attention in older adults was also found to be larger in physically unfit people leading researchers to conclude that this deficit may be partly related to slowed processing speed (Bunce et al., 1996). Zanto & Gazzaley (2017) concluded that decline in sustained attention with age may possibly be linked with factors such as task difficulty, physical fitness, or other non-sustained attentional processes, however the onset of this decline may take place years later than the onset of other forms of attentional deficits.

2.4.1.4. Divided Attention. Divided attention is the ability to share sustained attention between two or more stimuli at the same time. Divided attention has usually been associated with significant age-related declines, particularly when the tasks are complex. Divided attention, as measured by dual-task interference, has

been explained by three models namely: 1. The Resource based, or Capacity Sharing model, 2. the Central Bottleneck, and 3. Crosstalk model. The Capacity Sharing model of Tombu and Jolicoeur (2003) postulated that humans have a limited capacity for processing information and so, in a dual-task situation when the tasks exceed this limited capacity, then performance in one or more tasks will decline. In contrast, according to the Central Bottleneck by Navon and Miller (2002), processing of one task delays the processing of a second task particularly when the two tasks are completed within a short period of time. Finally, according to the Crosstalk model by Navon and Miller (1987), the relationship between the two tasks being performed and the content of the component tasks influence the degree of dual-task interference. Zanto and Gazzaley (2017) discussed three types of divided attention in ageing namely: ***multi-stream divided attention***, or the ability to allocate attention to more than one piece of information in the same modality with one task goal; ***multi-modal divided attention***, or the ability to allocate attention to many pieces of information in varied modalities with the same task; and ***multi-tasking***, or the ability to perform more than one task at the same time. The authors concluded that increasing task difficulty affected multi-stream divided attention negatively, and it was also prone to some left hemifield neglect. Zanto and Gazzaley (2017) added that visual multi-stream and multitasking showed that age-related decline in divided attention was evidenced across detection and identification tasks, mental image rotation (Plankin task), and tracking and memory recognition (Sternberg task). However, deficits in the tracking ability were attributed to reduced processing efficiency due to generalized slowing. One of the most important tasks of everyday life is driving. This noted decline in divided attention affects some vital areas of everyday functioning in the elderly such as driving, social participation, gait and walking that are required for enjoying a decent quality of life.

Driving is another name for independence, especially among the elderly, and the loss of this independence has been well documented to influence rapid cognitive and functional decline in the elderly. Fitness to drive as people age has been a controversial topic and measures that test this fitness to drive have been argued about. Moreover, older drivers were found to have a 74% increased fatality risk to themselves than others on the road, compared to younger drivers (Haas, 2010) which demands the development of robust measures which can accurately evaluate one's fitness to drive. On that note, Grundler and Strasburger (2020) concluded that attentional measures were found to be a more important predictor for fitness to drive

than either visual acuity, size of the visual field, or contrast sensitivity, that are currently used to predict fitness to drive.

Speech perception under complex listening conditions was seen to decrease with ageing which can challenge older adults' social participation. Such deterioration has been attributed to a decline in preparatory attention, and gating of subsequent task-related speech information, under conditions of divided attention in the elderly (Getzmann et al., 2015).

De Bruin and Schmidt (2010) noted that individual gait characteristics of their older adult participants were associated with divided attention, thus confirming that divided attention affected walking behaviour. As participants of their study were relatively fit and healthy older adults, the authors predicted that the relationships between measures of cognitive functioning and gait could be expected to be more pronounced in older adults with increased deterioration in physical functioning. They concluded that as divided attention was a complex construct, its limitations were predicted to be profound and persistent difficulties in divided attention could rapidly escalate cognitive impairments.

In summary, divided attention showed significant age-related declines in performance, particularly when tasks were complex. This suggests that increased mental operations are required which become over-extended in older adults when attention is divided between two or more sources. This decline in divided attention affected various areas of everyday functioning in the elderly.

2.4.1.5. Switching or Alternating Attention. The ability to switch attention rapidly among different tasks, skills or cognitive sets is described as alternating attention; older adults have been found to be slower than younger adults in global change of the cognitive set (Callaghan et al., 2017; Grundler & Strasburger, 2020). General slowing in older adults, or an inability to disengage attention from one task and refocus attention on another task quickly enough, especially for novel tasks, has led to such difficulty in switching and authors have reported that training may not be as effective in the ageing as in youth. Clapp et al. (2011) explained that the disruption occurring in the ageing brain to dynamically switch between functional brain networks interrupted the retention of information over brief periods of time during multi-tasking. Older adults, when interrupted, were able to disengage from a memory maintenance network and relocate their attentional resources towards the interrupting stimulus, but they were unable to complete these actions (that is disengage from the interruption and re-establish functional connections associated

with the disrupted network) simultaneously, that resulted in the interruption. Such deficits in switching attention were apparent in driving among older adults.

Fatigue during driving increases crashes and the use of an alert-maintenance task (AMT) was used to compare younger drivers (N =29, mean age = 21.38) with older ones (N =39 with mean age of 65.5) in improving alertness during driving (Song et al., 2017). Despite the decline in switching attention in the elderly, older drivers compared to younger ones, did not demonstrate increased driver errors with fatigue and their driving did not deteriorate more significantly than younger adults, during participation in the alert-maintenance task (AMT) condition as predicted, although they showed more variable speed during AMT condition (Song et al., 2017). In summary, variability in speed (including slowed processing) was shown to impact alternating or switching attention in older adults that in turn affected older adults' driving ability.

In conclusion, selective, divided and switching or alternating attention have all been shown to decline with age and this decline is more pronounced with increased task difficulty. Selective attention and divided attention were reported to improve with training whereas alternating attention did not improve with training. On the contrary sustained attention was only seen to decline in adults above the age of 70 years. Focused attention was not relevant for this study for reasons stated in the initial paragraphs.

2.4.2. Attention and MCI

Saunders & Summers (2011) found stable pattern of deficits to attention, working memory, and executive function in both the a-MCI and the na-MCI groups. Moreover, the decline in simple sustained attention in the a-MCI and n-MCI groups and decline in divided attention in the a-MCI group led the authors to predict that such deficits may be early indicators of possible transition to dementia from MCI. Deiber's (2009) study found reduction of induced theta activity at baseline in progressive MCI when compared to stable MCI which suggested early deficits in the directed-attention network in progressive MCI but functional preservation in stable MCI. Deficits in executive functioning and episodic memory were identified as important predictors of cognitive decline in the MCI (Chehrehnegar et al., 2020; Guarinoa et al., 2020) and attention is a core component of both these cognitive abilities. Chehrehnegar et al. (2020) reported that both executive function and memory function shared similar pathophysiology. Executive function, inhibitory control, and attention deficits regulate memory functions including storage, retrieval

and recollection of source information; therefore, executive function disturbance could be connected to memory loss in MCI. Cognitive flexibility and attentional switching were identified as indicators of impairment in MCI participants. Difficulties in dual-task performance with efficiency and slowed processing speed may lead to MCIs making errors in their daily tasks but being able to complete the tasks. Such deficits are likely to compromise the daily life in the elderly. Charettea et al. (2020) found deficits for visuo-spatial attention, memory and multi-tasking abilities, coupled with balance and decreased confidence for falls efficacy in the elderly with MCI.

In conclusion, similar areas of attentional decline (selective attention, divided attention and switching attention) were found in normal cognitive aging as with people with MCI. Slowed processing speed was also a common declining factor that impacted varied areas of cognition; such attention deficits affected memory and executive functioning in both the populations The main difference between the two populations was the way such cognitive impairments affected their functional life − with healthy older adults showing minimal impact compared to older adults with MCIs showing relatively greater impact, but not sufficient to require ongoing and constant care and supervision. Compensatory scaffolding is thought to be achieved through various interventions– this leads to investigating the role of cognitive training in addressing the cognitive changes mainly cognitive decline in the population studied.

PART 3

2.5. Cognitive Training in Healthy Ageing and MCI

Cognition-oriented treatments is a broad term used to explain several non-pharmacological treatment approaches applying a range of techniques to engage thinking and cognition with various degrees of breadth and specificity. The aim of such training is to improve or maintain cognitive processes, or address the impact of impairment in cognitive processes on associated functional ability in daily life (Gavelin et al., 2020). Baltes and Baltes (1990) were pioneers in the use of cognitive training in older adults. They used cognitive training within studies on the plasticity and developmental reserve capacity with a research strategy called “testing-the-limits” (Baltes & Kliegl, 1992). Baltes has indicated that older adults have the reserve capacity to improve their cognitive performance (Zając-Lamparska, 2020).

Cognitive training can be human-guided, or computerised, and can be delivered in any cognitive domain including attention in healthy and cognitively impaired older adults. Improved cognitive performance and activation changes in cortical regions were seen to emerge after just a few weeks of novel cognitive training or engagement, indicating improved neural efficiency and decreased resource utilization as a result of training (Chen et al., 2019). Cognitive interventions, it has been argued, provide a superior level of specificity and neural targeting that is lacking in pharmacological treatments, which tend to act in a diffuse manner in the brain to influence chemicals involved in widespread neurotransmitter or neuromodulator systems linked to a deficit or disorder (Zokaei et al., 2017). Another advantage of cognitive intervention over pharmacological intervention is that cognitive interventions can be personalised to accommodate individual differences based on the cognitive profile or 'fingerprint' of the participant whereas the dosage and type of medication is dependent on normative data.

2.5.1. Computerized Cognitive Training (CCT)

Computerized cognitive training (CCT) has gained popularity in the recent decade. Although such training has been criticized for varied reasons yet the number of older adults purchasing and using computers continues to increase. On the contrary, CCT's popularity stems from the fact that its relatively inexpensive and it aims to maintain cognition in older adults. It involves training and practice on standardized tasks designed to improve specific cognitive processes targeting single or multi-domains, typically without overt teaching of memory or problem-solving strategies, but adapting task difficulty to individual performance (Hill et al., 2017). Brain games in addition to structured computerised cognitive training is a hotly debated topic in the literature.

A preliminary exploration of the health and nursing databases identified EBSCOHost: CINAHL, Academic Search Ultimate and Nursing Academic; Science Direct; PsychINFO, Medline, Embase, ProQuest, Ovid and PubMed as databases that provide access to suitable journals with good coverage of this topic. Search terms were also tested. Final search terms included cognitive training, cognitive intervention, multidomain training, executive function, ageing, game training, older adults, elderly, healthy older adults, computerised cognitive training, attention training, attention abilities, cognition. The search was executed in the identified databases and limited to the years 2012-2022. Relevant articles were downloaded to the project EndNote Library. Relevant articles regarding young adults, physical

training, physical conditions, medical conditions, mindfulness, psychological health were omitted. Articles included in the study were all peer reviewed, published in scholarly journals, and reported original research. Additional articles that meet these criteria were identified via citation searching of the included articles and were also downloaded to the EndNote Library. Articles on systematic reviews and metanalysis were considered.

Studies measuring the impact of computerised cognitive training (CCT) and/or computerised attention training on the specific attention ability of healthy older adults (HOA) or people with MCI have been difficult to identify in the literature. Computerised cognitive training in memory and executive functions were the most common ones found in the literature (Nguyen et al., 2019; Racine et al., 2017). Moreover, most systematic studies on CCT measured the impact of CCT training on varied cognitive domains, among which attention was one (Hallock et al., 2017; Sala et al., 2018). The studies identified (Sala et al., 2018; Hallock et al., 2017 and Nguyen et al., 2019) reported small insignificant negative to null effect of training on different cognitive abilities assessed. Probably the most promising results among all the included studies identified above, was Shah et al. (2017), systematic review of 26 clinical trials with HOA aged over 50 years, using 7 commercial CCT programs having varying evidence levels (ranging from 1 to III). Improvements in attention with small to large effect sizes were found in 3 studies using training programs such as Posit Science and Cognifit - considered as delivering level 1 evidence, and small effect size ($p = 0.04$, $d = 0.9$ for alertness, $p = 0.05$, $d = 0.43$ for reduced distraction) was found in one study using Lumosity considered as providing level III evidence. Often it was noted that attention was measured as part of working memory or executive function domains, rather than it being a stand-alone cognitive domain. For example, due to the overlap between inhibitory control and selective attention, improvement in selective attention rather than other types of attention (for example, divided attention, switching attention) might be improved by core-EF training (Nguyen et al., 2019). Therefore, the authors did not suggest the breaking down of attention into different facets as it would further limit the number of studies within each analysis, and consequently, any results obtained from such analysis would likely be unreliable and further investigations would be required to arrive at a conclusion regarding CCT efficacy in improving attention. A closer look into the limitations of CCT was warranted to establish the need for other modes of cognitive training particularly on attention abilities of older adults with and without

MCI. Moreover, such investigation was considered important for the purposes of the current study that utilised a face-to-face approach as opposed to CCT.

2.5.1.1 Limitations of CCT. Though CCT has gained popularity due to several factors outlined in the above paragraphs, yet computerised training especially with the older population is not desirable due to multiple factors. Some of these factors are the possibility of increased social isolation, lack of knowledge and desire to engage in technology resulting in participants' unwillingness to engage in interventions using technology (such new technology and complex commands can be quite challenging for many elderly people, even more with participants with any level of sensory deficits), perceived increased financial costs (electricity and cost of resources), challenges of accessing technology in rural and remote areas (difficulty accessing internet services), or emotional costs such as lack of interest or motivation to engage in technology due to unfamiliarity, self-doubt and increased anxiety over performance on the games (for example, older people often say "I have never done it, I don't think I can do it, what if I make mistakes?") and on the other extreme may lead to a compulsive addiction to spending inordinate time practicing the games (Blazer & Wallace, 2016).

Social interactions have been shown to have protective effect against age-related cognitive decline; a broad social support system can promote healthy ageing as one grows older – social support has been identified as a positive influencer on several outcomes in aging and functional decline (Dause & Kirby, 2019), increased communication and interpersonal interactions requiring cognitive resources can act as protective factors against cognitive decline. Such broad social support and social integration act as buffers between stress and health – referred to as the stress-buffering hypothesis (Toyama & Fuller, 2020) by encouraging health-promoting behaviours among older adults which supports the utilisation of face-to-face group training on attention, as well as relaxation, provided in the current study. Moreover, interpersonal connectedness (Schore, 2019), vital for any learning to occur can only be possible from face-to-face therapy and interaction.

Hawthorne effects, which is the change in behaviour due to participants' awareness of being observed, and variations in motivational level are absent in the non-active control group usually present in CCT interventions. The effects of motivation and expectations of participants that can influence results have also not been separately investigated in the studies on commercially available computerised brain exercises. Mapping compliance in the elderly using CCT that influence

outcomes, cannot be accurately achieved. Participants' compliance also may not match the expectations of the investigator. The research on CCT do not capture the positive learning experiences and the possible novel cognitive processes/gains used by the participants during the actual training.

In addition to the above-mentioned limitation of the computerised mode of cognitive training, some limitations of the product itself, that is commercially available computerised brain games, have been discussed by the leading cognitive psychologists and neuroscientists from the Max Planck Institute for Human Development and Stanford Center on Longevity (2014). They concluded that the results obtained from commercially available computerised brain games are often exaggerated and misleading. Zokaei et al. (2017), pointed out that video games used in cognitive training, were not originally designed to improve cognition and that made the comparison of different training tasks challenging, hence making it difficult or impossible to identify the most reliably effective components of a training regimen. Cognitive training effectiveness has been assessed by participants' ability to "transfer", which is the changes that influence untrained cognitive tasks. Transfer can be "near transfer" or the changes among close -in -function tasks to the ones trained, or "far transfer", meaning generalised improvement in tasks bearing little overlap to the task being trained. Though the authors (Zokaei et al., 2017) reported some evidence of small to medium effect sizes for near transfer of cognitive interventions in older adults, but the evidence of far transfer was reported to be scarce. However, these claims around transfer effects are questionable, considering the various factors (for example, computerised video games not originally designed for improving cognition, difficulty in generalising the results as training regimens varied widely in terms of the choice, duration and schedule of training tasks, the nature of control groups which are mostly absent in training games, and the possible lack of pre-post assessment batteries for these types of training games). The absence of discussions with participants, makes it difficult for investigators to understand and differentiate the results of the training due to actual learning taking place versus due to chance. The scientists also argued that even if such computerised brain training programs are scientifically validated and people were keen to use them, several questions need to be addressed beforehand, such as the length of time one needs to spend on such programs, the required duration of such programs that will yield optimum benefits in old age. Hence, face -to -face group training was preferred over individual computerised cognitive training for this present research. The literature

on face -to -face cognitive training has been rare for various reasons (for example, lack of trained group facilitators, increased costs involved such as venue, cost of the facilitator, cost of transportation of participants, and difficulty in allocation of a mutually agreed time due to differing commitments of the facilitator and the participants), so a combination of CCT and other modes found in systematic studies was explored.

2.5.2. Exploration of Studies Using Combined Modes of Training With HOA and MCI with specific emphasis on Attention

The same databases described above were utilised with some additional search terms such as attention training, divided attention, selective attention, sustained attention, switching attention, MCI, elderly, older adults, cognitive training, multidomain training. Relevant articles regarding young adults, physical training, relaxation training, mindfulness was omitted. Articles included in the study were all peer reviewed, published in scholarly journals, and reported original research. Additional articles that meet these criteria were identified via citation searching of the included articles and were also downloaded to the EndNote Library. Articles on systematic reviews and metanalysis were considered. Combined training modes (CCT and other modes) employed with both HOA and MCI populations, were explored to understand the possible benefits (if any) of the additional modality used in the training.

Positive findings on attention (in particular focused attention, speed of processing divided and switching attention) from CCT, therapist-based intervention and multimodal intervention for HOA and a small group of MCI was reported in Chandler et al. (2016)'s study. In Butler et al. (2018)'s systematic review with HOA using a combination of computer, paper-pencil based interventions and group-based intervention, improvement in attention with HOA was found but no effect of training was noted for the MCI population. As the studies cited above did not provide attention-specific training, it was difficult to estimate how many of the positive results in the specific attention domain reported, were contributed by the training in that particular attention type. Though the IHAM study (Wolinsky et al., 2013) mentioned in Butler et al. (2018) systematic review, showed positive findings for attention with HOA, yet it was not inspected further as it was only an interim analysis**.** This led to the exploration of individual studies that only focused on attention ability.

Gajewski et al. (2020) RCT consisting of a multidomain CT study (trainer-guided multidomain paper-pencil format and computerised CT) with HOA reported improved sustained and focused attention (attentional endurance) for the CT group when compared to the Active Control Group (ACG). Similar improvements were noted in focused attention and psychomotor speed although the interaction (group x session) showed similar trends to both the control groups. Bier et al. (2018)'s study with HOA comparing younger and community residing adults, reported improvement in attentional control abilities in HOA from training involving divided attention with variable allocation than from single task (repeated practise of individual task) training. The same trend was noted for visual reality (VR) dual task in older adults. Variable-priority (context transfer) compared to the single-task training showed larger generalization of training gains on the dual-task cost for the virtual car ride task for the older adults, in comparison to younger ones. Older adults were found to be impaired in their ability to flexibly vary attentional allocation at baseline. Moreover, all participants showed improvement in focused attention task in the single task training condition.

Golino et al. (2017) studied 80 community HOA, average age being 69.69 years, evaluating the impact of multidomain CT (focused on attention, processing speed, episodic memory and working memory) on cognitive abilities, reported a significant interaction between group by time interaction for Picture Completion, Digit Symbol-Coding and Digit Span supporting near transfer effects, but not a far transfer effect. Picture Completion measures perceptual reasoning abilities, Digit Span measures short- term auditory memory and attention, and Digit Symbol-Coding is a Processing Speed test.

Yang et al.'s (2020) multidomain attention training with MCI reported no improvement in attention outcomes (alertness, sustained attention or visual-spatial attention) in the experimental group after training, but this same group showed a significant improvement in attention, memory and orientation on the MMSE (Mini Mental State Examination and MoCA (Montreal Cognitive Assessment) used as secondary measures and these improvements were reported to be superior in comparison to the control group. A similar RCT by Li et al. (2019) with CCT for 6 months duration, reported significant improvements in training group from the revised Addenbrooke's Cognitive Examination (ACE-R). However no significant differences were noted between the two groups upon 12 months follow-up.

Computerised set shifting training in the elderly was shown to have long-lasting effects on trained tasks but not on far transfers, however this result cannot be generalised as the sample size studied was small (n =17 in the training group and n = 16 in the active control group) (Grönholm-Nyman et al., 2017). Penning et al.'s (2021) study found an increase in visual processing speed (VPS) in the intervention group of HOAs when VPS assessment scores did not differ significantly between groups (intervention and control groups studied) before training. This study too had a small sample size of 25 in each group (intervention and 2 control groups), hence the results could not be generalised. It was also unclear whether the training had longer term effects and whether the training effects can be transferred to daily-living activities.

In conclusion, some notable themes that emerged through these single-studies investigating attention with HOA were: improvements noted in sustained and focused attention with multidomain CT (Gajewski et al., 2020), older adults were found to benefit in attention control from dual-task training (divided attention with variable allocation) than single task training (Bier et al., 2018), and improvement in digit-symbol coding and digit span (tasks of attention) were found with multidomain CT (Golino et al., 2017). For the MCI population, improvements with cognitive training were seen only in screening tool measures such as the MMSE, MoCA and ACE-R (Li et al., 2019; Yang et al., 2020) rather than more robust psychometric measures.

2.6. Theoretical Basis for the Current Study

Life span models of cognitive ageing (such as the speed of processing theory, the inhibitory deficits hypothesis and self- initiated processing deficits theory) highlights the role of attention in cognitive ageing and decline.

Research on the varied types of attention employing attention training has been sparse due to the complexity of the mechanisms and processes underlying the different attentional domains, functions, types which makes it nearly impossible to study each of these attentional domains separately, this is further complicated by difficulties in segregating deficits in attentional functions from other cognitive domains such as memory, and executive functioning that have been well researched. Thus, this current research employed a structured Attention Training program that utilised the varied attentional tasks (selective, sustained and switching attention) and measured the changes (if any) on the varied attention domains from pre to post training for the two samples of Healthy Older Adult and MCI.

CHAPTER 3: METHODOLOGY

3.1. Rationale for the Choice of Assessment Tools in the Current Study

Physiological, neurological, structural and cognitive changes influence each other in varied complexities hence the measurement of this cognitive change as people age is imperative for early intervention to take place (Olaithe et al., 2019). Outcome measures administered pre-post trainings in both the studies (Study 1 with Healthy Older Adults and Study 2 with MCI samples) were the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) and the Test of Everyday Attention (TEA). RBANS is a brief 30-minute individual assessment mostly used in older adults to measure levels of cognitive functioning across 5 domains namely immediate and delayed memory, attention, visuospatial/ constructional and language. RBANS consists of 12 subtests that generates a global or total cognitive score and index scores for five cognitive domains stated above. It has been validated across the age span of 12-89 years, across a number of cultures including Australia, Russia, Asia, Turkey, and Spain and also translated into several languages (Muntal et al., 2020), in community samples as well as clinical populations such as Alzheimer's' disease, Huntington's disease, with hearing-impaired individuals, people with complex psychiatric history, stroke, depressive complaints in older adults, multiple sclerosis, Parkinson's disease (Shaughnessy et al., 2019), and traumatic brain injury. It has shown sensitivity of 84% and specificity of 97% for cognitive impairment in Alzheimer's disease (AD). RBANS is used to track progress of rehabilitation. As such its alternate forms are available for evaluating improvement of neuropsychological symptoms or cognition over time and help eliminate content practice effects, which made it an ideal measurement tool to capture changes pre-post training in the current study. Other utilities included screening for neurocognitive status hence it was used as an eligibility measure in this study. Due to its good test-retest reliability and convergent validity, its use in Memory clinics has been recommended (Dong et al., 2013).

The RBANS was favoured over two other brief cognitive screening tools commonly used to detect cognitive decline in older adults namely the Mini mental state examination (MMSE) and the Montreal Cognitive Assessment (MoCA), because MMSE has been shown to have limited normative data, to show age and education biases, and has poor sensitivity to mild cognitive decline and early dementia, whereas the MoCA had been heavily criticised for poor coverage of

cognitive domains and for potential ceiling effects (Olaithe et al., 2019). The study by Karantzoulis et al. (2013) reported that the RBANS demonstrated good sensitivity and specificity in the identification of patients with MCI.

The total index score of the RBANS and the Attention index score were used in the current study. The total index score was found to be the most robust measure for the purpose of the present study and attention index score of the RBANS was also considered so that it could be compared with the Test of Everyday Attention (TEA), the second measure used in this study. Total index scores in comparison to domain-specific indices tend to generate less impaired or extreme scores, thus alleviating outliers (Emmert et al., 2018). The authors cautioned against the interpretation of the RBANS index scores as five distinct cognitive domains, when there was minimal discrepancy across performance on the tests that comprised each index, in their study of five-factor structure of the RBANS in a clinical sample of older adults. The authors highlighted that the Picture Naming and Digit Span tests were considered as "outliers" given their low loadings on the Language and Attention factors; moreover, they reported that the Picture Naming test was sensitive to ceiling effects that may be problematic in factor analyses, and this was evident as the population studied were healthy older adults who demonstrated less variability between subtests and domain scores. Measurement of the changes in the varied cognitive domains is beyond the capacity of any single study, the area of attentional changes with age was focused on the current study as attention is a central component of learning and other cognitive processes therefore it has been also identified as of central importance in the recovery of function following cognitive changes. Most attentional models include functions related to maintaining attention overtime, capacity for information, shifting attention and filtering out nontarget information, regardless of their theoretical underpinnings. Though attention deficits have been found on established neuropsychological measures, it has been difficult to determine whether these deficits are the result of problems with specific attentional processes or with other cognitive processes utilised in those tests.

The TEA is an individual measure that provides norm-referenced scores on varied aspects of attention namely selective attention/visual selective attention (or the ability to select target items while ignoring strongly competitive distracter items), attentional switching/alternating attention (or the ability to switch attention flexibly from one concept to another), sustained attention (or the ability to attend to repetitive stimuli) and divided attention (or the ability to pay attention to more than one

stimulus at one time) (Robertson et al., 1996). The TEA is used for adults 18-80 years of age. It is sensitive enough to show normal age effects in the general population and is validated with patients with closed head injury, stroke, and Alzheimer's disease including those with low educational level. No TEA test has been performed with people with a diagnosis of MCI. People with Traumatic Brain Injury (TBI) are at a higher risk of developing MCI and Dementia as they age (Snowden et al., 2020), hence the closest to the MCI population that was studied using the TEA were people with TBI.

The TEA has 3 versions namely A, B and C that can be used for test-retest purposes and it takes 60 minutes for administration. Coefficients for the test-retest reliability of versions A to B of the TEA ranged from 0.59 to 0.86. For versions B to C, test-retest reliability coefficients ranged from 0.61 to 0.90. TEA form A and B were used in the current study. The TEA has high face validity for individuals with intact auditory and sensory acuity. The TEA was designed to measure attentional abilities during tasks that one might undertake in their everyday life (van der Leeuw et al., 2017), and hence it was considered the most appropriate measure of attention for older adults participating in the current study. TEA was considered the most suitable measure for reasons stated above and was expected to capture the changes, discretely in the area of attention, and systematically in the varied domains of attention, from the direct training in attention offered as an intervention in the current study.

The TEA was found to have the following potential benefits over other tests of attention: TEA is the only test of attention that is based on simulations of real-life materials that have face validity and acceptability for patients and participants; its three parallel versions can be used analytically to identify different patterns of attentional breakdown; it can also be used with varied participants ranging from people with early Alzheimer's disease to young healthy subjects.

The TEA underwent a principal component analysis (PCA) that revealed that all its subtests loaded on four factors (Robertson et al., 1996). Various authors have subsequently conducted PCA on the TEA since its development with slightly different population; Table 1 summarises the varied TEA subtests that contributed to each of its factors obtained from those studies:

Table 1

Different Models Explaining the Factors of the TEA

Factors	(Robertson et al., 1996) 4-factor	(Chan et al., 2006) 4-factor	(Bate et al., 2001) 4-factor
Visual Selective attention	MS, TS	MS, ECR TS	MS, TS
Sustained Attention	EC, TSC, L	EC, L	L, VE
Attention Switching	VE	ECD, VE	ECD, ECR
Auditory Verbal Working Memory	ECR, ECD		
Divided Attention	-	TSC	TSC, EC

Note. MS: Map Search; TS: Telephone Search; EC: Elevator Counting; TSC– Telephone Search while Counting measured by dual task decrement; L: Lottery task; ECD: Elevator Counting with Distraction; VE: Visual Elevator; ECR: Elevator Counting with Reversal.

Much of the confusion in the interpretation of the relationships among the tests is due to the assessment of attention by varied methodologies that yield factors that are specific to a specific population, rather than generalisable to a range of populations. A comparative analysis of the different studies on the TEA is tabulated in Table 2.

Table 2

Comparative Analysis of the Different Models of the TEA

Criteria / Model	(Robertson et al., 1996) 4-factor	(Chan et al., 2006) 4-factor	(Bate et al., 2001) 4-factor
Sample size and characteristic	N=154 "normal" participants aged 18-80 years	N=21, (mean age 37.29 years), participants with closed head injury versus 21 (mean age 37.19 years) normal controls in Hong Kong, Cantonese version of the TEA used.	Mixed group of normal (N=35, mean age 30.2 years) and patients with severe traumatic brain injury (N=35, mean age 28.9 years)
Factors	Visual selective attention, Sustained attention, Switching attention Auditory Verbal Working Memory	Visual selective attention, Sustained attention Divided attention, Switching attention	Visual Selective attention Sustained attention Divided attention, Switching attention.

Chan et al. (2006) study could not be generalised to an Australian sample of older adults as his sample consisted of Cantonese-speaking Hong Kong people. Results from Chan et al. (2006) study reported ceiling effect in the Elevator Counting subtest, and the Map Search (2 mins) subtest was identified as a problem in the correlation matrix that was not a positive definite. Moreover, 3 subtests (namely 2 subtests – Elevator Counting and Lottery in sustained attention and Visual Elevator) were relatively weak markers of the three factors for the model identified as they had reduced variance possibly due to the relative ease for healthy older adults in completing the tasks. While determining the subtests for the current study, the above results were taken into consideration.

Though TEA was chosen as the best measure of attention for this study for reasons stated above, yet it can be confidently stated that all the studies reporting the factor structure of the TEA for example Bate et al. (2001), Chan et al. (2006), and Robertson et al. (1996) had very low sample size required for confirmatory factor analysis (CFA) (Hu & Bentler, 1999). Given this evident limitation and in consideration of the small sample size (N=63) in this current study, as well as to obtain a robust analysis of the data obtained from the TEA and from other sources (RBANS scores, relevant clinical information) whilst retaining the clinically

significant attributes of the subtest profile, a decision had to be made as to the choice of the TEA subtests to be included that could adequately capture the varied factors of the TEA to be investigated in the current study. Table 3 provides justification for the choice of subtests and the factors considered in the current study.

Table 3

Justification for the Choice of Subtest and Factors of the TEA for the Current Study

Visual Selective Attention – VSA	
Subtest/s chosen	Rationale
MS1-1 min	MS is a task of visual selective attention. Both MS1 and MS2 tasks have the same instructions-the only difference between them is the length of time participants are given to complete the task. MS1 was preferred over MS2 in this study as the latter may have a confounding variant (length of time) which could measure other possible types of attention (example sustained attention) other than VSA. Correlation between MS1 and VS in different models cited ranged between .81 to .91; moreover, MS is one of the subtests that consistently loaded on the VSA factor in the 3 models cited above. MS also showed good test-retest reliability for forms AB (ICC=0.72) in a sample of 90 older adults with chronic stroke (Chen et al., 2013).
Subtest/s rejected	Rationale
MS2- 2 mins	The correlation matrix was not a positive definite due to this subtest (Chan et al., 2006).
TS	Though TS contributed to VSA factor in all the 3 studies cited, it was not considered for the current study as processing speed contributes to the measure of TS. Processing speed as mentioned earlier, is a confounding factor especially with the population studied. Moreover, TS have shown to have small to medium practise effects (absolute value of Cohen's d = 0.15-0.56) when using parallel forms with 90 patients with chronic stroke, due to its demand on speed (Chen et al., 2013).
Sustained Attention – SA	
Subtest/s chosen	Rationale
L	L has consistently loaded on the factor of SA in the 3 models discussed. This task is the longest in duration out of all the subtests of the TEA, hence it is expected that it would capture sustained attention adequately which is the ability to pay focused attention overtime. L also showed excellent test-retest. reliability (ICC=0.67-0.85) in a sample of 90 older adults with chronic stroke (Chen et al., 2013).
Subtest/s rejected	Rationale
EC	EC was found to have ceiling effects and was considered a weak marker leading to reduced variance in a sample of healthy older adults (Chan et al., 2006). The results of the current study also indicated ceiling effects. It loaded on the SA factor for 2 out of 3 models cited.
Sustained Attention – SA	

TSC	TSC only loaded on the SA factor in 1 of the 3 models discussed above. TSC measured performance in dual task response that included identification of target telephone numbers in a list provided while counting auditorily-presented tones simultaneously. Hence TSC loaded on the divided attention factor in 2 of the 3 models cited above.
	Switching Attention – SWA
Subtest/s chosen	Rationale
VE	VE was favoured as the current study was using the (Robertson et al., 1996) model and VE is the only subtest that loads on SWA in this model. Moreover, other confounding factors such as difficulty differentiating tones by older adult participants, who were more likely to have hearing difficulties was considerably minimised in this subtest as the stimuli were presented in the visual modality, and the stimuli were clear and large enough for examinees to see and respond at their pace.
VE1	VE1 (raw accuracy score) which is the number of correct responses was preferred.
Subtest/s rejected	Rationale
VE2	VE2 (timing score) which is the total number of switches correctly completed over the total time spent for each item was not preferred as it factors in speed of processing. Aging affects speed of processing negatively and this maybe a confounding factor in the assessment of the attention ability in older adults. Moreover, VE2 have shown small to medium practise effects (absolute value of Cohen's d = 0.15-0.56) when using parallel forms due to its demand on speed with 90 patients with chronic stroke (Chen et al., 2013).
ECD	Correlation between SA and ECD in varied models cited ranged between .63 and .83 indicating a wider range. The stimuli for the ECD task were presented in an auditory modality, the same problem of difficulty in differentiating tones due to varied levels of hearing difficulties can be expected in the population studied thus increasing the chances of a confounding variable.
ECR	ECR is a measure of auditory verbal working memory in Robertson et al (4 factor model, 1996) and a measure of VSA in Chan et al. (4 factor model 1999).

Note. MS: Map Search; TS: Telephone Search; EC: Elevator Counting; TSC– Telephone Search while Counting measured by dual task decrement; L: Lottery task; ECD: Elevator Counting with Distraction; VE: Visual Elevator; ECR: Elevator Counting with Reversal. ICC: intra-class correlation coefficients.

In summary, the 3-factor model of Robertson et al. (1996) was used in the current study as it was found to be the most parsimonious model among others (Chan

et al., 2006). According to this model, Map Search (1 min), Lottery and Visual Elevator (raw accuracy score) subtests were chosen for the 3 factors namely Visual Selective Attention, Sustained Attention and Switching Attention respectively. Training in the above 3 factors of attention were provided through the Attention Training program in the current study hence the measurement of the untrained factor (divided attention) was not considered to be imperative. Moreover, the functional mechanisms or neuronal pathways underlying divided attention and attention switching overlaps (Wimmer et al., 2015) which makes it difficult to tell whether one is utilising divided attention or switching attention back and forth to complete a task.

Though there may be theoretical parameters that differentiates these 2 factors, clinical and /or functional differentiation of these 2 factors of attention switching and divided attention is nearly impossible. Hence measuring one factor (switching attention) based on the model used was considered sufficient. The rationale for the choice of the above-mentioned subtests can be summarised as consistent loading of those subtests against their respective factors noted in at least 2 of the 3 models cited, robust test-retest reliability, elimination of ceiling effects and possible confounding factors such processing speed and difficulties with hearing in the population studied. To conclude, TEA relies heavily on reasonably intact visual and auditory senses and a fair degree of psychomotor capacity−which makes it increasingly difficult for older adults who often experience deficits in varying degrees on these above faculties thus the potential influence of these deficits was considered in the interpretation of results in the current study.

Considering the gaps in the literature examined in Chapter 2, the impact of a specific group face-to-face Attention Training program on participants' attention ability (core domain) and general cognition was evaluated in both the studies. Study 1 comprising of healthy older adults received both the Intervention training (Attention Training) and the Active Control group training (Relaxation Training) whereas due to a very small number of participants in Study 2 with the MCI sample, only the Intervention training was offered. All participants were tested before and after the receipt of their respective training programs. Detailed below is the rationale and description of the training programs offered in this research.

3.2. Training Programs

3.2.1. Attention Training Program (Intervention Program: Appendix A)

The impact of this intervention training on attention abilities of participants was investigated in this study. This program consisted of the following components: psychoeducation (on topics such as the brain and neuroplasticity, general functions of the brain, cognition in everyday life, types of attention, aging and cognition, attention and driving, factors impacting brain health, cognition training and its use and how can we keep healthy) of 30 minutes duration with mostly video presentation to make it interesting and engaging at the start of the session. This was followed by an individual attention training task of 40 minutes duration, and then a group attention training task of 30 minutes duration. Both targeted one or more aspects of attention namely, visual selective attention, sustained attention and switching attention; each task was followed by discussions and feedback on the challenges and processes participants used when completing the various individual and group tasks of attention which lasted for 10 minutes. A 10-minute break was allocated in the 2-hour session, but participants were so engrossed with the various tasks that they often did not take any breaks.

The ideas for the individual attention training tasks were obtained from Brainwave-R Attention module (Malia et al., 2002) and from the Brain Injury Workbook (Lincoln, 2004), both of which included cognitive training tasks. The Brainwave-R is a comprehensive paper-pencil- based cognitive rehabilitation program and consisted of five modules over varied cognitive domains namely Attention, Visual Processing, Memory, Information Processing, and Executive Functions (Malia et al., 2002). The Attention module of the Brainwave-R program was consulted for this study, that consisted of exercises aimed at optimizing functional skill development through training on basic cognitive skills, generalization, and strategy training for people with moderate to mild cognitive deficits. The Brain Injury Workbook (Lincoln, 2004) used a collection of exercises, games and information sheets, questionnaires, and quizzes for group rehabilitation of individuals with brain injury. Though both these resources were developed for people with cognitive deficits, it was believed that they could be adapted for older adults who were expected to experience some degree of cognitive changes (possibly decline) because of ageing. The specific cognitive exercises on Attention also targeted one or more types of the attention (visual selective, switching attention, and sustained attention) being studied in the current research. Moreover, the same adapted training program could be used with participants with Mild Cognitive Impairment (MCI) in Study 2. It has been well established from the literature review

in Chapter 2, that cognitive training facilitated cognitive health and could possibly arrest or delay cognitive decline by stimulating positive changes at neural and behavioural levels. The participants received training in visual selective, sustained, and switching attention, but not divided attention. This would allow mapping of changes in the three designated types of attention differentially (if any) from divided attention that was not being trained in this study.

Each participant completing the Attention Training, was provided with a compiled booklet by the principal researcher at the start of the program (in the first session). This booklet consisted of topics that were discussed during the psychoeducation sessions throughout the program (**Appendix B).** This allowed the participants to reflect on the topics discussed during and after the completion of the training program.

Table 4

Individual Attention Tasks

Session	Attention types	Tasks	Score
1	Selective	Paced random number Paced random letters	Correctly recognised numbers and letters
2	Selective	Sound targeting and targeting particular word in a song	Correctly identified target sound and target word in the song
3	Selective, Switching	Categorising random words and category targeting	Correctly categorised number of words
4	Sustained, switching	Reverse counting	Number of errors / total number completed
5	Selective, switching and sustained	Addition/subtraction	Number of errors / total number completed Number of errors in switching/total switches
6	Switching	Variable attention with number switching task	Number of switches recognised
7	Selective, sustained	Paced random numbers with Music Paced random numbers with commentary	Correctly recognised numbers
8	Selective, sustained	Random dot to dot pictures	Total dots joined minus errors.
9	Selective and switching	Adding all odd numbers from list read out Adding a target number from a string of numbers presented auditorily Multiplying numbers	Correct numbers completed
10	Selective and sustained	Decoding	Number of words correctly decoded.

Group tasks utilized in the Attention Training program consisted of tasks that tapped three types of attentional skills such as visual selective, switching and sustained attention tabulated below.

Table 5

Group Tasks

Session	Task
1	"Get to know"- noting specific information from group members and introducing group members in pairs
2	Game "Simon says"
3	Action in numbers
4	20 Questions
5	Working out various types of puzzles in pairs
6	Storytelling using target phrases and remembering others' stories re-tell in the group.
7	Geometric Designs
8	Mindful drawing
9	Story with target faces and maps, remembering and re-telling the other groups' stories
10	Take Home Message

3.2.2. Relaxation Training Program

Changes in human behaviour are impacted by numerous intrinsic and extrinsic factors, which make accurate accountability for such change quite difficult. Therefore, a relaxation training active control group as part of the randomised control trial was required to evaluate the attention training program. The relaxation training program also consisted of 10, 2 hours weekly sessions. Participants attending the Relaxation training were given a CD on relaxation **Appendix C**: Gibson and Gibson (2022) and participants were encouraged to use this CD on a regular basis. The Relaxation training program consisted of an hour of psychoeducation (comprising of topics such as the brain and neuroplasticity, stress and its management, role of relaxation in managing stress, autogenic relaxation, progressive relaxation technique with and without tension, visualisation, guided imagery, and factors affecting brain health), and an hour of relaxation practise that included diaphragmatic breathing exercises, progressive muscle relaxation with and without tension, guided imagery, visualization exercises, fun activities such as watching movies, taking leisure walks and playing games that allowed the expression of emotions people may experience in their daily lives.

CHAPTER 4: STUDY 1 - EXPLORING THE IMPACT OF ATTENTION TRAINING ON THE ATTENTION ABILITIES OF HEALTHY OLDER ADULTS (HOA)

4.1. Background and Objectives

Age-related cognitive decline including attention difficulties, was explained by two important mechanisms namely limited time mechanism and the simultaneity mechanism. Moreover, it was found that older adults experienced difficulties inhibiting irrelevant information from the focus of attention that in turn affected the smooth operation of higher cognitive processes, such as reasoning, decision-making, problem-solving, and language understanding. Additionally, diminished utilisation of effective processes including attention, at either encoding or retrieval, impair memory accuracy. Therefore, age-related changes in HOA were noted in selective attention with specific difficulties in filtering auditory distraction from distinct spatial location, right attentional bias, decline in interference control and selectivity, and in active image processing. Functionally, such difficulties in selective attention predicted falls risk in HOA. (Fernandez et al., 2019). The onset of decline in sustained attention with age was found to be delayed than the onset of other forms of attentional declines. Divided attention declines in the elderly affected performance of complex tasks, affecting various areas of everyday functioning in them. Selective attention and divided attention were reported to improve with training whereas alternating attention did not improve with training. Though, the Scaffolding Theory of Ageing and Cognition (STAC) discusses the brain's ability to compensate for the losses brought about by ageing when provided with an enriched environment, it has been difficult to systematically evaluate this in practise. One of the many ways of providing an enriched environment for the ageing brain has been the utilisation of cognitive training (CT) programs. The impact of cognitive training on attention abilities of HOA have been scarce in the literature due to various reasons. The utilisation of non-specific training and training in cognitive areas (memory training and training in executive functioning) other than attention (Nguyen et al., 2019; Racine et al., 2017), make it difficult to attribute the training impacts on changes in attention abilities. Moreover, most systematic studies on CT measured the impact of CT on varied cognitive domains, among which attention was one (Hallock et al.,

2017; Sala et al., 2018). Of the rare single-studies investigating attention with HOA, the following conclusions were drawn: improvements were noted in sustained and focused attention with multidomain cognitive training (Gajewski et al., 2020), older adults were found to benefit in attention control from dual-task training (divided attention with variable allocation) than single task training (Bier et al., 2018), and improvement in digit-symbol coding and digit span (tasks of attention) were found with multidomain cognitive training (Golino et al., 2017). Thus, Study 1 investigated the specific impact of Attention Training on attention abilities (namely selective attention, sustained attention, divided attention and alternating attention) of HOA. No changes in divided attention were expected as the attention training implemented in this study did not include divided attention tasks. This exclusion was considered as it would allow the researcher to accurately map the impact of the attention training tasks on the specific attention abilities measured in Study 1.

4.2. Research Aims

1. Does a structured Attention Training program influence change in the attention abilities of cognitively healthy, older adults?
2. Does a structured Attention Training program benefit the Active Control group of participants and the Partial Crossover group, who receive Attention Training after their Relaxation Training?

Based on the above research questions the following hypotheses were deduced.

4.3. Hypotheses

1. The Attention Training program was expected to produce greater positive changes in attention ability and general cognition among healthy older adult participants (Intervention group) than their matched peers in the Relaxation Training (Active Control group).
2. For the Partial Crossover group, greater positive changes on attention and general cognition, were expected after this group received the Intervention Training.

4.4. Method

The CONSORT 2010 checklist for reporting randomised controlled trial was followed (Moher et al., 2010).

4.4.1. Trial Design

This was a non-stratified (aged 60 to 80 years), with imbalanced randomisation, double-blind, conducted in Toowoomba, Queensland. Participants

were randomly assigned to one of the six parallel groups, initially to receive either the Attention training or the Relaxation Training program. Once randomly allocated, participants in the Active Control group (those receiving the Relaxation Training) requested to go through the Attention Training program. Keeping in mind best practise guidelines based on the premise that if any intervention is predicted to influence positive gains, then it is ethically unacceptable to deny an intervention, amendments to this study was requested and approved by Darling Downs Health (DDH) Human Research Ethics Committee (HREC) and the University of Southern Queensland (USQ) Human Research Ethics Committee. Then interested participants of the Active Control group were subsequently assigned to the partial cross over group to receive the Attention Training program.

4.4.2. Participants

4.4.2.1. Eligibility Criteria. *Inclusion criteria:* Participants were recruited from the community and was aged between 60 years and 80 years, did not hold a diagnosis of Mild Cognitive Impairment (MCI) and/or Dementia in the last 3 months prior to recruitment. On the RBANS Update Form A, participants' scores were at least equal or above the mean, for their age and education matched peers on culturally appropriate normative data (APA, 2013). No reports of functional or cognitive decline as noted by client, significant other or GP. Participants were informed that they will be re-assessed of their eligibility status by using RBANS, if they or their significant other or their GP reported any rapid cognitive decline, during their participation period.

Exclusion criteria: People with a current or predicted diagnosis of Dementia (for both groups 1 and 2) and a predicted or current diagnosis of MCI (for healthy older adult group 2) were excluded from the study. If healthy older adults' scores are found to be suggestive of the possibility of either MCI or Dementia (2 or more SD or 3rd percentile or below appropriate norms, APA, 2013), they were provided a letter addressed to their GP, detailing their assessment results and they were encouraged to consult their GP with that letter.

Other exclusion criteria included severe sensory impairment that could potentially impact on their performance, acute medical condition or a severe medical condition needing intensive treatment, and intellectual impairment. These people are excluded as such conditions will hinder their ability to participate in the interventions.

A total of 63 healthy older adults aged between 60 and 80 years, who were independent in their daily activities and were able and willing to participate in regular group sessions (once a week for 10 weeks) were recruited for Study 1. According to the Scaffolding Theory of Aging and Cognition (Reuter-Lorenz & Park, 2014), scaffolding needs to be provided in a timely manner; with progressive age and absence of appropriate intervention, the brain's ability to provide effective compensation can weaken over time. Moreover, there appears to be limited appropriate standardized and psychometrically sound testing that can measure cognition and attention of older adults above 80 years of age. This provided a rationale for the determination of the target age group for this study (60-80 years). Three interested participants over the age of 80 years, functioning independently in the society, were consequently declined.

All participants had basic reading and writing abilities as indicated by their educational status (completion of primary level education at the least) this was one of the main criteria, as participants needed sufficient comprehension to allow them to fully understand and participate in the assessment and training provided. The American Psychiatric Association (2022) suggests that people who score between 1 and 2 standard deviations below the mean for the impaired domain/s, for one's age and education matched peers, on culturally appropriate norms, may qualify a diagnosis of Mild Cognitive Impairment (MCI). Therefore, healthy older adults who obtained a total index score of 85 and above (corresponding to a percentile rank of 16 and above) for their age and education matched peers, on RBANS Update Form A (assessment tool used for eligibility), were considered cognitively intact and were eligible for the study. For the RBANS (Update A) total index score, 5 participants scored in the very superior range (130 and above), 6 participants scored in the superior range (120-129), 15 participants scored in the high average range (110-119), 32 participants scored in the average range (90-109) and 5 participants scored in the low average range (85- 89 with 85 being the cut off score for this group of participants).

4.4.2.2. Settings and Location Where the Data Were Collected. Several recruitment drives were initiated. University 3rd Age, or U3A, members were believed to be ideal for this study as they satisfied all the eligibility criteria namely age, education level, cognitive status (not diagnosed with Mild Cognitive Impairment, MCI or dementia), and occupational commitments. Moreover, they appeared to be motivated to engage in activities that they believed would help them,

if not improve their cognitive health. These U3A members were cognitively healthy older adults or those in their 'third age', retired, semi-retired and usually with no parental responsibility who had joined U3A to enjoy an active retirement (for many), to form new friendships, develop personal interests, and discover the benefits of lifelong learning in a safe, comfortable environment. The programs offered as part of the current research (Attention Training and Relaxation Training) were assumed to provide a novel and enriching experience similar to the programs offered through the U3A initiative. Thus it was anticipated that retention rates would be good as these participants were engaged in active retirement (Stevens et al., 2021), through the U3A programs.

The President of the U3A (Toowoomba branch) was approached, who helped to advertise the study through their Facebook page. The principal researcher also delivered an education session at the U3A's Dynamic Ageing Lecture series, which was attended by one hundred and fifty U3A members. A presentation was also conducted for the Arthritis Support Group (Toowoomba branch) in one of their regular monthly meetings. Several other organisations such as the Toowoomba Regional Council (TRC), the Probus Club of Toowoomba, as well as the Editor of the Senior's Weekly newsletter, were contacted by email and phone, by the principal researcher for recruitment. TRC assisted in the recruitment by advertising the study in one of their monthly newsletters for seniors. Pamphlets **(Appendix D)** were distributed widely, and word of mouth assisted in the recruitment drive. Eligibility assessments, pre-post training assessments and the trainings were provided at the University of Southern Queensland's Psychology Clinic (Toowoomba campus).

4.4.3. Interventions

4.4.3.1. Ethical Permission for Study 1- Healthy Older Adults.

Permission to conduct Study 1 was received from the Darling Downs Health (DDH) Human Research Ethics Committee (HREC) with an approval number HREC/18/QTDD44877, and the University of Southern Queensland (USQ) Human Research Ethics Committee with an approval number H19REA038 **(Appendix E).** All the relevant guidelines outlined in the National Statement on Ethical Conduct in Human Research (National Health and Medical Research Council et al., 2018) and the University of Southern Queensland guidelines (University of Southern Queensland, 2019) were conscientiously followed. An amendment to Study 1, with amendment number HREC/19/QTDD/44877/AM03, to the original ethics application was submitted and approved in February 2020. This was also accepted

by USQ HREC. The amendment sought permission to use the data collected on the RBANS and TEA from the partial cross-over group. Once ethical approvals were granted, the recruitment drive detailed in the above paragraphs was initiated. At the same time this research was registered with the Australian New Zealand Clinical Trial Registry (Trial ID: ACTRN12619000820101, **Appendix F**) and changes to the original protocol were also updated in the ACTRN register. Participant Information Sheets with Reply Slips were distributed to interested parties (U3A, Arthritis Support Group, Toowoomba Regional Council, The Probus Club of Toowoomba and so on).

4.4.3.2. Initial Contact for Recruitment. The principal researcher contacted the prospective participants who enquired about the research. In the initial contact over the phone, the principal researcher explained about the research (in particular, the aims and what participation involved) to the interested party, and then emailed or posted them the Participant Information Sheet and Reply Slip **(Appendix G).** The principal researcher, after receiving back the completed reply slips, contacted the prospective participants by phone, followed by an email confirming their scheduled appointment for eligibility testing and pre-assessment **(Appendix H).**

4.4.3.3. Training of Research Assistants. Pre and post training assessments were conducted by trained USQ Master of Clinical Psychology students as part of their practicum included in their study program. The Clinic Director of the Department of Psychology and Counselling, USQ was approached by the principal researcher in person, followed by an email, to help identify appropriate students (students in their first year of Master of Clinical Psychology program who were completing their clinical placement at the USQ Psychology clinic) interested and available to assist with data collection. For their assistance in data collection for this study, the students were able to count these data collection hours as face- to- face clinical hours for their first practicum, and the training provided by the principal researcher was counted towards their clinical supervision hours in the same practicum. These students (research assistants) were provided with training on the specific assessments (RBANS and TEA) by the principal researcher prior to commencing the assessments. The structure of the pre-training assessment was also explained to the research assistants, and they were also provided with clear written instructions. Such structured training of the research assistants at various points throughout the study ensured consistency of instructions and enabled the research assistants to conduct the assessments in a consistent and standard way. This was

vitally important to improve the conditions of generalisability of the data obtained and improve its conditions of reliability (Liamputtong, 2020).

4.4.3.4. Eligibility and Pre-Training Assessment. Pre-training assessments were scheduled in consultation with the trained research assistants. Once mutual dates and times were finalised, the research assistants received an email copy of the participants they were allocated to assess. On the day of the pre-training assessment, the research assistant welcomed the participant, re-explained the key points highlighted in the participants' information sheet before obtaining consent for the pre-training assessment. At this stage, participants completed the clinical questionnaire (**Appendix I)** that collected relevant demographic information of the participants, and signed Consent Form 1 **(Appendix J:** consenting to the eligibility assessment) before completing the RBANS (Update, Form A) assessment. After that the participant took a short break while the research assistant scored their RBANS (Update Form A) responses to determine whether the participant qualified for the research. Then the participant was told by the research assistant about their eligibility status, and only eligible participants went on to further sign the Consent Form 2 **(Appendix K**: consenting to participate in the respective training programs they will be allocated to and in the post -training assessments) and complete the rest of the pre-training assessment (TEA- Form A). Participants who did not qualify for the research were informed by the research assistant that the principal researcher would contact them for further information and guidance. The principal researcher then contacted the ineligible participants, explained to them the reason for their ineligibility, and provided them with options to seek further help if they desired (Such as, getting a referral from their GP to be seen in a Memory Clinic for further investigation into their reported and observed cognitive difficulties.) – a letter to aid this follow-up was provided by the Principal Researcher (**Appendix L**) to the participant.

4.4.3.5. Trainings Provided. Participants were randomly allocated to the Attention Training (Intervention group) and the Relaxation Training (Active Control group) (Invitations to Training Programs letter – **Appendix M**) described in Chapter 3. Participants in the Intervention group received 10 weeks (2 hours weekly) of structured Attention Training program and the Active Control group participants received the same number of Relaxation Training sessions, in the same frequency. The psychoeducation provided in the last session of the Attention Training program was a recapitulation of the information provided to the participants in the

psychoeducation sections of the previous 9 sessions, referred to as "Take Home" messages. Both types of training were provided by the principal researcher. Principal researcher kept a record of the individual participants' performance on each individual task completed for the entire 10 weeks' program.

Upon completion of the Relaxation Training, interested participants of the Active Control group (n = 21) who formed the Partial Crossover group, were contacted by the principal researcher and were further offered the same Attention Training Program (10 weekly sessions x 2 hrs each) in groups of 5 participants maximum. Thus, this group received 10 sessions of Relaxation Training (as Active Control group participants) and 10 sessions of Attention Training (as Partial Crossover group participants.

4.4.3.6. Post-Training Assessment and Feedback. After completion of the group training programs (Attention Training and Relaxation Training), each participant was re-assessed using the RBANS (Update Form B) and the alternate form of the TEA by the research assistants. Mutually scheduled appointments for post-training assessments were organised by the principal researcher who communicated with both parties about their scheduled appointments (**Appendix N**). Feedback on the entire Attention Training program **(Appendix O**) as well as feedback on the challenges and processes used by the participant for each individual task were collected from all participants, individually. This feedback was utilised to justify some of the findings of Study 1 elaborated in the discussion section of this research. As measurement-based care is an undisputed element of best practise, the Active Control group participants were re-assessed by the research assistants, upon completion of their Attention Training program by the alternate forms of the same assessments (RBANS and TEA), even though initially it was not determined whether this data will be used in the current research.

4.4.4. Outcomes

4.4.4.1. The Repeatable Battery for the Assessment of Neuropsychological Status (RBANS). The measures in the dataset included the RBANS Update Form A and B (Randolph, 2012). RBANS (Update A) was initially used as an eligibility measure in this study. Participants had to obtain a total index score of 85 and above to qualify for this study. Then eligible participants' RBANS (Update A) scores were used as the pre-training assessment data set which was compared against their RBANS (Update B) scores that was obtained after completion of their respective training. Two RBANS measures were analysed namely the total

index score (measuring overall cognitive ability) and the Attention index score (measuring overall attention ability).

1. *RBANS total index score:*

The RBANS total index score was obtained from the cumulative index scores from the 5 domains of the RBANS (namely Immediate Memory, Visuospatial/Constructional, Language, Attention and Delayed Memory).

2. *Attention index score of the RBANS:*

Attention ability on the RBANS was examined by recalling a series of numbers (Digit Span) and completing a visual scanning task (Coding).

4.4.4.2. Test of Everyday Attention (TEA – form A and B), (Robertson et al., 1994). The TEA (Forms A and B) was another pre-post training assessment tool. The rationale for the choice of these measurement tools in the current study was explained in Chapter 2.

There are 8 subtests factor analysed into 4 domains of the TEA namely: Visual Selective attention, Sustained attention, Attention Switching and Divided Attention. The TEA does not generate either a total score, or a domain-specific total score; each subtest of the TEA can be analysed individually that reflects their respective domains. Only 3 out of 4 domains of the TEA were examined in this study for reasons discussed in Chapter 2. Moreover, the analysis for this study (see below) examined each domain of the TEA with only one subtest namely Map Search (1 min) contributing to the visual selective attention domain, Visual Elevator (raw score) contributing to the switching attention domain and the Lottery subtest contributing to the sustained attention. The rationale for the choice of the domains and their respective subtest has been explained in Chapter 2.

1. *Map Search (visual selective attention):*

In the Map Search (1 min, MS1) subtest of the TEA, participants had to search for target symbols on a coloured map. Higher number of symbols identified within the 1 minute indicated better performance, than low number of symbols identified within that stipulated time (1 minute).

2. *Visual Elevator (VE1, switching attention):*

The VE1 task required participants to count the number of floors one has imaginarily travelled by looking through a series of "doors" pictured as elevators and arrows pointing up and down indicating the direction the elevator is travelling to.

3. *Lottery subtest: (L, sustained attention):*

In the Lottery task, participants were required to identify the letters preceding the stimulus double digit number of a "lottery" from a long list of lottery numbers that is auditorily presented to the participants for 18 mins 36 secs (Form A) and 19 mins 14 secs (Form B) at a stretch.

4.4.4.3. Clinical Observations during Intervention Training.

Understandings of participants' worldviews can enrich the interaction between practitioners and researchers and provide creditability to the quantitative data gathered. The aim of any research is to implement the findings in real-life and improve the current understanding on the topic and quantitative data is unable to give meaning to the subtleties detected through such observations. Thus, in the current study, participants were asked to provide their insights into how the training tasks (for the Intervention program – Attention Training program) challenged them and what strategies they found useful in completing the training tasks. To capture this data, a feedback form (Appendix I) was designed by the primary investigator to obtain feedback from the participants. In addition, after completion of each individual task of attention in the Attention Training program, participants were asked the following questions: what was easy for you? What were the challenges? What processes or strategies did you use to complete the tasks? The common themes that emerged from this data were collated and reported. Since the current research was a cognitive-based study, it was not deemed necessary to collect qualitative data initially, however, the researcher who is also a practising psychologist considered it necessary to gather this clinically meaningful data which could thoroughly explain the strategies and processes participants used to complete the various tasks and add value and understanding to the quantitative outcomes assessed formerly in the study. Another reason for gathering qualitative findings was to capture the importance of social interaction and how it might affect cognitive outcomes, that became increasingly evident as the trainings progressed.

4.4.5. Sample Size and Its Determination

Practical significance of a study is indicated by the effect size as opposed to its statistical significance that is influenced by sample size. Effect sizes are independent of sample size and shows that the effect is large enough to be meaningful in the real world. As such the APA guidelines require reporting of effect sizes (Bhandari., 2020). A-priori sample size was determined by G power analysis. This was calculated for medium effect size (.20 to .50) for 2 groups (namely one treatment and one active control group of participants), with repeated measures pre-

post training (Cohen & Cohen., 2008). Hence the total number of participants was calculated to be 64 with 32 in the treatment group and 32 in the active control group, however a total of 63 participants was recruited with an uneven distribution of 34 participants in the Intervention group and 29 in the Active Control group as explained in the flowchart.

4.4.6. Randomisation and Blinding of Sample

The ideal number of participants for any given cohort was determined to be 16, to be randomized into 2 groups of a maximum of 8 participants each, however in practice, this could not be achieved for various reasons (withdrawal of participants upon recruitment, predicted delays in the recruitment due to the pandemic situation, participants being away for varied reasons such as holidays, family commitments and so on). The size of a group should not exceed 6-8 participants as recommended by practitioners from diverse program (Stewart et al., 2009). Considering that there was only one facilitator, a group size of more than 8 was certainly not recommended. As such the facilitator would be able to pay individual attention to each and every participant in the group, encouraging optimal participation and interaction among group members.

To maintain confidentiality, each eligible participant was coded with a number (1-64) based on the order of their recruitment to the study. Once a minimum of 10 participants were recruited, codes 1-10 were fed into the "List Randomiser" program from "Random. Org". This program randomly renumbered participants, for example, participants (indicated by P) 1 to 10 (original code) might have the following new codes generated by the "list Randomiser".

P1 was newly coded to P8
P2 was newly coded to P1
P3 was newly coded to P9
P4 was newly coded to P4
P5 was newly coded to P3
P6 was newly coded to P10
P7 was newly coded to P6
P8 was newly coded to P2
P9 was newly coded to P5
P10 was newly coded to P7

The new codes were then used to assign participants to the 2 groups (for example 1-5 were allocated to the treatment group: Attention Training and 6-10 were

allocated to the control group: Relaxation Training (Appendix O). This method of randomisation meant that participants were not favoured in the order of their recruitment. This phase of randomisation was over and above the general reasons for randomisation (elimination of selection bias, maintain balance between the groups with respect to many known and unknown confounding or prognostic variables, and free statistical test of the equality of treatments). This method was used for all 63 coded healthy older participants.

4.4.7. Statistical Methods

4.4.7.1. 2x2 Repeated Analysis of Variance (ANOVA). 2x2 ANOVA was chosen for analysis of results for Hypothesis 1, as the main effects and interactions to be studied were a series of dichotomous independent variables (Tabachnick & Fidell, 2006). The research question was whether there was a significant difference between the intervention (Attention Training) group and the Active Control (Relaxation Training) group on the varied measures at time 2. The independent variable was the training program offered (Attention Training or Relaxation Training). Participants were assessed at two time points. The first suite of measures was completed face- to-face prior to commencing their respective training program (time 1− pre-training assessment) and the same suite of measures were completed by participants after completion of their respective training programs (time 2 − post- training assessment). Five dependent variables that measured the outcome of the trainings provided (Attention Training or Relaxation Training) were as follows: the total index score of the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS – Update) measuring overall cognitive ability, Attention index score of the RBANS measuring overall attention ability and the raw scores of the 3 chosen subtests of the Test of Everyday Attention (TEA) Map Search in 1 min (MS1), Visual Elevator (VE1) and Lottery (L) measuring visual selective attention, switching attention and sustained attention. The rationale for the choice of only 3 subtests of the TEA from a total of its 8 subtests have been explained in Chapter 2. The two-way repeated-measures ANOVA compared the scores in the 2 different conditions (Attention Training versus Relaxation Training) across 2 time points (pre- and post- training), as well as examined the interaction between them. Data was calculated from 63 participants (N=63; 34 Intervention group and 29 Active Control group).

4.4.7.2. One-Way Repeated Analysis of Variance (ANOVA). A one-way repeated ANOVA was conducted to evaluate the null hypothesis, whether there was any change in the Partial Crossover group's (N = 21, formed from the interested

participants of the Active Control group) RBANS index score (overall cognitive ability), attention index score (overall attention ability), MS1 (visual selective attention), VE1 (switching attention) and L (sustained attention) scores when measured before, and after participation in the attention training.

Study 1 data was analysed using Version 27 of the Statistical Package for Social Scientists (IBM Corp, 2021).

4.4.8. Data Management

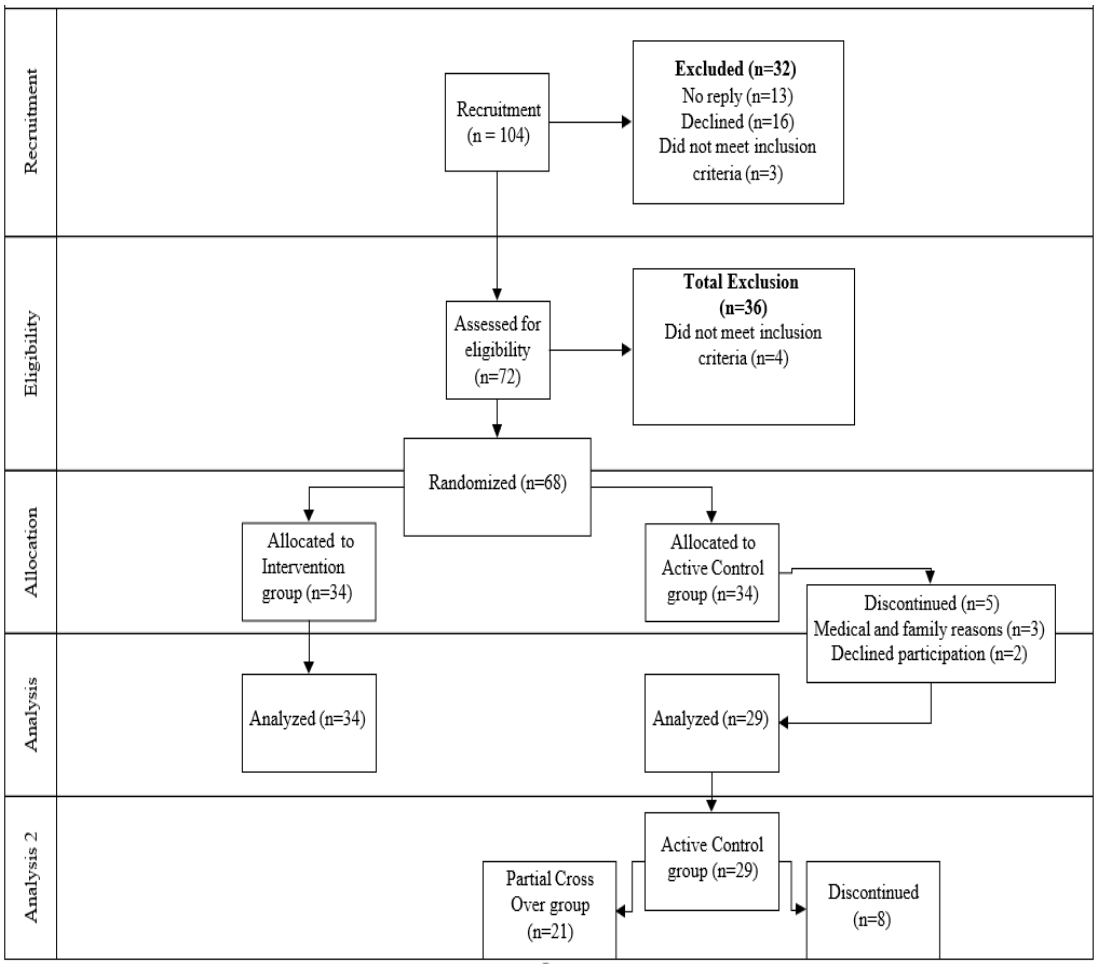
A research data management plan was completed according to the USQ research ethics guidelines. Hard copy files for Study 1 participants were stored in the locked filing cabinet in the USQ Psychology Clinic with restricted access to the principal researcher only. Digital data was stored in a system called the Research Data Bank Storage Application (ReDBank). An application to set up and access this system was obtained after USQ ethics approval. Through ReDBank, data was stored in a way that aligned with USQ's Research Data Management Policy. Responsibility for this study's data management resided with the principal researcher and the research (HDR) supervisors (associate investigators). Research supervisors only had access to the coded data. Interested participants were provided with a synopsis of the outcome of the research after completion of the study. A lucky draw of $100 was conducted towards the end of the study as a token of appreciation to participants for their participation in the study. The principal researcher also shared the findings through various clinical and peer reviewed publications, conferences, and poster presentations.

4.5. Results

4.5.1. Participant Flow

Figure 4

Participant Flow



4.5.2. Recruitment

Recruitment of participants was carried out in blocks or cohorts. The reason for this is that as there was only one facilitator, a group of maximum 8 participants could only be formed (reasons explained in the above paragraphs). Since there were 2 groups, only a maximum of 16 participants could be recruited in a cohort for equal randomisation to take place. As such, 6 cohorts were ultimately formed with 10-12 participants in each cohort except for one that had 9 participants who went through the training towards the end of 2019. As no intervention could be provided during the Christmas vacation, a decision was made to proceed with the already recruited 9 participants before the holiday period, as delaying the group until the new year could possibly lead to increased attrition. Eligible participants were recruited from February 2019 to January 2021. The two programs were delivered in groups from May 2019 to March 2021. The Partial Crossover group program was delivered in 3 groups from January 2020 to July 2021. Once a cohort was obtained, participants in that cohort were randomly assigned to either the Attention Training group or the

Relaxation Training group using a computer-generated randomization number available at random.org (Gibbs, 2007). The intention was that each group would receive equal number of participants. This, however, could not be achieved due to withdrawal of participants after recruitment as explained in the flowchart.

4.5.3. Baseline Data

Table 6

Demographic Characteristic of Healthy Older Adults (HOA)

Characteristics	**Intervention Group**	**Active-Control Group**	**Partial Crossover Group**	**Total Sample**
Age				
60-80 years	34	29	21	63
Gender				
Male	2	6	4	8
Female	32	23	17	55
Marital Status				
Married	14	17	11	31
Divorced	8	6	5	14
Widow	11	3	2	14
Never married/Single	1	2	2	3
In a relationship	0	1	1	1
Educational level				
Primary	2	2	2	4
Secondary	6	9	5	15
Tertiary	22	15	13	37
Trade	4	3	1	7
Employment Status				
Retired	28	27	20	55
Semi-Retired	6	2	1	8
Sensory Deficits				
No Impairment	1	3	1	4
Vision (glasses)	26	18	14	44
Hearing (with aids)	2	1	1	3
Both (using aids)	5	7	5	12
Medical Condition				
0-1 condition	20	15	10	35
>1 condition	14	14	11	28
Prescriptive Medication				
0-1 medication	17	13	10	30
>1 medications	17	16	11	33

4.5.4. Descriptive Statistics

The means and SDs of total RBANS index score and Attention index score (RBANS) for both the groups (Attention Training and Relaxation Training) of participants aged 60-80 years in this study, were similar to the mean and SD for the standardization sample aged 60-69 and 70-89 years with higher than HS level education. This similarity could be possible due to the education levels of the current sample which were mostly high school and greater (15, 37 and 7, participants in the current study had secondary, tertiary, and trade education levels respectively, totalling 59 out of 63, total number of participants). No normative data were available for the measures of the TEA.

Table 7

Descriptive Statistics with RBANS Measures for Both Time Points

	Time 1				Time 2			
	Intervention		Active Control		Intervention		Control	
Scale	M	SD	M	SD	M	SD	M	SD
RBANS TIS	108.94	14.42	106.24	11.34	109.29	13.19	107.48	11.02
Attention IS	107.50	15.72	104.90	14.83	110.35	15.73	107.86	11.07

Note. IS = Index scores

Table 8

Descriptive Statistics with TEA Measures for Both Time Points

Scale	**MI**	**SDI**	**MAC**	**SDAC**
MS1 Time 1	27.03	11.915	24.97	9.916
MS1 Time 2	18.41	7.390	20.93	7.096
VE1 Time 1	8.71	1.528	8.72	1.386
VE1 Time 2	9.15	1.329	9.14	1.093
L Time 1	9.03	1.314	9.62	.728
L Time 2	9.21	1.298	9.55	.827

Note. MI = Mean for Intervention Group, SDI = SD for Intervention group
MAC = Mean for Active Control group, SDAC = SD for Active Control group

4.5.5. Data Screening

Prior to conducting analyses on the data obtained at each time point (pre-training and post-training assessments) for Study 1 group of healthy older adults, all data gathered over the 2 time points for each dependent variable (overall cognitive ability measured by the RBANS total index scores, overall attention ability measured by the Attention index scores, visual selective attention, switching attention and sustained attention measured by the Map Search−MS1, Visual Elevator−VE1, and Lottery− L subtests of the TEA respectively) − a total of 10 dependent variables, were screened using SPSS 27, for accuracy of data input, missing data, duplicate cases, and evaluation of the multivariate analysis, assumptions of normality, linearity, homogeneity of variance (homscedascity), multicollinearity, and multivariate outliers. No missing values or duplicate data were detected in the data set.

a) Skewness and Kurtosis

The thumbnail cut-off of the absolute value of twice the standard error was considered in the evaluation of skewness and kurtosis, in all the variables studied, as an initial test of normality (Cohen, 2013). The RBANS total index scores (overall cognitive ability), the attention index scores (overall attention ability), and the MS1 (visual selective attention) scores met the critical cut-off for skewness for both time points, whereas the VE1 (switching attention) and L (sustained attention) scores did not meet the critical cut-off for skewness for both time points. The latter scores were all skewed to the left or negatively skewed. Since for both time points the skewness for the VE1 and L were on the left, and since the raw scores of these two measures were used (Chapter 2 provides rationale for the use of the raw scores), which had a maximum score of 10 and majority of the sample scored between 9 and 10, indicating ceiling effects and the skewness for these measures were considered normal.

The RBANS total index scores, the attention index scores, and the MS1 scores for both time points met the critical cut-off for kurtosis, whereas the VE1 the L scores for both time points did not. Both these measures at both time points were leptokurtic indicating that most participants gained the maximum score of 10, that was achievable for these measures. Thus, inclusion of the participants who had low scores in these measures was acceptable as such low number of deviant scores would not have any significant impact on the whole statistical analyses. Moreover, the distributions were remarkably consistent over the two time points, and performing transformations in the data to boost robustness in statistical techniques would

diminish the clinical significance of the data (Tabachnick & Fidell, 2006). Given that this is a clinical thesis, focus on the meaningfulness of the data was deemed more important than the normality of assumptions. Violation to the normality or any other statistical assumption may only influence the statistical robustness of the data negatively but would not necessarily invalidate the data (Tabachnick & Fidell, 2006).

b) Shapiro-Wilk's Test

Data was also analysed for normal distribution using the Shapiro-Wilk's test. The data was considered to have a normal distribution and the null hypothesis was accepted for the RBANS total index score for time 1, and the Attention index scores and the MS1 scores for both time points as the Shapiro-Wilk's test of normality for each of these measures were greater than p = .05; for all the other measures (RBANS total index score for time 2 and the VE1 and L scores for both time points) the null hypothesis was rejected and the data obtained were not considered to be normally distributed as their individual Shapiro-Wilk's test of normality were lower than p = .05

c) Multivariate Outliers

Data obtained for each of the variables (RBANS total index score measuring overall cognitive ability, Attention index score measuring overall attention ability, MS1, VE1 and L measuring visual selective attention, switching attention and sustained attention respectively) at both time points were screened for multivariate outliers using the Mahalanobis distance (MAH) ($p < .001$). No outlier was detected.

4.5.5. 2x2 Analysis of Variance (ANOVA)

a) Main Effect (Time)

The time main effect suggested no significant change over time for the combined groups for the RBANS total index score (overall cognitive ability), VE1 (switching attention), and L (sustained attention). In contrast, the main effects for each of the Attention index score (overall attention ability) and MS1 score (visual selective attention), suggested statistically significant change over time for the combined groups. This is depicted in Table 9.

Table 9

Main Effect (Time)

Time	Wilks' Lambda Value	F	Hypothesis df	Error df	Sig	n^2

RBANS (Total)	.99	.39	1.00	61.00	.53	.01
Attention Index Score	.93	4.40	1.00	61.00	.04	.07
Map Search 1 (MS1)	.61	39.20	1.00	61.00	<.00	.40
Visual Elevator (VE1)	.95	3.27	1.00	61.00	.08	.05
Lottery (L)	1.00	.11	1.00	61.00	.75	.00

b) Main Effect (Time* GROUP)

Table 10 indicated that there was no interaction between training group and time for RBANS total index score (overall cognitive ability), Attention index score (overall attention ability), Visual Elevator (VE1, switching attention) and Lottery (L, sustained attention) scores. However, for MS1 scores (visual selective attention), there was a significant interaction between group and time, with participation in the groups leading to weaker performance over time.

Table 10

Main Effect (Time GROUP)*

Time*GROUP	Wilks' Lambda Value	F	Hypothesis df	Error df	Sig.	n^2
RBANS Total Index score	1.00	.12	1.00	61.00	.73	.00
Attention Index Score	1.00	.00	1.00	61.00	.97	.00
Map Search 1 (MS1)	.92	5.14	1.00	61.00	.03	.08
Visual Elevator (VE1)	1.00	.00	1.00	61.00	.95	.00
Lottery (L)	.99	.55	1.00	61.00	.46	.01

c) Tests of Between-Subjects Effects

Table 11 indicated no significant group effect for RBANS total index score (overall cognitive ability), Attention index score (overall attention ability), MS1 (visual selective attention), and VE1(switching attention) scores. Moreover, RBANS total index score (overall cognitive ability) for intervention and active control groups in time 1 were different as obtained from their mean scores in time 1 and the groups maintained this difference in time 2 (as noted from their mean scores). For the L subtest (sustained attention), the groups' scores in time 1 differed (mean score for intervention group was 9.03 and mean score for active control group was 9.62). But the groups did not interact differently with each other, with change over time. Therefore, the significant group effect noted above was not further investigated.

Table 11

Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig	n^2
			RBANS Total Index Score			
Intercept	1460132.58	1	1460132.58	5395.14	<.00	1.00
GROUP	159.25	1	159.25	.59	.45	.01
Error	16508.96	61	270.64			
			Attention Index Score			
Intercept	1451034.51	1	1451034.51	3981.56	<.00	.99
GROUP	203.09	1	203.09	.56	.46	.01
Error	22230.79	61	364.44			
			Map Search − MS1			
Intercept	65284.00	1	65284.00	457.71	<.00	.88
GROUP	1.62	1	1.62	.01	.92	.00
Error	8700.54	61	142.63			
			Visual Elevator − VE1			
Intercept	9981.78	1	9981.78	5255.54	<.00	.99
GROUP	.00	1	.00	.00	.99	.00
Error	115.86	61	1.90			
			Lottery − L			
Intercept	10950.36	1	10950.36	7096.44	<.00	.99
GROUP	6.87	1	6.872	4.45	.04	.07
Error	94.13	61	1.54			

d) Pairwise Comparisons – Time

Table 12 depicting pairwise comparisons (time) for MS1 scores (visual selective attention) indicated that there was statistically significant difference between the treatment group and the active control group over time (between time 1 and time 2) and both the groups performed poorly in time 2 compared to time 1. Moreover, the Active Control group (mean difference = 4.03) performed better than the Intervention group (mean difference = 8.62).

Table 12

Pairwise Comparisons – Time

Map Search (MS1)						95% Confidence Interval for Difference	
Group Type	Time (I)	Time (J)	Mean Difference	Std Error	Sig	Lower Bound	Upper Bound
Attention	1	2	8.62	1.37	<.00	5.88	11.36

Relaxation	1	2	4.034	1.49	.01	1.07	7.00

In summary, statistically significant differences were only noted for the Attention index score of the RBANS (overall attention ability) and the MS1 raw scores (visual selective attention) of the TEA, with positive changes over time in the combined groups for Attention index score (overall attention ability) whereas negative changes over time for the MS1 scores (visual selective attention). The RBANS total index scores (overall cognitive ability), the VE1 raw scores (switching attention) and the L raw scores (sustained attention) of the TEA did not show any statistically significant results.

4.5.6. One-Way Repeated Analysis of Variance (ANOVA)

a) Descriptive Statistics

Table 13 shows the results for each of the measures of the dependent variables. Though changes (both increments and decrements) in various measures noted below were seen from pre to post training assessments, but not all these changes were statistically significant. Further analyses reported below discusses the statistically significant changes over time.

Table 13

Results for Each of the Measures of the Dependent Variables

Scale	M1	SD1	M2	SD2	M3	SD3
RBANS TIS	105.71	11.727	106.48	11.514	109.14	11.173
Attention IS	102.48	14.320	108.29	11.850	105.48	14.794
MS1 T1	25.29	10.041	20.76	7.848	19.81	8.830
VE1 T1	8.67	1.278	9.00	1.183	9.00	1.140
L T1	9.62	.805	9.57	.811	9.48	.981

Note. 1=Time 1 (pre- training assessment scores), 2= Time 2 (post- Relaxation Training assessment score) and 3= Time 3 (post- Attention Training assessment score).

b) *ANOVA analysis*

For the RBANS Total Index Score, the results of the ANOVA indicated a significant time effect, Wilks' Lambda = .73, F (2,19) = 3.44, p =.05, n^2 = .27. Post-hoc comparisons indicated that there was no significant difference in pairwise comparison between time 1 and time 2 or between time 2 and time 3 but there was a significant difference in pairwise comparison between time 1 and time 3 p <.05, which suggested that participation in both training programs increased participants' RBANS total index score (overall cognitive ability) from time 1 to time 3. For the Attention Index Score (RBANS), the results of the ANOVA indicated a significant time effect, Wilks' Lambda = .65, F (2,19) = 5.11, p <.05, n^2 = .35. Post-hoc comparisons indicated that there was a significant difference in pairwise comparison between time 1 and time 2, p <.05, but there was no significant difference in pairwise comparison between time 1 and time 3 or time 2 and time 3, which suggested that participation in Attention Training group did not increase participants' Attention index score (overall attention ability). The results of the ANOVA for the MS1 scores indicated a significant time effect, Wilks' Lambda = .64, F (2,19) = 5.35, p <.05, n^2 = .36. Post-hoc comparisons indicated that the difference between time 1 and time 2, and time 1 and time 3 were statistically significant, p < .05, but the difference between time 2 and time 3 was not statistically significant, p > .05. This meant that only the Intervention Training did not affect the MS1 scores (visual selective attention) but both types of training together impacted negatively on the scores of this group over time. The results of the ANOVA indicated a nonsignificant time effect, Wilks' Lambda = .93, F (2,19) = .76, p >.05, n^2 = .07 and Wilk's Lambda = .99, F (2,19) = .14, p >.05, n^2 = .01 for the VE1 and L scores respectively. Post-hoc comparisons indicated that each pairwise difference was not significant, p = .05. There were no changes in the scores over time for both measures, suggesting that participation in the attention training did not change participants' VE1 and L scores (switching attention).

Table 14

ANOVA Analysis

Outcome Measure						95% Confidence Interval for Difference	
	Time	**Time**	**Mean Difference**	**Std Error**	**Sig**	**Lower Bound**	**Upper Bound**
RBANS (Total)	1	2	-.76	2.33	.75	-5.63	4.10
		3	-3.43	1.58	.04	-6.73	-.13
	2	3	-2.67	1.70	.13	-6.20	.87
Attention (RBANS)	1	2	-5.81	1.85	.01	-.97	-1.94
		3	-3.00	3.32	.38	-9.92	3.92
	2	3	2.81	2.78	.32	-2.10	8.61
MS1	1	2	4.52	1.358	.00	1.70	7.35
		3	5.48	1.96	.01	1.39	9.56
	2	3	.952	1.24	.45	-1.64	3.54
VE1	1	2	-.33	.29	.26	-.93	.27
		3	-.33	.35	.35	-1.10	.39
	2	3	.00	.34	1.00	-.71	.71
L	1	2	.05	.25	.85	-.42	.58
		3	.14	.27	.60	-.42	.71
	2	3	.10	.26	.72	-.44	.63

In summary, for the Partial Crossover group, significant changes were noted in RBANS total index score (overall cognitive ability), Attention index score (RBANS, overall attention ability) and MS1 scores of the TEA (visual selective attention), but no significant changes were noted in the VE1 and L scores of the TEA (switching attention and sustained attention) respectively. In particular, both types of training increased participants' scores from time 1 to time 3 for the RBANS total index scores (overall cognitive ability) whereas the same trainings decreased participants' scores from time 1 to time 3 for the MS1 measure (visual selective attention). For the attention index score (overall attention ability), increased scores were noted from time 1 to time 2 but no significant change in scores were noted for time 1 to time 3 or time 2 to time 3. This indicated that Attention Training had no impact on the Attention index measure of the RBANS (overall attention ability). In other words, while that contrast is significant, the change was all between time 1 and time 2, so no changes were noted as a result of additional training.

4.6. Discussion

From analysis 1 the following was reported:

a) Contrary to the hypothesis, no statistically significant differences between the two groups or when the groups were combined, from pre to post trainings, for general cognition (measured by the RBANS total index score).
b) No statistically significant differences between the two groups from pre to post training conditions for general attention ability (measured by the Attention index score, RBANS), but, when both the groups (Intervention and Active Control), were combined, better performance was observed post-training than pre-training.
c) Contrary to the hypothesis, for visual selective attention (measured by MS1), statistically significant lower scores from pre to post training for both groups. When the groups were compared lower scores were found in the Intervention group than in the Active Control group, from pre to post training conditions.
d) Contrary to the hypothesis, no statistically significant differences between the two groups or when the groups were combined, from pre to post trainings, for switching attention (measured by VE1).
e) Contrary to the hypothesis, no statistically significant differences between the two groups or when the groups were combined, from pre to post trainings, for sustained attention (measured by L).

From analysis 2, for the Partial Crossover group, the results indicated the following:

i. In line with the hypothesis, statistically significant increment for general cognition (RBANS total index scores) from time 1 to time 3 but not from time 1 to time 2 or time 2 to time 3.
ii. Contrary to the hypothesis, statistically significant increment for overall attention (Attention index scores) from time 1 to time 2, but not from time 2 to time 3 or time 1 to time 3.
iii. Contrary to the hypothesis, statistically significant decrement for visual selective attention (MS1 scores) from time 1 to time 2, and time 1 to time 3 but not from time 2 to time 3. This decrement was more from time 1 to time 3 than from time 1 to time 2.
iv. Contrary to the hypothesis, no statistically significant change in switching attention (measured by VE1) from time 1 to time 2 or time 2 to time 3, or time 1 to time 3.

v. Similarly, contrary to the hypothesis no statistically significant change in sustained attention (measured by L) from time 1 to time 2 or time 2 to time 3, or time 1 to time 3.

The discussion below collectively addresses the findings from analyses 1 and analyses 2 for each of the domains of attention and general cognition studied. *From analysis 1, no statistically significant differences between the two groups or when the groups were combined, from pre to post trainings, for general cognition (measured by the RBANS total index score). Moreover, from analysis 2, statistically significant increment for general cognition (RBANS total index scores) from time 1 to time 3 but not from time 1 to time 2 or time 2 to time 3 for Partial Crossover group.*

The lack of any significant change over time for individual groups (Attention Training and Relaxation Training) or their combination on the overall cognitive ability may be due to the fact that the training tasks may not have had any transfer impact on the assessment tasks. Overall cognitive ability measured by the RBANS total index score is a composite measure of index scores on immediate and delayed memory, attention, language and visuo-constructional domains. The training tasks were focused on attention only, thus improvements in other domains of RBANS mentioned above, that contributed to its total index score, were not found.

On the other hand, it can be said it is not possible for the attention domain alone to compensate for all the other domains so as to affect a statistically significant increase in the overall cognitive ability. The overall attention index score did not improve from time 2 to time 3 for the Partial Cross Over group, thus it is reasonable to conclude that the improvement in overall cognitive ability from time 1 to time 3 for the Partial Cross Over group was certainly contributed by the other index scores (Immediate and Delayed Memory, Language and Visuo-spatial indices) that contributed to the total index score of the RBANS. Even though the attention training tasks may not have had a direct transfer to the overall attention ability, they may have indirectly contributed to other domains of cognition, the result of which seen in the increased overall cognitive ability for the Partial Cross Over group.

Moreover, the Partial Crossover group received 20 sessions of training than 10 sessions received by the Intervention group. Firstly, training employing a combination of cognitive and non-cognitive components (Relaxation Training) may have had greater impact on overall cognition than its specific domains. This is supported by a number of studies (Gajewski & Falkenstein, 2018; Godde &

Voelcker-Rehage, 2017; Hudes et al., 2019; Xu et al., 2017) on the positive impact of cognitive training as well as physical and non-cognitive training on varied cognitive abilities. A Gajewski and Falkenstein (2018) study on older adults (mean age = 70 years) demonstrated the positive impact of cognitive training on working memory (WM) capacity whereas the relaxation training group (a social control group) showed positive changes in the EEG recordings (reduction in activity) used as an outcome measure with other neuropsychological assessments. Though the authors reported the most gains in WM capacity from multidomain cognitive training, yet the positive yet indirect impact of the relaxation training on cognition could not be denied. Godde and Voelcker-Rehage (2017) studied 43 older adults aged 63-79 years, participating in either a walking, or a motor-coordination intervention or a relaxation and stretching exercise group, and showed a positive association between initial motor status and activation change in the right dorsolateral prefrontal cortex (DLPFC). The authors concluded that the physical training in older adults allowed them to free-up cognitive resources otherwise needed for the control of locomotion and training benefits were observed most in dual-task situations requiring execution of motor and cognitive tasks concurrently. The authors added that a control condition (standing still) also required attentional control and thus the right DLPFC activity, particularly seen in low-fitness participants only, mirrored additional activation interpreted by the authors as "compensatory" mechanisms of age-related changes ("Hemispheric asymmetry reduction in older adults (HAROLD)" hypothesis; Cabeza, 2002 discussed in the literature review in Chapter 2). Xu et al. (2017) systematic review and meta-analysis (10 studies of 14 analyses) of nearly 1000 healthy older adults (HOA) 65 years and older, found positive effects of music intervention on cognitive functions. The authors also acknowledged the positive impact of other leisure activities (reading, board games including music) on cognitive performance of HOAs. Music enhanced sleep quality as reported by the authors, similar to relaxation training which improves sleep quality as well (Bagheri et al., 2021). Hudes et al. (2019) systematic and meta-analytic study with healthy older adults using various memory training strategies, including relaxation techniques also reported improvements with training.

Secondly, 20 sessions of any training have a better impact than 10 sessions of training as with the Partial Crossover group participants that had 20 sessions as opposed to 10 sessions of intervention training. The very mechanism of neuroplasticity is based on the premise of repetition and practice. Neural pathways

have a better chance of establishment when neurons fire together incessantly, wire together. For neuroplasticity to thrive, it requires an enriched environment that includes variety and breadth of any such enriching experience. Moreover, the principle of habituation with rewarding experiences has been coined by Skinner – the father of operant conditioning since 1948 – that applies to the breadth of training as well. The positive impact of 20 sessions over 10 sessions of training is supported by the following studies: Alizadehsaravi et al. (2022) found that performance in balance control improved gradually over multiple sessions in older adult participants aged 65 years and above. Similarly, Turunen et al. (2019) from the well-known Finnish Geriatric Intervention Study to Prevent Cognitive Impairment and Disability (FINGER) study reported that 60–77-year-old participants (N =631) with increased dementia risk, randomized to receive a multi-domain lifestyle intervention, including computerised cognitive training (CCT) of 10-18 sessions, showed beneficial effects of CCT on processing speed and cognitive impairment. The authors concluded that even smaller amounts of CCT were sufficient when combined with other interventions in improving cognitive function and reducing cognitive decline. The variety of training offered (example CCT and other interventions), was considered more important than mere number of sessions. Twenty sessions of the combined relaxation and attention training for the Active Control group had greater positive impact than 10 sessions of only Relaxation Training. Another study by Wilkinson and Yang (2016) examined the plasticity of inhibition in 48 healthy older adults who were assigned to either a practice group or a no-contact control group and found that all three inhibition tasks demonstrated significant improvement across practice sessions, suggesting practice-induced plasticity.

From analysis 1, no statistically significant differences between the two groups from pre to post training conditions for attention ability (measured by the Attention index score, RBANS), but, when both the groups (Intervention and Active Control), were combined, better performance was observed post- training than pre-training. Moreover, from analysis 2, statistically significant increment for overall attention (Attention index scores) from time 1 to time 2, but not from time 2 to time 3 or time 1 to time 3 for the Partial Crossover group.

It is noteworthy that the individual types of training did not have an impact on the individual group performances but in combination, the groups' performances improved over time (time 1 to time 2). Concurrently, for the Active Control group the Relaxation Training impacted positively on performance of the group over time

(time 1 to time 2), but the intervention training appeared to have no additional benefits to the Partial Cross Over group from time 2 to time 3. The participants of both these groups were demographically matched, hence, it can be concluded that the positive improvement noted in the Partial Crossover group from time 1 to time 3 can be possibly attributed to the Relaxation Training.

Relaxation training has been found to have a positive impact on attention skills as validated from several studies (Ma et al., 2017; Niemann et al., 2014; Olivo et al., 2021; Sun et al., 2013). The potential benefit of diaphragmatic breathing in improving cognitive performance particularly sustained attention through reduction of negative subjective and physiological consequences of stress in healthy adults was demonstrated by Ma et al. (2017). Sympatho-vagal stress response is said to return to an optimal balance with diaphragmatic breathing (Lehrer et al., 2010). Self-relaxation was seen to significantly improve cognitive functions of older adults directly and indirectly: indirectly by improving sleep quality and regulation of one's behaviour rapidly and flexibly to changing environmental demands and directly through neuroplasticity which is associated with a functional reorganisation of activity patterns in prefrontal cortex and in the insula (Sun et al., 2013). Niemann et al. (2014) demonstrated that motor fitness and coordination training in older adults were positively associated with volume of the basal ganglia nuclei- with larger volume of the basal ganglia nuclei being associated with better performance in an executive control task. The authors proposed that strengthening motor fitness and new movements in older adulthood might be beneficial for their inhibitory performance levels in cognitive tasks- inhibitory performance is a key component of attentional processes. The active control group as part of the relaxation training engaged in progressive muscle relaxation exercises. Olivo et al. (2021) demonstrated the decrease in grey matter blood flow (GMBF) following shortly after a single session of 30-minute physical exercise at moderate intensity, in healthy older adults. Cerebral circulation plays a preponderant role in boosting cognitive performance by augmenting the supply of excitatory neurotransmitters in key brain regions and this was shown to be achieved during a single session of 30 minutes physical exercise (Olivo et al., 2021).

Difficulties with attention exist in all ages, and older adults are no exception. On one hand there is pathological attention deficit termed as Attention Deficit Hyperactive Disorder (ADHD) a neurodevelopmental disorder, characterised by inattention, hyperactivity and impulsivity mostly diagnosed in children but persists

throughout lifespan, and on the other hand, is minor everyday attentional slips that most people experience in their daily lives. Fullen et al. (2020) reported that a combination of medical and psychological interventions, as opposed to medication alone, produces greater outcomes for the management of ADHD in adulthood. The authors reported that among different psychological interventions, mindfulness was identified as one of the interventions that provided the most empirical support for the management of adult ADHD. Since mindfulness training is beneficial for pathological deficits of attention, minor attentional difficulties seen in normal ageing and in the MCI population could also benefit from mindfulness training. Mindfulness practice has been shown to have a relaxing impact on the mind and body (Gentile et al., 2022; Isbel et al., 2020; Malinowski et al., 2015; Vidic, 2021) just the way the relaxation training would induce a relaxing effect. Luberto et al. (2020) pointed out several similarities between Mindfulness and Relaxation that included stimulation of relaxation response to offset the stress response improving health outcomes by reduction of stress and tension, relaxation practice involving mindful awareness with openness and acceptance leading to similar cognitive decentring and lastly, but importantly, mindfulness promoted the effective use of relaxation practices by helping people become aware of whether or not behaviours that are intended as relaxing were actually relaxing.

Many studies have highlighted the importance of relaxation and mindfulness practise, in cognitive abilities particularly attention abilities in individuals. Malinowski et al.'s (2015) reported that mindfulness meditation training improves the maintenance of goal-directed visuospatial attention. Sevinc et al.'s (2021) study demonstrated that mindfulness training improved cognitive performance in cognitively intact older adults and strengthened connectivity within the default mode network, which is claimed to be particularly vulnerable to ageing effects. Similarly, Cantarella et al.'s (2017) study also reported the positive impact of psychological well-being training, comprising of relaxation exercises, on working memory performance. This could also explain the increase in the Attention index scores of the RBANS from time 1 or time 2 (after completion of the Relaxation Training) but not to time 3 (completion of the Attention Training) for the Partial Crossover group who may have reached a ceiling point upon reaching time 3.

From analysis 1, contrary to the hypothesis, for visual selective attention (measured by MS1), statistically significant lower scores from pre to post training for both groups. When the groups were compared lower scores were found in the

Intervention group than in the Active Control group, from pre to post training conditions. Moreover, from analysis 2, statistically significant decrement for visual selective attention (MS1 scores) from time 1 to time 3 but not from time 2 to time 3 for the Partial Crossover group. This decrement was more from time 1 to time 3 for the Partial Crossover group than from time 1 to time 2 for the Active Control group.

Ageing affects selective attention. Research has shown that slowing of response times in older adults in the presence of irrelevant or distracting stimuli, but enhancement of relevant information is not affected by age. In the context of higher levels of visual load, as seen in the MS1 task of the TEA (where participants had to search for the target stimuli amongst a busy map), older adults have trouble enhancing relevant stimuli (Geerligs et al., 2014). Moreover, when a time limit is added as a factor in the mix, as in the timed task of MS1 of the TEA, this ability to suppress distracting stimuli further diminishes. This can be explained by the inhibition hypothesis framework, lower visual short-term memory (VSTM) capacity, conditional exclusion, familiarity and possible difficulties in relation to the difference in the target stimuli presented in two time points, and a generalized detrimental impact of ageing on information processing speed, attentional effects, and performance accuracy (Condello et al., 2017; Sanders et al., 2014).

According to the Inhibitory Deficit hypothesis elaborated in Chapter 2, older adults were found to have difficulties inhibiting irrelevant information from the focus of attention. All three mechanisms of Access, Deletion, and Restraint were predicted to be less efficient in older adults than younger counterparts (Hasher and Campbell., 2020) who found that visual distractions slow older adults as the irrelevant stimuli add to the intrusions. In the MSI task of the TEA, the stimuli are presented amidst a very busy (visually crowded) map with minimal differentiation between the stimuli and the background, which could easily increase participants' probability of getting distracted and lost. Mayr and Jost (2016) suggested that suppression of irrelevant distraction is possible in older adults, only if they are allowed more time. MS1 was a timed task, hence with the added pressure of time (1 minute allocated to count as many target stimuli as participants could) and reported sensory limitations (44 out of a total of 63 participants used visual aids) the task would be more difficult. Distraction can be external or internal as from irrelevant thoughts (Andrews-Hannah et al., 2014). Thus, inhibition is critical to suppress competition at retrieval. This was consistent with the feedback received from some participants who expressed difficulty in distinguishing the target symbols in the MS1 task.

Künstler et al. (2018) reported lower visual short-term memory (VSTM) capacity, higher visual threshold (at least numerically) and a lower perceptual speed in older adults, negatively affected their dual-task performance (such as performing a simple tapping task concurrently with a visual attention task). The authors concluded that a simple motor task is more challenging for older adults than for younger people. This could possibly explain the reasons as to why the MS1 task measuring visual selective attention appeared challenging for participants. Moreover, Gur et al. (2011) confirmed that conditional exclusion was significantly more impaired than abstraction or inhibition in the elderly compared to the younger people.

The difference in the level of familiarity between the target stimuli in the two time points, may have influenced a negative change from time 1 to time 2 for both groups of participants. The target stimulus was knife and fork in Version A of the TEA (time 1), and screwdriver with spanner, (time 2) in Version B of the TEA. Knife and fork are items of everyday living whereas spanner is not an item of everyday living and is only used sparingly, that too a tool possibly more familiar to males than females, which makes it more unfamiliar for a sample consisting of majority of females. Familiar objects (target stimuli) are easier to detect in an unfamiliar environment (background) as they stand out whereas if both the stimuli object and the environment (background) are somewhat unfamiliar there appears to be a blurring of the distinguishing features making it difficult to be selected. The image of the knife and fork  **Figure 5**, as a pair could have been easier to detect as it occupied slightly more space, had slightly bigger contour as opposed to the image of an upright spanner  **Figure 6**, which is a single object that appeared to merge with the background. Monge and Madden (2016) discussed the importance of contrast sensitivity in comparison to acuity. Whereas Lawrence et al.'s (2018) findings attributed these differences in inhibitory spread of attention, limiting the distribution of attention, to declines in working memory with ageing, or possible decreased peripheral acuity leading to "tunnel vision", decline in the visual system with ageing leading to decreased spatial contrast sensitivity with ageing and more internal perceptual noise. Familiarity with the target stimuli may impact on contrast sensitivity which may explain HOA's pre and post assessment performances. Moreover, the duration between test-retest with different versions (A

& B) of the TEA in the standardisation sample (was 1 week, as opposed to the duration between test-retest in this research which was 10 weeks minimum. This may have changed the level of familiarity with the test tasks and items on both occasions.

Being a timed test, also induced additional pressure on performance due to normal ageing decline on psychomotor performance and decline in reaction time in elderly. This difficulty could be compounded by deficits in self-initiated processes that explain that cognitive operations (shallow processing or limitations in encoding that utilises attention abilities), are executed too slowly to be completed successfully (Dennis, Gutchess & Thomas., 2020). Slowed reaction time, reduced motor control and coordination are markers of age-related neural impairments. The upper limbs represent the most active part of the human motor system; thus, the decline of its functioning with age can significantly affect any task that requires the use of upper limbs, as completing a paper-pencil task (Frolov et al., 2020). Similar findings were reported by Blomkvist et al. (2017) who also reported increased mean reaction time and an increased rate of increase, with increasing age (greater in older adults than younger counterparts) with males having a faster reaction time than females. Majority of the sample population in the current study were females (males: females was 8:55). Haring et al. (2013) also confirmed less efficient execution of selective attention in older adults in comparison to their younger counterparts, due to their slowed processing and failed suppression ability. Woods et al. (2015) too reported age-related slowing in visual choice reaction time latencies brought about by delays in response selection and production. Such slowed reaction time could have been more pronounce due to added time pressure, and difficulty in detecting unfamiliar target stimuli in the current study.

From both analyses, contrary to the hypotheses, no significant changes (improvement mainly) found in ether Switching Attention or Sustained Attention in the Intervention group from pre-post training conditions when compared with the Active Control group. Neither any positive changes found in the Partial Cross Over group over time as a result of the intervention training.

This may be due to ceiling effects. The highest score which can be obtained for the Visual Elevator (VE1) and the Lottery (L) tasks of the TEA measuring switching attention and sustained attention abilities respectively, is 10 which was very close to the means and SDs of the VE1 scores at time 1 (M = 8.71, SD = 1.53; M =8.72, SD = 1.39 and M = 8.71, SD = 1.45) and the means and SDs of the L

scores in time 1 (M= 9.03 SD=1.31; M=9.62, SD=.73 and M=9.30, SD= 1.12) for the Intervention , Active Control and the combined trainings respectively. Hence, it can be concluded that this group of healthy older adults were already proficient in switching attention and sustained attention to begin with, and training in these types of attention did not reap any additional benefits as predicted. Chapter 2 has explained how cognitive training provided "compensatory scaffolding" (Reuter-Lorenz, & Park, 2014), for structural and functional degradation that results from ageing. This group of healthy older adults was not expected to experience any major functional degradation in these particular types of attention as indicated by their high performance on switching and sustained attention tasks of the TEA, and as such may not have required any training in these types of attention.

In conclusion, for the healthy older adults' sample, not many positive gains were found as a result of intervention (Attention Training) except that participants found the program to be beneficial and many of them stated that they felt they have improved in their attention and memory abilities and reported being challenged by the varied tasks that they completed. Some common themes that emerged from the participants' feedback on the individual tasks of the Attention training and the overall Attention Training program can be summed up with the acronym "CLAMPS" where C stands for "challenge, come out of comfort zone, consciously re-focus, be curious and have fun"; L stands for "listen carefully and pay attention"; A stands for " active engagement in an enriched environment"; M stands for "Manage fear and anxiety and other distractions, mind wandering"; P stands for "practice for building neural pathways" and lastly but importantly S standing for "Slow down and stimulate". Symbolically, clamps can be compared to people's attention ability. As clamps is a tool that is used as a "brace, band, or clasp for strengthening or holding things together" (Oxford University Press), similarly the attention serves as a binding function that connects all other cognitive domains. Participants particularly enjoyed the social interaction. The powerful impact of group interaction cannot be underestimated especially in older adults, and more so during the COVID 19 pandemic, where opportunities for face- to- face social interaction were considerably reduced and, in fact, discouraged. Hence, both the Attention Training and Relaxation Training) provided an opportunity for social activity during months of isolation. This is substantiated by participants reporting the following benefits − "you interact and think"; "interaction with facilitator and other group members"; "social aspect-meeting new people" (IDs: 7, 12, 15, 22, 23, 29, 30); "we had a good varied group

that got on well" (IDs: 9, 16, 17, 33); "the general socialisation and interaction with the group members- the social aspect- I sense an increased "sharpness" in my cognitive function" (IDs: 17, 19, 23, 29, 31); "it has introduced me to some lovely people- we may keep in touch and it help towards research in the field of aging and dementia" (IDs: 3, 4, 11, 13, 18, 25, 26); "having the intellectual challenge with new ideas, new people to interact with and having a regular time table to work with" (IDs: 1, 5, 9, 14, 22); Mental stimulation and large social networks can also improve cognitive function in ageing. Much like physical exercise, cognitive stimulation appears to enhance neuroplasticity by increasing neurogenesis and boosting levels of important neurotrophic factors. People who perform cognitively demanding work or engage in stimulating activities such as reading, solving puzzles, or playing a musical instrument have lower rates of cognitive decline with ageing. An active social life has also shown to be beneficial for cognition as we age (Zhaoyang et al., 2021). Studies by Kelly et al. (2017) showed that social activity improved global cognition as measured by global or composite measures of cognitive function. The impact of social relationships cannot be differentiated from cognitive, leisure, or physical domains of activity, as social behaviour includes aspects of all three domains, and it is impossible to isolate purely the social factors (Kelly et al., 2017). This is substantiated by some of the participants' feedbacks such as "I do not know whether our group was different, but I could not have a better group to share the experience with" (IDs: 6, 10, 27); "We were a good mixture of backgrounds and interests" (17, 20, 28); "yes, I enjoyed the interaction within the group, I enjoyed the challenges" (IDs: 4, 5, 26, 30); "the free discussions led to interesting points and welded us together as a group very well" (IDs: 2, 7, 30, 33).

Nishita et al. (2016) longitudinal study over 10 years, demonstrated the importance of cultivating openness to experience that is possible from group interaction and group programs. The authors concluded that higher openness to experience in community-dwelling older adults was associated with lower risk of cognitive decline. This was possible as individuals with higher Openness to Experience tend to be imaginative, creative, original, curious, and liberal and they tend to engage in a variety of cognitive, social, and physically stimulating activities that effectively maintain a higher level of cognitive function. However, to foster the cultivation and maintenance of this attitude around Openness to Experience, provision of age-appropriate cognitively stimulating activities should be made available for older adults. Such enriched environment allows neuroplasticity to

thrive. The training programs in the current study provided an enriched environment and participants were open to this new experience as they reported "discussions with others are good, as get different perspectives and writing stories (creativity) I enjoyed; continuing learning is always good; the importance of attitude- sense of fun and curiosity – are very helpful" (ID: 29).

Moreover, Lee and Kim (2016) emphasized the importance of face- to- face social activities in maintenance of cognitive health and reduction of cognitive decline in the elderly. Their study demonstrated several important findings, such as, older adults who participated more frequently in senior citizen clubs or senior centres at baseline, had lower risk of cognitive decline 4 years later than those who did not, such association was noted to be independent of the influence of age, sex, education, income, marital status, Activities of Daily Living (ADLs) and Instrumental Activities of Daily living (IADL), chronic diseases, depressive symptoms, elevated depressive symptoms, quality of life, and cognitive functioning at baseline. The authors reasoned that senior centre participants were more involved in cognitively and emotionally stimulating activities than non-participants as it allowed the provision of intellectually challenging activities and active interpersonal exchanges that has been hypothesized to increase or maintain cognitive reserve; allowing individuals to cope longer before cognitive impairment is manifested. Such cognitive reserve provides a buffer against age-related cognitive decline by allowing the individual/s to utilise an enriched environment such as social interaction or mentally challenging activity. The latter was effectively provided in the current study that utilised the Attention Training program and the Relaxation Training.

Cognitive decline has been closely linked to loneliness experienced in older adults in the Glostrup 1914 Cohort – 30 years study by Gow and Mortensen (2016). Though the causes of loneliness are varied and individual and beyond the scope of this study yet one can ascertain that the current pandemic resulting in social isolation is one of the key contributing factors of loneliness among the older population in recent times. So, the group intervention offered in this study proved to be a buffer against this sense of isolation and community disconnection and could have the potential to maintain cognitive health of participants. This is supported by the general feedback received from participants about what they found useful, and whether they would recommend participation to others as noted above: "discussion with others was good, as get different perspectives", "interaction with facilitator and other group members", "sharing of ideas/articles, books with other members of the

group", "the general socialisation and interaction with the group members- the social aspect", "working in a group and noticing/discussing individual differences / approaches" and "you interact and think".

Self-efficacy is an important determinant of cognitive functioning especially in the elderly population (Bollaert & Motl, 2019) as ageing brings about cognitive, functional, physical and other changes that can possibly change one's perceptions about self and the world around them. Positive group interaction as indicated by some of the participants from their experience from the interventions provided (example "good to see others in the same boat - I am not alone") may have helped to positively boosted their self-efficacy, hence both interventions appeared to provide comparable gains.

Mattering, or feelings of being important to others, in ways that give people the sense that they are valued, and other people care about them is vitally important for any age particularly among the elderly (Flett & Heisel, 2020) and at any time, especially during atypical times associated with the COVID-19 global pandemic. Mattering has been well-documented to positively affect physical and mental wellbeing (Flett & Heisel, 2020). The group interventions provided in the current study validated these findings from the reported experiences of participants. This was further substantiated by the very low rate of attrition (reasons indicated in the methodology) and absences from training (at the most 2 out of 10 sessions absence noted for very few participants and this rare absence was related to urgent matters such as appointments and sicknesses). In fact, participants expressed dissatisfaction upon finishing the groups, and most of them expressed their desire to continue further. Participants who received 10 sessions of attention training complained of not receiving the relaxation training as they felt they had missed out. Participants also felt valued through their sense of contribution, example "great opportunity to assist Sumi- her studies and myself" (IDs: 7,11,26,31). Such validation provided motivation and direction for the future as indicated by this quote: "From the course I have been reminded to not allow myself to become too comfortable intellectually- I will challenge myself with original puzzle and posers" (ID: 4). Hence the Intervention program provided positive protective factors and competencies that possibly assisted in heightening the resilience, engagement, and involvement among the participants. Some competitiveness among participants during task completion was noted, however this was channelled in a positive direction by the group.

4.7. Limitations and Conclusion

In conclusion, though participants reported that they learnt novel ways and realised the importance of attention in their memory and recall of things, the attention training alone did not improve participants' performance in the any areas of attention and general cognition measured, for the Intervention group and the Partial Crossover group. One plausible reason for this lack of positive gains from the intervention could be that no deficits in the various areas of cognition and attention, were noted in the participants to begin with, as indicated by their pre-training assessment scores, thus no clinically significant gains could be obtained. The revised Scaffolding Theory of Ageing and Cognition (Reuter-Lorenz, & Park, 2014) model elaborated in Chapter 2 stated that life-span neural resource enrichment factors and neural resource depletion factors may increase or decrease the capacity for scaffolding, but these predictions proposed by this theory are difficult to test; in particular to design a training that can create new scaffolds or/and exert their strongest effect in late-life cognitions as every individual's neural network is unique and hence no same result is possible for two different individuals. The means and standard deviations for general cognition and overall attention for both the groups at pre- training were within the average range and the variability among individual scores was also low. This may possibly indicate that the sample of healthy older adults may not have experienced any major functional degradation and thus the need for the training may be questionable. Secondly, though the Test of Everyday Attention (TEA) is a validated tool for assessing attention in older people, it is doubtful whether this tool effectively captured any gains resulting from the Attention Training program. This could be due to the following reasons: firstly, due to the differing nature of the training tasks and the assessment tasks that may not have yielded any near transfer effects. Secondly, the duration between test-retest with different versions (A & B) of the TEA in the standardisation sample was 1 week, as opposed to the duration between test-retest in this research which was 10 weeks minimum. This may have changed the level of familiarity with the test tasks and items on both occasions. Lastly, most participants reported discomfort and worry about their performance on some of the tasks of the TEA measure, mainly due to reported sensory difficulties (though this was managed appropriately). Such anticipatory anxiety and consequent low self-efficacy prior to the assessments (especially in the post-training situation) could have affected their performance negatively. This is consistent with Cavuoto et al.'s (2021) study where participants' experience of test failure prior to memory testing affected their self-efficacy

negatively leading to poorer memory performance. Thus, cognitive measures on its own may not be meaningful and psycho-social measures (around apathy, motivation, self-efficacy) are required to explain cognitive functioning.

CHAPTER 5: STUDY 2 – EXPLORING THE IMPACT OF ATTENTION TRAINING ON THE ATTENTION ABILITIES OF PEOPLE WITH MILD COGNITIVE IMPAIRMENT (MCI)

5.1. Background and Objectives

The range of neuropsychological deficits in MCI can be varied due to the diversity in the manifestation of MCI. Deficits in more than one cognitive domain (such as memory, attention and executive functions and language) were identified. Neuropsychological deficits affect decision making, independent living and autonomy in MCI in varying degrees depending on the level of decline experienced by individual person at any given point in time and the level of support available. The heterogeneous nature of MCI makes assessment and intervention complicated and consideration to various factors such as biological, psychological, cognitive, social, cultural, metabolic are imperative. Moreover, the transient nature of MCI adds to the complexity. Assessment of MCI needs to account for both objective and subjective measures. Given this context, Study 2 explored the impact of a specific attention training on attention abilities and general cognition of people with MCI.

5.2. Research Aim and Hypothesis

Research into the individual impact of attention training on attention abilities of older adults with MCI is sparse, as indicated in the literature review in Chapter 2. Considering this gap in literature, Study 2 aims to answer the research question as to whether a structured attention training program can produce changes in the attention abilities of participants with MCI? It was hypothesized that a structured Attention Training would produce improvement in attention ability and general cognition among this sample in Study 2, from pre to post training conditions.

5.3. Method

5.3.1. Trial Design

Permission to conduct Study 2 was received from the Darling Downs Health (DDH) Human Research Ethics Committee (HREC) with an approval number HREC/18/QTDD44877, and the University of Southern Queensland (USQ) Human Research Ethics Committee with an approval number H19REA038. All the relevant guidelines outlined in the National Statement on Ethical Conduct in Human Research (National Health and Medical Research Council, 2015) and the University of Southern Queensland guidelines (University of Southern Queensland, 2015) were conscientiously followed in Study 2. An amendment to Study 2, with amendment number HREC/19/QTDD/44877/AM03, to the original ethics application was submitted and approved in February 2020. This was also accepted by USQ HREC. The amendment sought permission to offer the same Attention Training delivered to participants in Study 1 to participants in Study 2 in groups of a minimum of 2-3 participants. It also kept the provision of delivering this same Attention Training program to individual participants in the event that a group of participants (such as a minimum of 3 participants) was difficult to recruit and retain. This amendment was requested due to the difficulty of recruiting people with MCI. Moreover, the statistical analysis for Study 2 had to be changed considering the small number of participants- the amendment also sought permission for this to take place.

5.3.2. Participants

5.3.2.1. Plans and Eligibility for Recruitment. Participants will be recruited from the Memory Clinic, Geriatric Adult Rehabilitation and Stroke Services, GARSS, Toowoomba Hospital, from Geriatricians in their private practise as well as General Practitioners (GPs) from the community. All participants will have a confirmed diagnosis of MCI. MCI status need to be recent within 3 months of recruitment to this study.

The GARSS Memory Clinic (also called the Memory and Cognition Clinic), provides a multi-disciplinary, specialist service for assessment, diagnosis and treatment of clients experiencing difficulties with memory and cognition, and whose symptoms are not primarily caused by mental illness (Memory and Cognition Clinic, GARSS, Darling Downs Hospital and Health Service, State of Queensland, 2016). Patients in this clinic are assessed by a Geriatrician, clinical nurse, psychologist and a pharmacist. Information required to be considered for further cognitive assessment are: The Dementia Screen- CT head scan (within 6 months of referral date), ECG (within 3 months of referral date), pathology reports (including FBC, U&E, LFT, Ca,

Vit D, Vit B12, Folate, TFT, ESR, CRP, Fasting Cholesterol, Fasting Glucose within 3 months of referral date), previous cognitive tests (example MMSE's), current medication list and health summary and social history. Patients with their carers are screened by the above health professionals in the Memory Clinic before a confirmed diagnosis is provided by the Geriatrician. For this screening the psychologist at the Memory Clinic completes a battery of assessments with the patients and their carers. The assessments used are the Addenbrooke's Cognitive Examination (ACE-III), Geriatric Depression Inventory (GDI), Geriatric Anxiety Inventory (GAI), Frontal Assessment Battery (FAB), Short form of the Informant Questionnaire on Cognitive Decline in the Elderly (IQCODE) and a questionnaire on independent activities of daily living and instrumental activities of daily living. Additionally, assessments used by the clinical nurse is the Mini Mental State Examination (MMSE) and general medical examination (blood pressure and height and weight, blood sugar levels, heart rate) of the patient. This information obtained from these various sources assists the Geriatrician to confirm a diagnosis of either Dementia, or Mild Cognitive Impairment, or cognitive decline due to other reasons.

Additional to their MCI status, all MCI participants, within 3 months of recruitment to this study, will be screened by the research assistant for their eligibility by using RBANS (Update form A). Their RBANS score should be between 1 and 2 SD below the mean or between 3rd and 16 percentiles for their age and education matched peers on culturally appropriate normative data (American Psychiatric Association, 2013). Cognitive impairment maybe seen in one or more cognitive domains measured by the RBANS. However, participants will be independent with all their activities of daily living as reported by them, significant others or their GP. Participants of this group will be assessed with the RBANS at regular intervals of 3 months during their participation period, to ensure that they continue to hold their eligibility status. This 3 months' time frame is followed because a) test-retest of RBANS is 3 months b) for a review in the Memory clinic for MCI status, a minimum of 3 months interval is maintained only if the clients have not had any rapid cognitive decline in the interim c) As MCI status is variable over time, regular monitoring of MCI status is also recommended in the practice guidelines update summary for MCI (Petersen et al., 2018). Age of the sample population was determined to be between 60-80 years. This is based on the recommendations obtained from the STAC (revised model- 2014) that states scaffolding needs to be provided in a timely manner. With, progressive age and

absence of appropriate intervention, the brain's ability to provide effective compensation can weaken over time. Though the basic hardware of cognition significantly deteriorates with age, knowledge and expertise are relatively protected from this age-related decline, which may enhance the level of compensatory scaffolding. Moreover, participants will have basic (Grade 8) reading and writing ability to be able to participate in the assessments and intervention

Exclusion criteria:

People with a current or predicted diagnosis of Dementia were excluded from the study. Other exclusion criteria included severe sensory impairment that could potentially impact on their performance, acute medical condition or a severe medical condition needing intensive treatment, and intellectual impairment. These people were excluded as such conditions would hinder their ability to participate in the interventions

5.3.2.2. Settings and Location Where Data Was Collected. Several recruitment sources were targeted, the foremost being the Memory Clinic, Geriatric Adult Rehabilitation and Stroke Services (GARSS), Toowoomba Hospital (TH) and others such as Ipswich Hospital and geriatricians in private practise (private hospital - St Andrews, Toowoomba as well as in private clinics in Toowoomba).

Pamphlets on the study (**Appendix P)** were distributed to all the designated recruitment sources to create awareness about the study, and doctors and other professionals working in these places were informed about the study by the principal researcher through emails and face- to- face meetings. There were no responses to the recruitment initiatives from any other source than the Memory Clinic, GARSS, TH. So, all participants of Study 2 were recruited from the Memory Clinic, GARSS.

People newly diagnosed with MCI in the Memory Clinic, GARSS, TH, and their carers, were contacted by the principal researcher by telephone or face- to- face contact during their appointments at the Memory Clinic. In this initial meeting, they were informed about the research, and the process and requirements of participation, by the principal researcher. If they were interested to progress further, they were emailed, or posted, or handed the Participant Information Sheet together with the Reply Slip **(Appendix Q)** which would assist them in making an informed decision about participation. These interested participants (carers and patients) were again contacted by the principal researcher after 2 weeks, or mutually convenient time, for clarification of any doubts they may have about the research or participation, and to confirm their decision on participation. Request by prospective participants for

increased time to think through their decision on participation was considered by the principal researcher, and if the participant or his/carer did not get back to the principal researcher in 2-3 weeks' time, no further contact with the prospective participant, was made. The pre-post training assessments data was collected at the Memory Clinic, GARSS, DDH by the research assistant and the intervention was provided to the participants in a group by the principal researcher at the Toowoomba Hospital foundation. Study 2 received a Toowoomba Hospital Foundation (THF) grant (**Appendix S**).

5.3.3. Intervention

5.3.3.1. Training Program: Attention Training Program. All 4 participants participated in the Attention Training (Intervention group). Participants attended a total of 10, 2- hour weekly sessions of structured Attention Training.

5.3.3.2. Recruitment and Training of Research Assistant. The grant obtained from THF was primarily used to pay for the employment of a research assistant (with preference to Queensland Health employees) with the necessary qualifications to assist in the research. The research assistant was recruited by the principal researcher following Qld Health employment and recruitment protocols and procedures. As such, a registered psychologist assisted in pre- and post- training assessments of participants of this study. Training and research instructions provided to the research assistant in Study 2 were identical to that provided to research assistants in Study 1.

5.3.3.3. Initial Contact After Recruitment. Once the 5 participants and their carers confirmed participants' availability and interest to participate in the research, they were contacted by the principal researcher to further clarify any queries they may have regarding the research, and to schedule their respective eligibility and pre- training assessment sessions with the research assistant. This was followed by an email to the interested participant's main support person informing them of the details (time, date, venue and contact person, **Appendix T)** of participant's eligibility and pre- training assessment.

Study 2 utilised identical pre- training assessment procedures utilised by Study 1 with extra time allocated towards the consent process. Like study 1, study 2 utilised the same 2 consent forms (**Appendix R**). Though participants of Study 2 had the capacity to consent, as they were able to understand the information given in this research, they had difficulty retaining that new information over a period of time. Hence the consent process for them was rather lengthy and was repeated several

times, especially towards the beginning at the pre- training assessment stage. Accordingly, a significant other, identified by the participant as a trusted confidant, was included in the consent process.

Consent process was lengthy and very transparent - participants were informed about the research in simple terms, mainly what participation involved, and this information was repeated by the principal researcher, significant others, and the research assistant several times, so that the participants were clear on what they were consenting to. Participants were also made aware that they could withdraw participation **(Appendix U)** at any stage even if they had given consent, without giving any reasons. Once training started, participants were comfortable with the process as it became a routine for them, and they expressed sadness when the Attention Training ended, as they wanted to continue coming.

Participants who did not qualify for the research were contacted by the principal researcher and provided options for further referrals (for example those who scored below the eligibility criteria were encouraged to contact their GPs regarding the possible occurrence of further cognitive decline and seek advice from him/her regarding future assessment and care. Those who scored above the upper limit of the criteria were offered the possibility of participation in a different Attention Training group offered to GARSS outpatient services, TH).

After completion of the program, participants and their carers were informed of the mutually agreed date and time of the post-training assessments. Post-training assessment protocols followed in Study 2 were identical to Study 1 assessment protocols.

5.3.4. Outcomes

5.3.4.1. Clinical Observation of Participants' Performance. In addition to the RBANS and the TEA, the principal researcher also kept a record of the individual participants' performance on each individual task completed for the entire 10 weeks program. Recordings of the feedback received from participants at the end of each individual attention training task, and at the end of the entire program, were used in the discussion of the results of Study 2.

5.3.4.2. Statistical Analysis Utilized in Study 2. Reliable Change Index. The Reliable Change Index (RCI) was the chosen statistical analysis for Study 2 due to a small number of participants (N=4). The RCI was not generated from the given sample due to its very small sample size. The RCI, introduced by Jacobson and colleagues in 1984 (Duff, 2012), stated that the amount of change an examinee

showed on specific psychometric instruments (in this context the RBANS total index score, Attention index of the RBANS, and the identified subtests of the TEA) between pre- and post- training were considered reliable only when that change was larger than reasonably expected due to measurement error alone. Thus, RCI is a measure of evidence-based practice. A pre-requisite for clinical significance of change is reliability of change (Jacobson & Truax, 1991). RCI is equal to the individual's time 2 (post- training) assessment score (in this study the Attention Training Program) minus their time 1 (pre- training) assessment score and the answer divided by the standard error of the difference of the test.

$$RC = \frac{x2-x1}{SDiff \text{ or } SEdiff}$$

$$SEdiff = \sqrt{2(SEM^2)}$$

$$SEM = s\sqrt{(1-rxx)}$$

RC = reliable change, SDiff or SEdiff = standard error of difference, x1 = each participant's pre-training assessment score, x2 = same participant's post training assessment score, sqrt = square root, SEM = standard error of measurement, s = standard deviation, rxx = test-retest reliability calculated as Pearson's correlation.

As the TEA generated different test-retest reliability, based on the sample population under investigation, for example TEA standardization sample of 154 individuals, (Crawford et al., 1997) versus 90 patients with chronic stroke, (Chen et al., 2013) - yielding various test-retest reliability coefficients, it was decided that test-retest reliability (rxx) will be obtained from the scores obtained from Study 1 and used in the calculation of SEM. Moreover, as both the participant samples groups used in this study (Study 1- healthy older adults and Study 2- participants with MCI) were matched in relation to their demographic characteristics, using the test-retest reliability (rxx) and standard deviation (s) obtained from the pre-training assessment measures of the healthy older adults' sample (in Study 1), for calculation of the SEM was considered most appropriate, because no change was expected. Thus, the pre-training (time 1) measures obtained from the healthy older adults' participants in Study 1was used in the calculation of the standard deviation.

5.3.4.3. Data Management. The hard copies of the pre-post training assessments (RBANS and TEA) and of any data collected during the training program were stored in a designated research-only locked filing cabinet in the workspace of the principal researcher (GARSS Day therapy) with restricted access

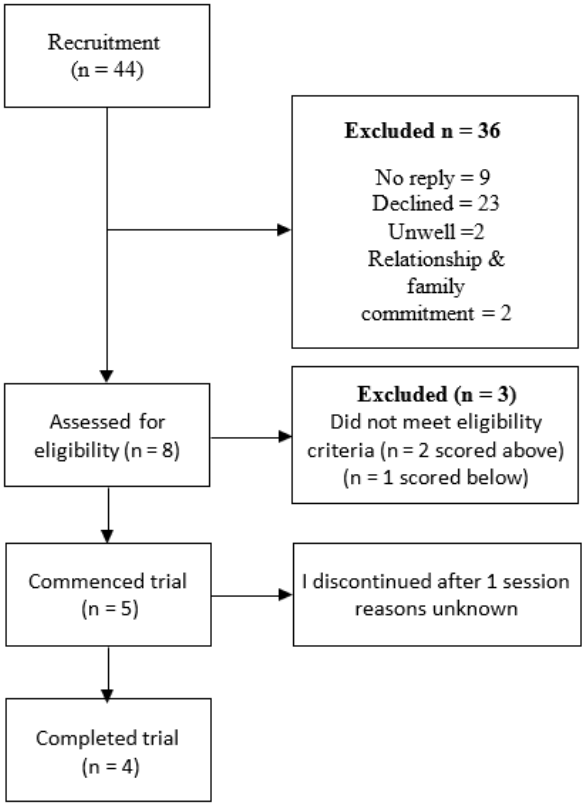
during the duration of the research. These hard copy files were then handed over to the DDH Senior Librarian, who was identified as one of the gatekeepers to the research filing cabinet located in the library. This data will be stored for a minimum of 5 years (according to DDH policies). De-identified data from the participants of Study 2 was stored digitally on the DDH secure network drive Data 7 (W:), with restricted access to the researchers.

5.4. Results

5.4.1. Participant Flow

Figure 7

Participant Flow (MCIs)



5.4.2. Recruitment

Recruitment initiatives started in 2019 and was finally able to obtain sufficient number to start a group in 2021.

5.4.3. Case Study Summaries of Participants of Study 2

Participant 1

Participant 1 was a 72-year-old Caucasian female with long term Traumatic Brain Injury (TBI) and recent diagnosis of MCI in the last 3 months. She used hearing aids. She lived with her husband. She attended 9 out of the 10 sessions offered. No reliable change in pre-post training scores were found for participant 1. She was very motivated to participate in the sessions and would remember to come for the sessions on her own. She often reported feeling worried about losing her memory. This was not an unusual worry as long term TBI was seen to be correlated to increased neurodegenerative process, mediated by genetic factors and environmental factors such as injury cascades, including prolonged inflammatory events (Bramlett and Dietrich., 2015). Moreover, TBI was also associated with increased risk of early onset of MCI and more rapid progression of MCI to Alzheimer's disease (LoBue,.2018).

Participant 1 presented as an overly anxious person, often needing re-direction. She was noted to become confused and reported feeling overwhelmed during the session, and instructions had to be simplified and repeated for her, with one instruction at a time. Writing the instructions stepwise on the board helped her to understand and focus better. She was noted to be impulsive and asked a lot of questions interrupting the facilitator and distracting self and others in the group. Due to her physical disability, she often complained of physical tiredness when having to write for long. However, she was noted to complete the tasks accurately if she was not time pressured and when she understood the tasks well. She got frustrated with herself if made mistakes that she could identify and appeared slightly competitive. She responded well to encouragement. When tasks were lengthy, she reported feeling exhausted. She took time to understand concepts and process information, which was somewhat affected by her impulsivity. It was difficult to distinguish whether Participants 1's behaviour and responses were due to her MCI diagnosis or her TBI or both, because disturbances of attention, memory, and executive functioning were reported to be the most common neurocognitive consequences of TBI at all levels of severity (Arciniegas & Wagner., 2002)

Participant 2

Participant 2, a 77-year-old Caucasian male, had a diagnosis of MCI from the last 3 months. He wore glasses and was a fit and healthy-looking man. He lived with his wife and had to be prompted and motivated by his wife to come for the sessions. Though he reported that the sessions would benefit him, yet he preferred to

enjoy other activities of choice (gardening, working on his cars in his shed) rather than coming for an "educational group"- as considered by him. He attended 9 out of the 10 sessions offered and missed one session as he had to attend a funeral. A reliable change (in the negative direction) from pre to post training scores was found in Sustained Attention for participant 2.

Participant 2 was a cooperative and relaxed throughout, he took interest in some tasks mainly the ones that required him to complete mathematical calculations or solve puzzles and appeared disinterested in language-based tasks such as stories or narrations and playing games like "Simon Says" or mindful drawing. He did not mind others interrupting the session. He was able to understand the tasks readily and knew what was required of him but was selective in his choice of tasks. He tended to score well on the tasks he was interested in and poorly making careless mistakes in the tasks he was less interested in. Participant 2 did not care much about encouragement.

Participant 3

Participant 3 was a 79-year-old Caucasian female, diagnosed with MCI in the last 3 months. She lived with her husband and was a retired nurse. She used glasses and would sometimes complain that the fonts or numbers were small and unclear when others had no complaints. She needed constant reminders and still forgot to complete tasks and come for the sessions. Thus, regular communication with her husband was necessary who was her carer. She often forgot things (for example her homework, glasses, and objects of everyday use). She reported enjoying the social interaction and was very talkative, and difficult to interrupt if she was telling a story as she was very circumstantial and somewhat tangential. She needed a lot of re-direction to focus on the training tasks. She attended 9 out of the 10 sessions offered and missed one session as she was away on a vacation with her family. A reliable change (in the negative direction) from pre to post training scores was found for participant 3.

Participant 3 was rather a sociable person and did not feel the need to attend any training. She attempted the tasks but was noted to be distracted in the middle of it- often staring in space and forgetting instructions. Thus, she needed individual attention and test instructions were simplified and repeated for her. She appeared to have given up hopes for herself and often remarked that she was very good at such tasks in the past when she was at school, but these tasks do not interest her any more

referring to mathematical calculations. She was often noted to lose her train of thought. Her performance was very inconsistent- at times she appeared very sharp and able to complete tasks accurately and the next moment she appeared to have lost her train of thought and was all confused and did not know what to do. This trend in her performance was noted throughout the training sessions. She performed better with language-based tasks (stories, narration – though the validity of her reported stories was questionable at times) than with mathematical operations. Though her handwriting was good, she found it hard to write on a blank page, especially calculations and often lost track of what she was writing (with numbers especially) on a blank page. It was not that she did not know how to perform the task but often had trouble remembering what she was required to do and the steps to follow. Losing track of the line and having trouble remembering the instructions of the task and getting confused with the steps to follow led her to making a lot of mistakes on continuous calculations (example tasks like counting backwards in 3s). She seemed somewhat apathetic about her performance and did not put in much effort, thereafter.

Participant 4

Participant 4 was an 80-year-old Afro-Caribbean British female diagnosed with MCI in the last 3 months. She lived with her daughter and had migrated from England years back. She had long been divorced from her husband. She too used glasses. She was a rather quiet and reserved lady and lacked the motivation to come for the session but was encouraged by her daughter and the facilitator to take part in the study. She also suffered from depression and would often worry about her family members. She attended 6 out of the 10 sessions offered and reported being unwell for 2 of the sessions and had family commitments for the other 2 missed sessions. A reliable change (in the positive direction) from pre to post training scores was found in Switching Attention for participant 4.

Participant 4 was readily able to understand tasks and complete them successfully, she hardly interacted with any other members in the group but appeared to quietly appreciate the company of others. She needed significant encouragement to attend the sessions and would often give a lot of excuses for not attending. Though her daughter thought it was a good idea for her mother to come along for the sessions, Participant 4 did not see the benefits of attending the sessions but politely agreed to her daughter's wishes. She was readily able to understand the instructions, did not require prompts and was often the one completing the tasks on time and

accurately. She quietly enjoyed subtle encouragement provided to her by the facilitator

Table 15

Characteristics of the Participants With MCI

Age		**Gender**	
60-70 years	0	Male	1
≥ 70 years	4	Female	3
Marital Status		**Educational level**	
Married	3	Secondary	4
Divorced	1		
Employment Status		**Sensory Deficits**	
Retired	4	Vision	3
		Both (using glasses and hearing aids)	1
Medical Condition		**Medication use (prescription-based)**	
>1	4	>1	4

Reliable Change Index (RCI) with a value of 1.96 and greater indicates statistically significant difference whereas a RCI less than 1.96 indicates a non-significant difference. As stated above SEM is required for the calculation of RCI. The Standard Error of Measurement (SEM) obtained from time 1 were as follows: RBANS total index score- 6.87, Attention index score (RBANS) -7.40, MS1 - 5.73, VE1 - 1.19 and L-0.68.

Table 16

Reliable Change Index Scores

Outcome Measures	**Pre-Training**	**Post-Training**	**RCI Calculation**	**Reliable Change**
Participant 1, 72 years				
Cognition, RBANS -Total	78	77	-0.10	No reliable change
Attention, RBANS	75	79	0.38	No reliable change
Visual Selective Attention, MS1	21	15	-0.74	No reliable change
Switching Attention, VE1	9	8	-0.59	No reliable change

Sustained Attention, L.	8	7	-1.04	No reliable Change
Participant 2, 77 years				
Cognition, RBANS -Total	72	74	.21	No reliable change
Attention, RBANS	82	88	0.57	No reliable change
Visual Selective Attention, MS1	9	17	0.99	No reliable change
Switching Attention, VE1	8	9	0.59	No reliable change
Sustained Attention, L.	9	5	-4.15	**Reliable Change**
Participant 3, 79 years				
Cognition, RBANS -Total	78	78	0	No difference
Attention, RBANS	85	82	-0.29	No reliable change
Visual Selective Attention, MS1	14	8	-0.74	No reliable change
Switching Attention, VE1	5	4	-0.59	No reliable change
Sustained Attention, L.	6	1	-5.19	**Reliable change**
Participant 4, 80 years				
Cognition, RBANS -Total	79	79	0	No difference
Attention, RBANS	79	91	1.15	No reliable change
Visual Selective, Attention, MS1	23	10	-1.60	No reliable change
Switching Attention, VE1	4	9	2.97	**Reliable Change**
Sustained Attention, L.	9	8	-1.04	No reliable change

From Table 16, it can be concluded that none of the 4 participants showed reliable change between their time 1 (pre- Attention Training) assessment and time 2 (post- Attention Training) assessment measures for the RBANS scores (RBANS total index score, overall cognitive ability and the Attention index score of the RBANS, overall attention ability), and the visual selective attention as measured by their Map Search task (MS1-1 minute) of the TEA.

In contrast, 1 out of 4 participants showed reliable increase from time 1 (pre- Attention Training) to time 2 (post- Attention Training) assessment measures for switching attention as measured by the visual elevator task (VE- raw score- VE1) and 2 out of 4 participants showed reliable decrement from time 1 (pre- Attention Training) to time 2 (post- Attention Training) assessment measures for sustained attention as measured by the Lottery task (L).

5.5. Discussion

It can be said that the intervention (Attention Training) did not have any significant impact on the attention abilities measured by the RBANS or the TEA measures used in this research. This can be explained by the difficulties noted and voiced by the participants while completing the training tasks. These difficulties experienced by them could be due to their cognitive deficits which may act as a barrier to their learning. Moreover, the absence of any training effects could be due to the possible mismatch of the training tasks with the particular assessment tasks used, mainly for visual selective attention resulting in the lack of transfer of learned skills to assessment.

Firstly, clinical observations of the participants' behaviour and responses during the training may highlight the possible inherent difficulties experienced by the participants of the MCI group that reflect the various characteristics of people with MCI, as elaborated in the literature review section (Chapter 2)

Possible Dominance of Visual Cues Over Auditory Cues and Difficulty Prioritising Listening to Instructions Over Response - Possible Impulse Control Issues

Participants were distracted by unnecessary details on the response sheets example "Day 1", "exercise". Despite the repetition of instructions, participants needed time to focus on the answer sheet to complete the "Paced numbers and letters" and the "dot-to-dot" tasks. In the "action in numbers" group task, participants found it difficult to act out what was written in the stimulus cards without reading it aloud, as per instructions. They needed multiple reminders to read silently in their mind and act what was on their stimulus cards for others to follow. Such difficulties indicated possible dominance of visual cues (what they saw on their response sheet or stimulus cards) over auditory cues (presenter's instructions on the task) or even choosing to hear the instructions and adhere to it. The facilitator had to demonstrate what she wanted the participants to do. Impulse dyscontrol in people with MCI is characterized by closely connected symptoms of irritability, agitation, and rigidity (Saari et al., 2021). Possibly the latter symptom of rigidity may explain some of the above-described test behaviour seen in this sample. Moreover, the speed of perceptual shift from auditory stimuli (listening to the instructions) to visual cues (cues in the response sheet) affected their prompt decision making and execution of responses. Perceptual speed also affected their performance on the group task of "Simon says". This is supported by Duke Han et al. (2015) study highlighting the impairment in perceptual speed that accounted for the most variance in decision making among participants with MCI.

Difficulties With Selection, Prioritisation and Organisation of Information Affecting Response Choice and Execution

Secondly, participants needed strict structure of tasks and reminders as well, or else they were found to lose focus and not remember what was required of them. Difficulty selecting important pieces of information, organising them in a coherent, structured way to answer the question asked, and prioritising important from unimportant details was evident in how information was processed by these participants and was manifested in a number of training tasks such as: introduce your partner, categorising task, storytelling, geometric designs and puzzles. Fuster's (1997) model of the temporal organization of behaviour states greater executive resources are required to complete demanding tasks that require more time to complete. Fuster (1997) asserts that the time necessary to complete and sustain a complex mental set is a key function of the frontal lobes, that is, the capacity "to organize actions in the time domain is the most basic and essential of all prefrontal functions … and cannot be overstated" (pp. 3–4) which has been found to be deficient in some MCI populations (Eppig et al., 2011). Such difficulties are key characteristic of people with MCI as highlighted in other studies (de Siqueira et al., 2017; Salvadori et al., 2019; Vardaki et al., 2019). In particular, Vardaki et al. (2019) highlighted some similar specific difficulties characterising decision-making in older adults with MCI that affected their driving capacity, and utilised similar skills. People with MCI manifested late detection of targets in the peripheral view, exacerbated by slowed movement and problems in selecting relevant information. Thus, densely cluttered surroundings placed high demands on their attentional and psychomotor abilities. Other concerns included difficulties with attention sharing, or divided attention, combined with the executive skill of switching from automatic to conscious actions while maintaining attention. This explains the loss of trains of thought and possible neglect that increased errors during the "reverse counting" training task in the present study. Similarly, for the "variable numbers" task, some participants had to write down the variable numbers presented at a time, to be able to identify them correctly from a set of numbers – difficulty with switching their attention flexibly with the given stimuli at a time. Moreover, failure to suppress the default mode network (noted to be impacted by ageing) -deactivated during tasks that demand external attention (example: word comprehension) but activated during internal reflection (example mind wandering- reported by participants) – could

possibly explain the difficulties expressed by the participants in completing the intervention tasks (Dennis, Gutchess and Thomas., 2020)

Again, during the "20 questions" group task participants were found to lack the ability to ask varied questions to the researcher/therapist in order to arrive at the correct answer. They needed assistance from the therapist/researcher to ask varied questions as participants tended to perseverate and ask the same questions that affected their score negatively. Such perseveration, fragmentations and omissions have been noted to reflect impairment in abstract thinking (which includes attention ability) or an inability to generate responses that differ conceptually from each other, rather than a working memory deficit and was found to be present in people with MCI (Salvadori et al., 2019).

Comprehension and Connected Language Deficits

Another difficulty noted during training task completion was participants' difficulty understanding and retaining simple instructions for a multiple-level task (for example tasks such as listening to the words read out and then categorising each word according to the best category they belonged to – plants, animals and shapes", "sound targeting" and "mindful drawing"). For the categorising task, participants were found to write down the words given and then categorise them, as they apparently couldn't hear and categorise at the same time. Such sentence comprehension deficits were seen in people with MCI when the syntactic complexity was increased (Sung et al., 2020). This is also explained by the declining "connected language" associated with early subclinical declines in memory in the MCI population. "Connected language" (also referred to as "connected speech," "spontaneous speech," or "discourse") is defined as spoken language used in a continuous sequence, during everyday conversations. The production of spontaneous speech includes the use and coordination of multiple cognitive and physiological processes such as retrieval from semantic and episodic memory, the ability to sustain and divide attention for error monitoring, and the reliance upon working memory for syntax production, which makes it sensitive to early cognitive changes (Mueller et al., 2017). Thus, to maintain such skills, the authors suggested the use of performance-based measures that are more representative of the actual skills needed for activities of daily living than the use of standardized language and other cognitive tests. Hence, repetitions of instructions in a simplified manner and presentation of the stimulus at a much slower pace to the MCI participants as compared to the

healthy older adults' group, was undertaken in the current study, as the MCI sample needed time to process and execute action.

Sustained attention and switching attention use more complex attentional resources than simple visual selective attention or focused attention. People with MCI have difficulties with complex decision making that require higher level executive functioning. Deficits in executive functioning and episodic memory were identified as outstanding predictors of cognitive decline in the MCI (Chehrehnegar et al., 2020) and attention was identified as a core component of both these cognitive abilities. Though the specific attention type was not delineated yet one can confidently assume that the more complex attentional types such as sustained attention and switching attention would play a significant role in executive functioning. As such training tasks utilised in the current study including decoding, categorising, variable numbers, mathematical operations, reverse counting, geometric designs, 20 questions, and mindful drawing, were deemed as more difficult tasks by participants as they employed sustained and switching attention over and above selective attention skills, in comparison to simpler tasks such as paced numbers and letters, sound targeting, paced random numbers with music and commentary, action in numbers, Simon says, some puzzles, storytelling, and random dot to dot tasks, where the primary skill trained was selective attention.

Difficulties Reported by the Participants in Completing the Training Tasks

Some of the difficulties reported by the participants were self-doubt and mounting anxiety, difficulty concentrating, mind wandering when instructions were monotonous, change of speed in presentation of the stimulus, confusion understanding the task, novelty of the task leading to anxiety and consequent delay in completing the task, distraction from external sources (another participant, sound of the air-conditioning), difficulty distinguishing between the target sound and other noises inside and outside the room, mental fatigue, relying on past experiences to work out current tasks, time pressure, differences in the formatting: in how stimuli were presented to what was in the response sheet in the decoding task, inability to identify the subtleties of the presented stimuli, self-induced peer pressure, disregard of instructions that delayed response, worry and reminiscing good and bad memories at school.

Yates et al. (2017a) showed a clear and strong association between subjective memory complaints (SMC) and mood (anxiety and depression), both cross-sectionally and over time and SMC as an indicator of MCI has been elaborated in

Chapter 2. Ma (2020) reported the prevalence of generalised anxiety disorder in MCI negatively affecting their cognitive functioning – anticipatory anxiety being common. Chen et al. (2018) reported that the prevalence of anxiety in patients with MCI in community-based samples was 14.3% (95% CI, 9.7–20.5) whilst that in the clinic-based samples in their study was 31.2% (95% CI, 23.6–40.0). Smith et al. (2021) studied the association between MCI and anxiety in low- and middle-income countries (LMICs including China, Ghana, India, Mexico, Russia, South Africa), and the mediational effect of sleep problems in this association and reported from their final sample of 32,715 individuals aged ≥50 years with MCI, a pooled estimate (based on meta-analysis with random effects) of OR=2.27 (95% CI=1.35–3.83) and sleep problems explaining 41.1% of this association. Tonga et al., (2020) study informed that the effects of self-efficacy on quality of life may be partially mediated by depression and anxiety, with depression showing a stronger effect.

Typically, endurance and fatigue have been examined solely from a physical perspective, but both the brain and body are required to complete any activity and the brain is just like any other biological tissue, it can be overused and can suffer from fatigue. When participating in cognitive tasks, the brain resources are divided which may accelerate the development of physical fatigue. Mental fatigue was related to poor cognitive performance (speed-poor reaction time, attention, language and executive domains) in patients diagnosed with exhaustion disorder (Ellbin et al., 2018). If this phenomenon is common in healthy individuals, it can be expected to be pronounced in people with MCI who reportedly require more mental effort in completing everyday tasks due to the deficits in cognitive ability in comparison to healthy older adults. This validates the experience of mental fatigue reported by the participants in the current study.

Lack of Generalisability of Training Tasks With the Assessment Measures

RBANS total index score is a composite measure of index scores on immediate and delayed memory, attention, language and visuo-constructional domains. The training tasks were focused on attention only, thus improvements in other domains of RBANS mentioned above, that contributed to its total index score, were not expected.

The training tasks on visual selective attention in the Attention Training program were very different from its assessment tasks. Stimuli were presented auditorily in most training tasks example: “Paced Random Numbers” and “Paced Random Letters”, “Sound Targeting”, “Simon Says”, “Categorizing”,

"Addition/Subtraction", "Variable Numbers", "Paced Random Numbers with Music", "Paced Random Numbers with Commentary", "Random Dot to Dot", as opposed to the stimuli being presented visually in the assessment task. Moreover, the above training tasks and the assessments tasks of switching attention and sustained attention were different, which could have limited the transfer of training.

The assessment of overall attention ability by the Attention domain of the RBANS uses two subtests (Digit Span and Coding). The Coding task is rather a complex task requiring multiple mental operations which would have been difficult for people with MCI. The discrepancy in the scaled scores between Digit Span and Coding, ranged between 1 and 8 points (always lower scaled scores for Coding task than Digit Span task, even when the difference was minimal - 1 point difference between the two) in time 1 (pre- training) outcomes and between 1and 9 points (lower scaled scores for Coding task even when there was a 1 point difference between the two tasks) in time 2 (post- training) measure. These low scaled scores on Coding tasks contributed to the low index scores in the Attention domain of the RBANS that did not improve with training. Based on the limitations identified in the training tasks for the MCI population some changes in the training program were suggested.

5.5.1. Suggested Changes in the Training Program

Firstly, addressing the issues such as self-doubt and anxiety, external distractions, mental fatigue, formatting issues, identified by participants may influence meaningful participation in the future. Possibly a relaxation or mindfulness practice (15 minutes) prior to every session may help with ameliorating anxiety. Group or individual therapy in managing anxiety and time pressure could be provided prior to starting such cognitive training. Starting with short-duration sessions (45 minutes as opposed to a 2-hour session) and incrementally increasing it as participants' gain familiarity and confidence with tasks, could be beneficial. Secondly, an increased number of sessions, 20 or 30, with increased frequency, twice or thrice, weekly for 10 weeks would allow more intensive practice as opposed to a two-hour weekly session for 10 weeks, this would also facilitate the benefits of recency of practice which maybe essential for people with MCI. Provision of booster sessions within a designated time frame maybe beneficial. The number of booster sessions required could be estimated from the outcome of training sessions

provided. Thirdly, working on one aspect of attention as a block, mastering that skill before moving to the next and starting with the simpler type of attention, such as selective attention, and then gradually moving to sustained and switching attention. Fourthly, grouping participants with similar ability levels and working styles, as indicated from pre- training measures and presentations, so as to have more homogenous groups, may be essential. However, this was not possible as the number of participants in the current study was extremely small, and the 4 participants varied greatly from one another in terms of their working styles and their individual levels of cognitive abilities regardless of their common diagnosis of Mild Cognitive Impairment. On the other hand, a group of more than 5 participants with MCI maybe difficult to manage, due to the greater need of this population to benefit from closer assistance, compared to healthy older adults.

5.6. Limitations and Conclusion

In conclusion, it is difficult to generalise the results of Study 2 because of small sample size (n = 4) and wide variation in the characteristics, cognitive strengths and weakness, personality, interaction patterns, learning style and nature of participation among the 4 participants. However, 2 out of 4 participants showed reliable change between pre and post training assessments; in particular, 79-year-old female showed decline in Sustained Attention and the 80-year-old female showed an improvement in Switching Attention, after participation in the Intervention Training. Noteworthy, were also no difference in pre-post training scores for 77-year-old male in Sustained Attention and for 79 year and 80-year-olds females in general cognition. Since the MCI population is quite diverse and MCI exists along a continuum, as discussed elaborately in Chapter 2 and noted in the small sample of this study, it was questionable as to whether a single group program was adequate to cater to this diversity. Possibly a combination of individual and group format can be trialled out in future studies. This combination of individual and group programs may be better able to cater to the individual differences in the MCI status as well as allow members to enjoy the benefits of social interaction in a group environment simultaneously. Social engagement is beneficial to both mental health and cognition and thus some of the mood problems (anxiety and depression) experienced by people with MCI can be mediated by social networks (Yates et al., 2017b). Social networks may have beneficial effects on slowing the progression of cognitive decline. Participants with MCI were reported to have weaker social networks in the Cognitive Function and Ageing Study Wales (Yates et al., 2017b) and thus social engagement was utilised

with positive outcomes. The authors reasoned social support could cultivate a sense of purpose, leading to a positive self-image, that works as a buffer in stressful times or anxiety provoking situations, which may often be experienced by people with MCI, due to their cognitive decline and difficulties with independent activities of daily living (IADLs) requiring complex cognitive skills. So, the group face- to- face training utilised in the current research was a desirable mode of intervention.

Another important limitation was the utilisation of the same Attention Training program for both the healthy older adult sample and the MCI sample, in this research. The difficulties faced by the MCI sample and the modifications in the implementation of the Attention Training program for this MCI sample in this study were discussed in Chapter 4. Compensatory interactions between attentional networks affecting attentional abilities are different in healthy older adults from older adults with MCI (Karpouzian-Rogers et al., 2020). The interaction between the top-down and bottom-up processes is different in older adults with MCI from cognitively intact HOA (He et al., 2021). This significantly affects the way information is processed and how attention ability is utilised in information processing. Future studies in this area, should take into account the specific cognitive deficits, and the capacity and limitations encountered in training of the particular sample being studied example older adults with MCI. Moreover, consideration should also be given to the sample characteristics in designing an Attention Training program, as MCI exists along a spectrum. Study 2 provided deeper insight into how people with MCI process and execute complex cognitive tasks, and the challenges they experience in the process, which assisted the researcher in providing valuable recommendations in structuring cognitive intervention with this population. The STAC theory postulates that scaffolding should reflect the degree of neural insults such that more neural challenges as expected by the MCI population than in the HOAs, would be associated with more scaffolding (Gutchess & Thomas, 2020). This may explain the positive changes noted in one out of a very small sample of 4 participants from the pre to post training assessments condition. However, the authors also state that scaffolding can only occur up to a point after which no improvement in cognitive performance can be seen which may also explain why some of the participants did not show any improvement in any or all of the areas of attention, after receipt of the intervention. Moreover, the assessment of attention abilities utilising the TEA may not be suited for this population as elaborated above. No TEA test has been performed with the MCI population. Other appropriate

measures of attention and general cognition need to be investigated for this MCI population.

CHAPTER 6: GENERAL DISCUSSION AND SUMMARY

6.1. Limitations

The results of the current research for both the samples studied (HOAs and MCI) did not show any significant positive impact of Intervention Training. It is to be noted that both the studies are very different due to the different sample characteristics, sample sizes and the study designs, thus generalised findings cannot be drawn. However, based on the fact that no significant impact of Intervention Training (Attention Training) on post training outcomes were achieved, the effectiveness of a single domain attention training with older adults is questionable. Recognition of the ageing process and limitations brought about by it need to be recognised in the first place. Some of these challenges brought about by the ageing process that affected attention in the elderly could be sensory deficits, slowed processing speed, limitations in the re-allocation of top-down processing capacity towards compensating for declining bottom-up sensory inputs and stimulus information (Lustig & Jang, 2020), inhibition contributing to dedifferentiation and lack of perceptual tuning (Fabiani, 2012), diminished ability to shift between tasks due to ageing, decline of visual processing speed with age, psychosocial barriers possible with ageing, presence of comorbid health issues affecting cognitive functioning and long term impacts of medication side effects. Thus, designing of an effective training program needs to make calculated considerations of these factors.

Research around the interconnectedness between various cognitive and neural networks and its impact on functioning reflecting the individual changes brought about by ageing is still evolving. It is also unclear whether ageing leads to widespread changes that extend across brain regions or does ageing differentially affect distinct systems at different rates and different degrees. Though attention was certainly an important cognitive domain, yet due to its interconnectedness with other cognitive systems, it was rather difficult to study attention on its own. Moreover, the complexity of attention as captured by the Cognitive Atlas "any number of cognitive processes, organized as top-down or bottom-up, goal-directed or stimulus-driven, and more but generally reflecting an interplay between cognitive and sensory systems" (Poldrack et al., 2011), can be truly appreciated by taking into consideration the various models and theories on attention rather than relying on a single theory (Sohlberg and Mateer's in the current study) for its explanation. The

intricacy of attention is further enhanced by the interplay of multiple systems (the top down and bottom-up processes seen with ageing, and the emotional and motivational systems). (Lustig & Jang, 2020). Thus, it is also questionable whether such complexity of the attentional domain was sufficiently captured by the psychometric assessments utilised in this research. Moreover, whether at all attention can be assessed on its own is another area of contention. Another consideration is whether attention in the elderly can be captured adequately by the available assessment tools bearing in mind that the ageing population is increasing – with medical advancements, people are living longer and there are limited availability of psychometrically sound cognitive tools for people aged over 89 years. Though the TEA is undoubtedly a robust validated tool, it is difficult to ascertain whether it the best tool for measurement of attention in the elderly, considering the individual variations (example sensory difficulties, comorbid medical issues, cognitive variability and capacity, pain experiences) seen in this population. Though there are varied types of attention – experientially these types of attention are difficult to map individually as they are interwoven (Nguyen et al., 2019), this study suggests that it may not be possible to accurately map various types of attention individually.

6.2. Future Implications

Keeping in mind that the attentional system is a complex yet intricate system of networks (cognitive, emotional and motivational), any intervention should first understand how these networks are modulated.

Strategy selection and execution differs from the younger to the elderly population (Hinault & Lemaire, 2020). Lemaire (2010, 2016) proposed several strategy dimensions to understand ageing effects on cognition such as Strategy Repertoire (that discusses the type and amount of strategies utilised to accomplish cognitive tasks), Strategy Distribution (referring to the proportion of items on which each available strategy is applied), Strategy Selection (referred to the choice of particular strategy) and lastly Strategy Execution (that defines how each strategy is applied which is assessed by the accuracy and speed of one's performance associated with each strategy). Thus, it is recommended that a strategy perspective (or process-related training versus content related training) incorporating the above elements, to be considered in designing training programs for this elderly population. As distraction suppression is a primary challenge in maintaining attentional focus that is believed to play a central role in cognitive processing in the elderly, training targeted to improve this ability is recommended.

Multiple-modal approaches in training (group, individual or both, face- to face-, online) better fit the needs of a heterogenous population (Cohen-Mansfield., 2014). As cognitive changes in older adults are affected by multiple factors and is an individual experience, the option of multiple approaches in cognitive training should be made available to account for this heterogeneity.

Moreover, multiple component interventions (physical exercises, cognitive interventions, and groups focusing on social interaction and lifestyle changes) have been suggested for the elderly (Kueider et al., 2014). Thus, multicomponent interventions incorporating attention-specific skills building training can be trialled in the future. Such intervention may allow mapping of strategy selection and execution, in the area of attention more accurately and succinctly.

Multidomain training programs as opposed to single domain training program have also been recommended as they employ numerous cognitive processes and are likely to activate more widespread neural network that could have the potential to influence broader transfer effects (Nguyen, Murphy and Andrews., 2019). The interactional impact of these multidomain training can be mapped out that may help increase the accuracy of assessment of a particular cognitive ability (such as attention) through deductive approach.

This study established the combined importance of cognitive and psychosocial assessments for the measurement of attention and all other cognitive domains. Pure cognitive assessments are meaningless as cognition and neuropsychological states are interconnected and are affected by many factors (such as self-efficacy, motivation, personality and so on) as reported in the Discussions and highlighted in the Literature Review chapters.

Another limitation is the use of pure cognitive tasks used in the intervention training in the current study with limited everyday life experiences tapping into attention abilities. Though the links between the cognitive training tasks and the use of attentional ability in daily living were explored yet having some attentional tasks incorporated into participants' daily living would allow them to integrate the learning and practise into their daily life allowing for near, and possibly some far, transfer effects. Similarly, assessment measures should capture experiential learning through assessments of the cognitive ability (attention in this study) through activities of daily living in addition to cognitive measures. In other words, increasing the variety of modalities in assessment of attention ability may have been beneficial. Moreover, whether the intervention training had any transfer effect was not assessed. To ensure

the presence or absence of any transfer a longitudinal study with repeated assessments is necessary. This would allow the researcher to estimate the effectiveness of the intervention training so as to justify the implementation of such programs.

Clinical deficits in attention (example diagnosis of Attention Deficit Hyperactive Disorder, ADHD) compared to attention deficits experienced by older adults have been given a disproportionate attention in the assessment literature. Moreover, research into differentiating ADHD in older adults from attention decline due to ageing, is essential.

6.3. Conclusion

In addition to the commonly studied cognitive facets, this research established the importance of studying attention as a distinct cognitive faculty on its own, in the elderly undergoing cognitive changes as a normal and pathological phenomenon. It reinforced the timeless need to connect the brain and the mind and reiterated the idea that "individual neurons or single human brains do not exist in nature" because "relationships are our natural habitat" (Cozolino, 2014, p. 4). This profound and fundamental necessity for connection is even more pronounced towards the end of our life cycle, as old age brings about losses that can only be repaired through human interaction. Evolutionarily, human survival flourishes through interdependence. This demonstrates how relationships change the architecture and function of the brain. Despite the several limitations highlighted in the above paragraphs, this research has provided valuable insight into the study of attention with the elderly population which has implicated several considerations explicitly discussed in this chapter. Finally, the impact of group interaction was not directly assessed in this study, but it is certainly worthy of further attention.

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APPENDIX A

Attention Training Program

ATTENTION TRAINING GROUP MANUAL

STRUCTURE OF EACH SESSION:

- Psycho-education- 30 mins
- Individual Task/s- 40 mins
- Break- 10 mins
- Group Task – 30 mins
- Feedback and Discussion- 10 mins.

VENUE:

USQ Psychology Clinic/ Toowoomba Hospital Foundation

MATERIALS PROVIDE TO PARTICIPANTS:

- Information Booklet- Compiled from various sources and covers the Psychoeducation topics discussed during sessions.
- Individual Attention Training worksheets to practise in between sessions

SESSION 1

Individual Task- "Paced random numbers" and "paced random letters" -SELECTIVE ATTENTION

Instructions:

Task 1 Paced random numbers- Ex1

Therapist gives participants the worksheets with the number "2" and "15" and reads out the list of numbers aloud pausing at least 2 seconds between each one. Total time :10 mins each worksheet

Participants: *"You will hear a random selection of numbers being read aloud. Each time you hear the number 2, I want you to circle or strike it on your worksheet" (10 mins)*
Participants: *"You will hear a random selection of numbers being read aloud. Each time you hear the number 15, I want you to circle or strike it on your worksheet" (10 mins)*

Task 2 Paced random letters- Ex3

Therapist gives participants the worksheet with the letter "B" read out the list of letters aloud pausing at least 2 seconds between each one. Total time :10 mins
Therapist then gives participants the worksheet with the word "the" and reads out a passage. Total time :10 mins

Participants: *"You will hear a random selection of letters being read aloud. Each time you hear the letter "B", I want you to circle or strike it on your worksheet" (10 mins)*
Participants: *"I will read to you a passage that will have the word "the" several times in it. Each time you hear the word "the", I want you to circle or strike it on your worksheet"(10 mins)*

Group Task- "Get to know the group" – SELECTIVE ATTENTION, SUSTAINED ATTENTION AND RETENTION IN SHORT TERM MEMORY AND RECOGNITION

Therapist asks each group member to choose another member of the group.

Instructions:
Participants: *"I would like you to obtain the following information from your chosen partner. You may wish to write it down in the paper provided to you: Information on:*

- *3 significant features of the chosen partner (length or colour of hair, clothes they are wearing etc)- vision*
- *Favourite cuisine – auditory*
- *A holiday enjoyed in the past*
- *A movie enjoyed."*

After collection of information,
Participants: "*Now I would like you to introduce your respective partner in this exercise with the information you just gathered from him/her. DO NOT refer to your written notes."*

Discussion: Tell me the process you used in completing the tasks? How does these exercises translate to everyday life?
Hometask: 1. Mark Tree on your worksheet **Ex2**

2. Mark "the" on your worksheet – hearing a passage of your choice. **Ex 4**

SESSION 2

Individual Task- "Sound targeting" task SELECTIVE ATTENTION

Instructions:

Sound Targeting- Ex 6.

Therapist to sound 5 different sounds. Give participants the worksheet containing the word "SHHH".

Participants: "*You will hear a selection of 5 different sounds in no particular order. You should listen to this (therapist to play the chosen sound). Every time you hear the 5th sound, I want you to circle the word "SHHHH" on your worksheet".* (20 mins)

Participants: *"I will play a song to you. I would like you to count as many "the" as you can hear in that song and write it down on the paper provided" (20 mins)*

Therapist after the first task gives participants a blank piece of paper and plays a song "Raindrops keep falling on my head"

Group Task 1- "Simon Says" SELECTIVE, SUSTAINED AND ALTERNATING ATTENTION

Instructions: Did it in pairs and triplets (2 people and 3 people one after another demonstrating and then others following)

Each participant reads out an action for the others to demonstrate. Gives the participants 30 secs to demonstrate each task.

Participants "Each one will be given a card- on which an action will be written. Each card will have a number written in the front of the card. I will call out the numbers one by one randomly, and the person holding that number card must read out what is written in his/her card and the rest of the group will demonstrate that action. – while doing the action, please listen to the phrase -Simon says before the task and then only do the action. Do not respond to any instructions that does not say Simon says"

1. Simon says- smile at each other
2. Nod your head
3. Stretch yourself
4. Simon says put your left hand on your right shoulder and your right hand on your left lap
5. Rub your hands together
6. Simon says listen to the music being played
7. Was this music being played?
8. Simon says draw the sun
9. Simon asks you to open your mouth
10. Write your name on the paper in front of you
11. Simon asks you about the music that was played
12. Simon says give the picture of the sun you drew to the person sitting opposite you
13. Simon says do an action while the music is being played
14. Put your hands on your head
15. Simon says pick up a pencil
16. Simon says write the name of the person sitting next to you in the sheet of paper in front of you
17. Shake hands with the person sitting next to you
18. Look at the paper in front of you
19. Simon says put your left palm on your forehead.
20. Place your right hand above your left knee.

Discussion: Tell me the process you used in completing the tasks? How does these exercises translate to everyday life?

Group Task 2: Participant: 1. "Go around the group. Each person says the name of a person, in alphabetical order"

Example Anika, Brian, Courtney etc

2. “Go around the group. Each person says the name of a boy and a girl in alphabetical order”

Example Aaron, Betty, Crompton etc

3. “Go around the group. Each person says the name of a person and animal in an alphabetical order”

Example Aaron, Bear, Carla, Dog etc

Hometask:

1. Listen to one sound amidst other intermittent sounds (5 or more) and mark on your worksheet “sshhhhh”- for 5-10 minutes
2. Letter S only if it if it has an A before it – **Ex 5**

SESSION 3

Individual Task- "Categorizing" task SELECTIVE AND ALTERNATING ATTENTION

Task 1: Categorizing random words, Ex 7

Therapist: Give participants a sheet of the worksheet containing three categories namely animals, shape and trees. Read the words at a rate of 10 seconds between them.

Participants: "You will hear a selection of words being read aloud. Each time a word is read, look at your worksheet and put a check mark under the category/heading that best describes the category to which you think the word belongs" (20 mins)

Task 2 Category Targeting (Words) Ex 8

Therapist: Give participants a blank sheet of paper. Read a list of random words at a rate of 10 seconds between them.

Participants: "You will hear a selection of words being read aloud. Each time you hear the name of an animal for example- cat or tiger write it down on the paper provided to you" (20 mins)

Group Task- "Action in numbers" SELECTIVE AND ALTERNATING ATTENTION

Instructions:
Each participant will have a colour by which they will identify themselves. Each participant is given a card on which an action will be written as well as the number of times it has to be performed. Therapist will randomly call out a colour- the participant owning that colour will then demonstrate the action as many times as indicated in their card. The others need to observe and afterwards demonstrate the same action as many times it was shown.
Participants: "I will call out a colour. The person who owns the colour perform the action written on his/her card as many times as is indicated in the card. After he /she finishes demonstration, the rest of the group demonstrate that action"

Actions to be completed:
1 Breathe in and out
2.Put your palms together
3. Put your right hand up and move backwards
4. Raise your eyebrows
5. Sing two lines of a common song
6. Put your left thumb up and move to your left
7. March on spot
8. Sway from side to side
9. March while sitting
10. Put your hand left hand above your head and move forward
11. Blow out
12. Tap your left feet and hold your right ear.

Discussion: Tell me the process you used in completing the tasks? How does these exercises translate to everyday life?

Hometask:

1. Pick Vowels **Ex 10**
2. Mark numbers ending in zero **Ex 13**

SESSION 4

Individual Task- "Reverse counting" -SUSTAINED ATTENTION

Therapist gives a number to participants and after some time rings a tone and changes the counting frequency.

Instructions:
Participants: *"I will give you a number and you have to count backwards in 2s from that number and put your answer in the sheet in front of you. At the ring of a tone the frequency of backward counting will change. You need to be alert to hear the tone as well as hear me telling you in what frequency you need to count backwards". I will only say this once example "Count backwards in 2s", at the sound of a tone "Now count backwards in 5s"*
(40 mins)

Group Task- 20 QUESTIONS SUSTAINED ATTENTION AND SELECTIVE ATTENTION

Each participant thinks of a famous personality and the rest of the participants can only ask 20 questions to guess the famous personality thought by the chosen participant. (1 hour).

Discussion: Tell me the process you used in completing the tasks? How does these exercises translate to everyday life?

Hometask- Own creation- serial subtraction (letters and numbers**) Ex 14**

SESSION 5

Individual Task- "Addition/subtraction" ALTERNATING, SUSTAINED AND SELECTIVE ATTENTION

Instructions

Participants: *"I will tell you the starting number. You must then keep adding 3s to this number until I tell you to change to subtraction. You should then keep subtraction 3s from the number you have got to, until you hear me ask you to add again. I will keep changing the number for adding and subtracting, thus every so often so you need to listen carefully to me. Write down the answers in the paper provided to you" Example: "Start at 345 now keep adding 3s, now start subtracting 5s now start adding 7s"* (40 mins)

Group Task- "Working out Puzzles" ALTERNATING, SUSTAINED AND SELECTIVE ATTENTION

Each participant reads or shows the question to the person sitting next to him/her who performs the given task. If she fails to demonstrate correctly within the specified time, then the next question is asked by him/her to the next participant sitting beside them.

Instructions:

Participants: *"Listen to the instructions given and do what it says."*

1. Write the word red as many times as shown on the list -15 secs
2. Write the word green as many times as shown on the list -15 secs
3. Draw pictures of the words written in colours other than green-25 secs
4. Draw pictures of the words written in other colours other than blue and black-30 secs
5. Pick out all the red lentil from the bowl of varied lentils and spices given to you- 2 min. Hide a few things in the room – can you name the things hidden in their respective places -keys, pencil, eraser, phone, pen, book, paper, cup, spoon, paperclip.
6. "Please name the object you are going to find before you proceed to the location of the place it is hidden" – 10 mins
7. Write all the words except the ones written in blue -20 secs
8. Read the 7th sentence on the paper and then write the 5th sentence on the paper provided, then write 3rd sentence in the paper written in blue and finally write the 7th sentence that you read in the first place- 1 min
9. A series of sounds will be played. Can you identify what the 9th sound was? The 3rd sound? The 5th sound? – 3 mins
10. Close your eyes – you will feel different items having different textures. Provide them with the following items: Sugar, cloth, pen, paper, peg, flour, leaf, soil, paper clip, paper cup- 3 mins

1. Name the items you feel one by one.
2.Can you pick up the cloth?
3.Can you pick up the cloth and the pen?
4. Can you pick up the leaf, then the pen and then the sugar -

11. Take a piece of paper lying on your left side, close your eyes and then hand the paper to the person on your left- 20 secs
12. I will read out to you a list of some famous songs, REMEMBER THEIR ORDER: READ THIS LIST- 5 mins: Rudolph, The Red Nosed Reindeer; I Can Dream, Can't I? Chattanoogie Shoe Shine; The Cry Of The Wild Goose; Music! Music! Music!; If I Knew You Were Comin' Id've Baked a Cake; The Third Man Theme; Hoop-Dee-Doo;

Sentimental Me; I Wanna Be Loved; Mona Lisa; Goodnight, Irene; All My Love; Harbor Lights; The Thing; The Tennessee Waltz; If; Be My Love; How High The Moon; Too Young; Come On – A My House; Because Of You; Cold, Cold Heart; Sin (It's No Sin); Which songs were read before? Be My Love? The Third Man Theme
Which songs were read after? Harbor Lights; Rudolph, The Red Nosed Reindeer
Complete the rest of these lines below: Goodnight_____
Cold_____; Chattanoogie _____ Shine; How High _____Moon

13. Make a design with these seeds in front of you – 5 mins
14. Can you construct a short story with all the objects given to you – pen, paper, glasses, phone, hanky, book, some paper notes, a cup, bag, stapler holder- 10 mins. Participant after constructing a short story (at least 10 lines) narrates it to other.

Discussion: Tell me the process you used in completing the tasks? How does these exercises translate to everyday life?

Hometask:

1. Say the letter that is 2 letters from the letter I say- **Ex 17**
2. Task Maintenance – **Ex 18**

SESSION 6

Individual Task- "Variable Numbers" –ALTERNATING AND SUSTAINED ATTENTION – Ex 28

Therapist provides the participants with Answer sheet with stars.

Instructions:

Participants: *"You will hear a selection of numbers. To begin with, every time you hear the number 4, I want you to circle one of the stars on your worksheet. Every so often, I will tell you a different number to listen for. You should be listening to only one number at a time, the last number that I tell you"* (40 mins)

Do the 11 lines of numbers twice (20 mins). For the second time, participants had to mentally remember the numbers that they had to attend to without writing it down to remind them **as well as count the total number of switches they had made** (latter is divided attention)

Group Task- "Story telling" ALTERNATING, SUSTAINED AND SELECTIVE ATTENTION- CONTINUE FROM SESSION 5

TASK 1. Divide into two groups: Can you construct a short story with all the objects given to you : pen, paper, glasses, phone, hanky, book, some, a cup, bag, stapler holder- 10 mins. Then the groups give me the written stories constructed.

Participant after constructing a short story (at least 10 lines) narrates it to other group, in a group one my one verbatim.

TASK 2: Each one gets one each and they need to come up with a story and narrate to the group and the group need to repeat what the story was.

1. A stolen ring, fear of spiders, and a sinister stranger.
2. A taxi, an old enemy, and Valentine's Day.
3. Identical twins, a party invitation, and a locked closet.
4. A broken wristwatch, peppermints, and a hug that goes too far.
5. The first day of school, a love note, and a recipe with a significant mistake.
6. A horoscope, makeup, and a missing tooth.
7. A campfire, a scream, and a small lie that gets bigger and bigger.

Discussion: Tell me the process you used in completing the tasks? How does these exercises translate to everyday life?

Hometask

1. Odd and Even numbers- random focus Ex 29

SESSION 7

Individual Task- "Paced Random numbers + Music" ALTERNATING, SUSTAINED AND SELECTIVE ATTENTION Exercise 19

Task 1: Paced Random numbers + Music.

Therapist calls out random numbers one at a time while music is being played in the background. Participant need to circle the chosen numbers called out in the sheet provided.

Participants: *"You will hear a selection of numbers. You will also hear music being played in the background. Listen carefully to the numbers and ignore the music. Each time you hear the number 7, circle it in your worksheet"* (20 mins)

Task 2: Paced Random numbers + Commentary -Exercise 20

Therapist calls out random letters one at a time while a running commentary is being played in the background. Participant need to circle the chosen letter called out in the sheet provided

Participants: *"You will hear a selection of letters. You will also hear a running commentary being played in the background. Listen carefully to the letters and ignore the commentary. Each time you hear the letter M, circle it in your worksheet*" (20 mins)

Group Task- "Geometric Designs" task on SELECTIVE AND SUSTAINED ATTENTION

Therapist groups participants in pairs. Provides each member with some coloured shapes that they need to cut out. Then their partner sees a design made out of the shapes and dictates the design. The other party will need to hear the instructions and complete the design.

Participants: "All of you will need to cut out some shapes that I will provide you with – give each person a sheet to cut out and then have all the shapes mixed up and kept in the centre) After you have cut out (specific time) the shapes place it in the centre of this table.

Then divide into 2 groups.

Instructions to each group who is given one design each – "Now you need to write down the instructions of how to make this design on this paper" After completion let me know. Do not show your design to the other group.

Then from each group a volunteer reads out the instructions to the other group who as a group has to construct the chosen design by hearing the instructions. **Rules are: Instructions cannot be repeated, state a move wait 2 secs and then say the next move.**

Now one member will look at the design and give instruction to his/her partner on how to complete the design with the cut out shapes"

Homework :

Brain injury workbook –

1. Keeping in mind- calculations Pg 93
2. Count the "Ands" Pg 92
2. Match the logos- Pg 85

SESSION 8

Individual Task- "Random Dot to Dot" SELECTIVE AND SUSTAINED ATTENTION

Participants are provided with the "dot-to dot" picture sheet. Day 2 and 3.

Instructions:

Participants: 1. *"You will hear a selection of numbers read aloud. When you hear the first number, find the dot in relation to that. When you hear the second number, join the first dot to the second dot in the picture. I will only say the numbers once, so listen careful"* (40 mins)

Use picture 2. Do the same for picture 3 but call the numbers randomly.

Group Task 1- "Mindful Drawing" task - SELECTIVE AND SUSTAINED ATTENTION

Participants are given a piece of paper and a leaf.

Instructions: "Please look at the leaf minutely, piece by piece and copy it on the sheet given. Do not look at the paper, only follow the leaf bit by bit in order to copy it. You are not allowed to shift you gaze to anything other than the leaf".

Group Task 2: - Geometric Designs from Session 7

Group Task 3: - Dividing and Switching Attention, Exercise 26, Page 94- The Brain Injury Workbook.

1. Boys and Girls names
2. Animals and Places Name

Discussion: Tell me the process you used in completing the tasks? How does these exercises translate to everyday life?

Homework: Random dot-to dot pictures Ex 12

SESSION 9

Individual Task- "Decoding" task, SELECTIVE AND SUSTAINED ATTENTION

Ex 33

Participants are provided with a worksheet.

Instructions

Participants: *"This is a coded message. You can see the code at the top of your worksheet. Using this key, decode the message, writing each letter under the code."* (40 mins)

Group Task: Faces with Maps- Two groups of participants. One group chooses 10 faces and at least 5 places on the map and constructs a story with these stimuli. After that nominated group member narrates the story to the other group and then the other group listens and as a group remembers the story and then discuss among themselves and later nominates a member to narrate the story referring to the visual cues (faces and places on the map)

Hometask : Decoding Ex 33

SESSION 10

Individual Task 1 - Selective Attention Ex 26 Pg 94 (The Brain Injury Workbook)

10 mins each task

Participants are provided with a sheet of paper.

Instructions:

Participants: *"You will hear a list of numbers. What I would like you to do is to add up all the odd numbers. Write the number you are to add with the answer next to it as you go about adding the numbers."*

Participants: *"You will hear a list of numbers. What I would like you to do is to add up all the 3s. Write your answers as you go about adding the 3s"*

Individual Task 2 – Attention Switching (30 mins -10 mins each set)

"You will hear a list of numbers. What I would like you to do is to multiply your answer with the number that is called out each time. So, I will say the first 2 numbers that you will multiply, thereafter you have to multiply your answer with the number I say. Write each of your answers as you go about multiplying the numbers.

Now and again I will change the starting number so you need to repeat the same with the multiplication of first 2 numbers then subsequent multiplication of the answers with the number called out We shall do 3 sets".

Individual Task: -

General feedback of the program.

What did you find most useful?

What was least useful to you?

What were the tasks that you found easy?

What were the most challenging tasks?

Why were they challenging to you?

Would you consider implementing any strategy learned?

What strategy/ies would those be?

Overall, would you recommend anyone to this group?

If yes? Provide reasons

If not? Provide reasons

What can be done to improve the groups?

Group Task: Take Home Message.

EXTRA TASKS (TO BE USED IF REQUIRED)

- **Group Task 2: N-Back exercise 27, page 95, The Brain Injury Workbook.**

Participant: "Go around the group. Each person says the name of a person, animal then next vegetable and place in alphabetical order"

Example: Person 1- Anika, Bear
Person 2- , Carrot and Delhi

Participant: "Go around the group. Each person says the names of vegetable and fruit. Then the next person says the previous person's items and one of his own in alphabetical order"

Example: Person 1- Apple,

Person 2- Apple, Beetroot

Person 3- Apple, Beetroot, Custard Apple.

- Passing the parcel while music is being played and then stopping and saying a "Take Home Message" aloud.
- Faces with Maps- Two groups of participants. One group chooses 10 faces and at least 5 places on the map and constructs a story with these stimuli. After that nominated group member narrates the story to the other group and then the other group listens and as a group remembers the story and then discuss among themselves and later nominates a member to narrate the story referring to the visual cues (faces and places on the map)
- Names of vegetable, names, animals in alphabetical order. Then the next person says the previous person's items and one of the 3 types of her own in alphabetical order.
- Walk to Japanese Garden.

APPENDIX B

Attention Training Booklet

ATTENTION TRAINING

INFORMATION BOOKLET

Prepared By Mousumi Singh (Psychologist)

CHAPTERS

CHAPTER 1

THE BRAIN AND NEUROPLASTICITY

Central Nervous System (CNS):

The brain and the spinal cord make up what we call the Central Nervous System.

Neurons:
Brain and spinal cord are made up of cells called neurons.

Synapse:
Synapse is a structure in the nervous system, that permits a neuron (or nerve cell) to pass an electrical or chemical signal to another neuron or to the target effector cell (example a muscle).

Synaptic transmission:
Is the communication between one neuron (nerve cell) with other neurons or effectors, such as a muscle cell, at a synapse.

"Neurons that fire together wire together"
When brain cells communicate frequently, the connection between them strengthens. Messages that travel the same pathway in the brain over & over again, are transmitted faster & faster. With enough repetition (transmission), messages become automatic. That's why practise makes us perfect to the point it becomes an automatic behaviour or habit.
Adults build 700 neurons in a single day but this production can be inhibited by poor lifestyle.

What is Neuroplasticity?
It is the brain's ability to change and adapt as a result of experiences. It operates on the principle "neurons that fire together wire together"
Most Importantly *"PLASTICITY EXISTS FROM CRADLE TO GRAVE"* (Doige).
"Neurons that fire together wire together" -we can use or misuse this principle.
Plasticity can be a blessing or a curse. Example we practise counting we get better and faster at it, we stop practising it we lose that skill. There are 2 types of plasticity of the brain:

Structural Plasticity:
The brain's ability to change its physical structures as a result of learning.

Functional Plasticity:
The brain's ability to transfer functions from a damaged area of the brain to other undamaged parts. This is called functional gain.
Structural and functional plasticity are interrelated. For example, after a stroke one may lose many neurons in a particular part of the brain but the existing neurons in the brain "re-arrange" their connection (using structural plasticity) so that their functions can be restored to a certain degree.

How can neuroplasticity take place?
Enriched Environment is the key to neuroplasticity. An enriched environment is influenced by heathy lifestyle factors such as proper diet, adequate sleep, physical activity, social and recreational activities. An enriched environment is vital for neuroplasticity to occur.

Does attention training provide enriched environment?
Exercises targeted to improve attentional functions provide stimulating environment by challenging people. It creates a novel experience for the brain to do new things providing an opportunity for laughter, fun and play and hence can serve as an enriched environment.

CHAPTER 2

GENERAL FUNCTIONS OF THE BRAIN

The brain weighs about 1kg and looks like two halves of a walnut. It is divided into 2 halves or hemispheres: Right and left hemispheres.

Right Hemisphere:
Controls movement and sensation on the left side of the body. For most people, this part of the brain is more important for spatial and non-verbal skills.

Left Hemisphere:
Controls movement and sensation on the right side of the body. For most people, this part of the brain is important for language skills

The brain consists of the following parts:

Frontal Lobes- or Chief Executor:
Location: Behind forehead
Functions: Planning, organising, problem-solving, initiation, multi-tasking as well as control for personality temperament, mood, emotions and speech and other executive functions.

Temporal Lobes:
Location- Above the ears
Functions: Memory, hearing and understanding speech.

Parietal Lobes:
Location: Behind the ears, towards the back of the head.
Functions: Spatial judgement, sensory information, reading, writing and drawing

Occipital Lobes:
Location: Back of the head
Functions: vision, object recognition and identifying colours.

Cerebellum:
Location: Below the occipital lobe at the back of the head
Functions: Coordination, fine motor movement, balance, walking and speech articulation.
Brain stem:
Location: Connects brain to the Spinal cord

Functions: Alertness, breathing and swallowing (autonomic activities).

Diencephalon and limbic structures:
Ancient brain
Location: Heart of the brain
Functions: Primitive emotions and drives
Includes:

- Hypothalamus: Functions- body temperature, appetite, arousal and sleep-waking.
- Amygdala: Functions: emotions example anger and fear
- Hippocampus: Functions: memory

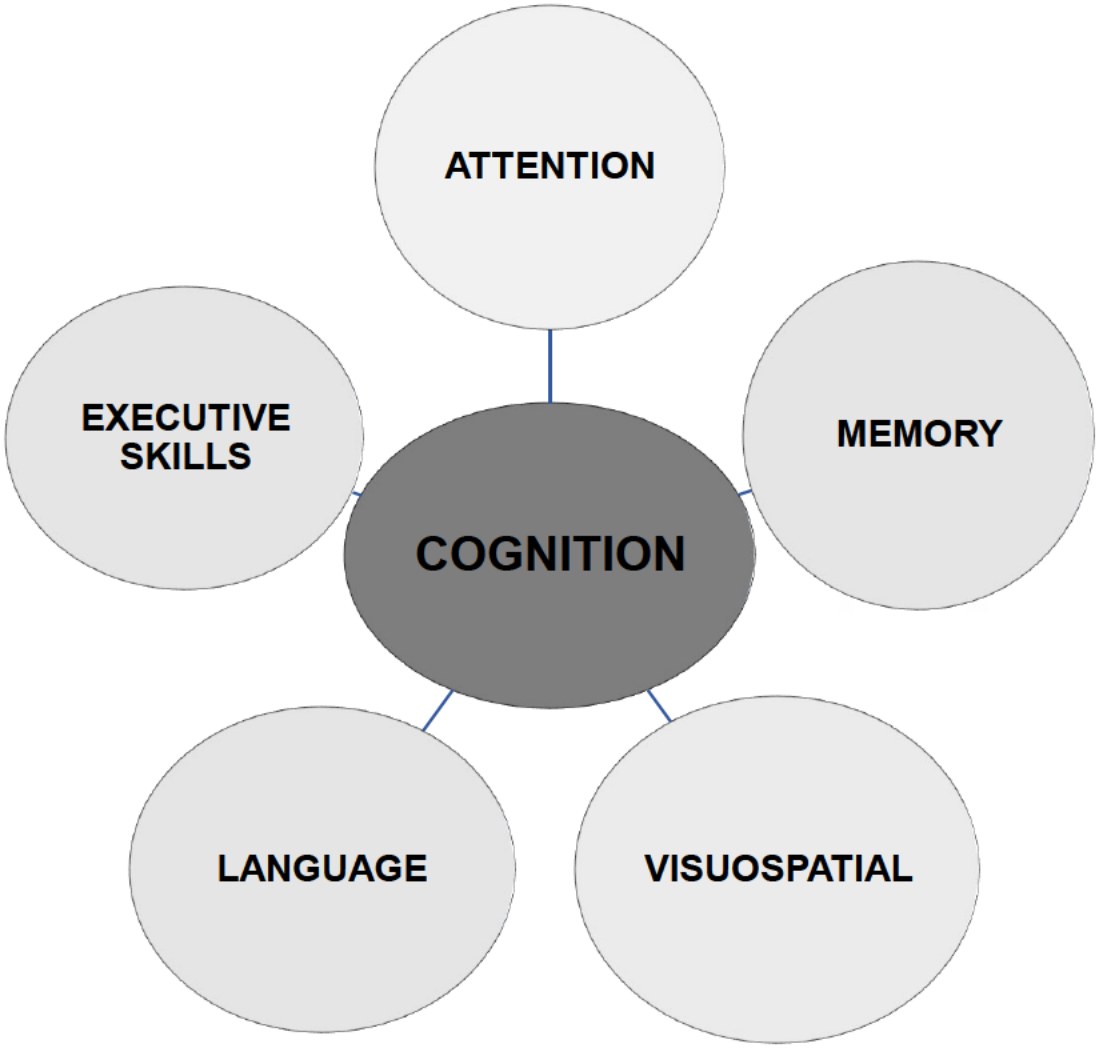
CHAPTER 3

COGNITIVE FUNCTIONS IN EVERYDAY LIFE

Cognition:

Comes from the word “Cognoscere” meaning “to know”. Cognition refers to the workings of the mind that enable us to

make sense of the world ((Malia & Brannagan, 2007).



- Attention is a core skill, central to all other cognitive or thinking skills
- Attention helps us to get full or correct information from the environment
- Only if we take in correct information, can we remember that information correctly.

Attention and Memory:

Memory is a process involving various stages such as Attention, Encoding, Storage, Consolidation and Retrieval. Attention is the mechanism by which information enters the brain. If we do not attend to information, it will not be encoded, stored and consolidated for retrieval when required. *Example:* Would you be able to remember a conversation if you were inattentive in the first place?

Attention and Language:
When we attend, we perceive. When we attend and perceive, we remember. When we attend, perceive, and remember, we learn. Processing of language requires an intact attention system so one can decide which information needs to be decoded as well as produced. Hence attentional deficits can cause deficits in language processing.
Example: We do not attend to language that we do not understand? As it makes no sense to us. Imagine that you are in a country where people speak a different language to you. You are in a crowd and you hear someone speak something in English. Would you attend to that conversation or not? Why would you attend to that conversation to the exclusion of other conversations by people whom you don't even know?

Attention and Visuospatial Awareness:
Interacting with the visual world is a highly complex cognitive process including our ability to see objects, touch objects, navigate around, and remember where we have been. Depending on our needs, we must quickly and accurately focus our attention to what is relevant while ignoring what is irrelevant, create brief or lasting visual representations in our minds, manipulate mental representations to guide our behaviour, and find our way through familiar or new environments.
Example: Difficulties with visuospatial awareness can challenge people when driving, having trouble navigating new routes, and forgetting where they placed their keys or parked their car.

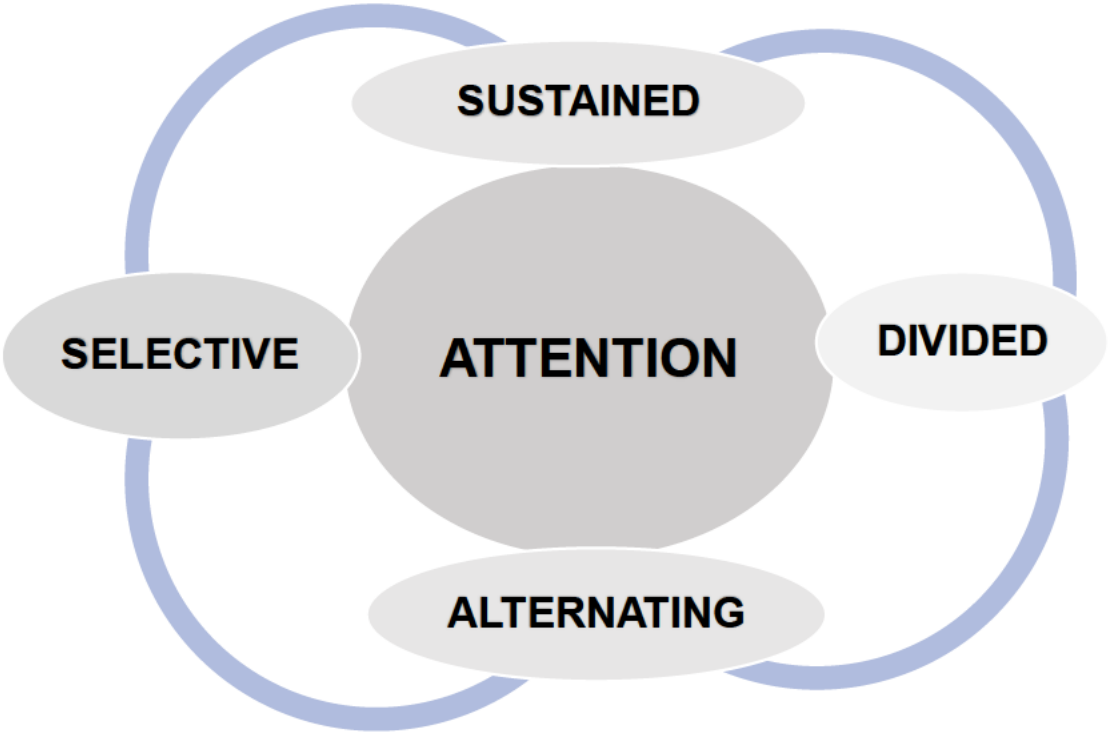
Attention and Executive Skills:
3 areas of Executive Function using Attention abilities:

- Working Memory: Ability to keep information in the brain and use it to your advantage or when needed.
- Cognitive Flexibility: Ability to think in more than one way. (Out of the box)- Taking in all information and flexibly manipulating that information which is required.
- Inhibitory Control: Being able to ignore distraction and temptations and keep our attention focused on to the task at hand.

In summary, perceiving, thinking, learning, deciding, and acting require that we "budget" our attention.

CHAPTER 4

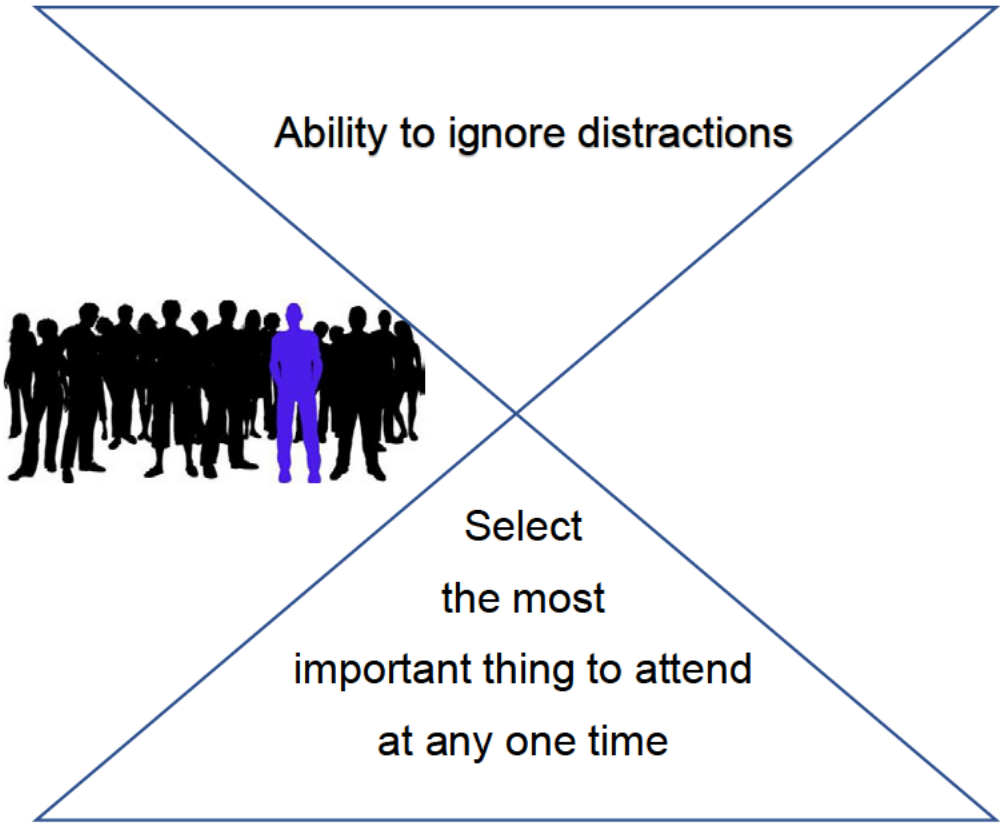
TYPES OF ATTENTION



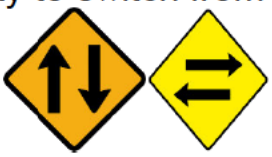
Attention
It is the ability to focus on certain aspects of the environment that are considered important and interesting to us and flexibly manipulate this information.

Concentration
Or
Sustained Attention
Ability to keep our attention on a task or thought long enough to get adequate information to enable us to understand and remember it

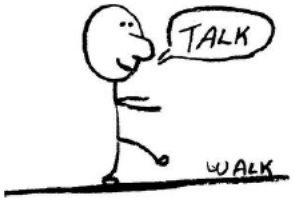
Selective Attention: It has 2 components.



Alternating Attention: Ability to switch from one task or idea to another and back again.



Divided Attention:
Ability to attend to two or more things at the same time



It is common to have problems with one or more of these attention skills

Strategies can be learned to minimise the negative effects of your attention problems in your life

Attention failures will cause problems with other mental skills, it is essential to improve attention skills or use strategies to prevent problems arising

REMEMBER:
Attention is not just for the things happening outside you but also for all your thoughts and feelings that arise within yourself.

CHAPTER 5

AGING AND COGNITION

Changes in our mental abilities or cognition is a normal process of aging. Some cognitive abilities, such as vocabulary, are resilient to aging and may even improve with age. Whilst, other abilities, such as conceptual reasoning, memory, and processing speed, decline gradually over time.

Processing Speed:
It is the speed with which cognitive activities are performed as well as the speed of motor responses. Older adults experience a "slowing" of both cognitive and motor functions. *Example:* driving, banking and so on

Attention:
Simple auditory attention span (also known as immediate memory) shows only a slight decline in late life. However, noticeable age effect is seen on more complex attention tasks, such as selective and divided attention. *Example:* cooking while having a serious conversation or knitting while having a serious conversation may lead to missing stitches or making a wrong stitch.

Memory:
One of the most common cognitive complaints among older adults is change in memory. Slowed processing speed, decreased ability to ignore irrelevant information and limited use of strategies to improve learning and memory account for age-related memory changes. The two types of memory are:

Declarative (explicit) memory- the conscious recollection of facts and events, this includes *semantic memory and episodic memory.*
An example of semantic memory is knowing the meaning of words whereas episodic memory or autobiographical memory is memory for specific personally experienced events.
Whilst both these memory decline occur with age the timing of these declines is different- with episodic memory showing lifelong declines and semantic memory showing late life decline.
Nondeclarative (implicit) memory
Example: Remembering how to sing a familiar song, such as "Happy Birthday."
Procedural memory -a type of nondeclarative memory, involves memory for motor and cognitive skills. *Example*: riding a bicycle.
Nondeclarative memory remains unchanged across the lifespan.
Rate of new learning or encoding new information into memory declines across the lifespan. Example: learning to use a

computer. However, *retention of successfully learned information* is preserved in cognitively healthy older adults *Example:* grandma's recipe or fixing a motorbike. *Retrieval of newly learned information* stored in the memory declines with age *Example:* appointments, new contacts.

Language:
Language ability remains intact with aging. Vocabulary remains unchanged and even improves over time.
***Exceptions*:**

- *Visual confrontation naming*- The ability to see a common object and name it, remains about the same until 70 years and then declines in succeeding years
- *Verbal fluency*- Searching words and generating words for a certain category (e.g., letters, animal names) in a certain amount of time shows decline with aging.

Visuospatial Abilities/Construction:
The ability to understand space in two and three dimensions declines with age. *Example:* assembling furniture from a box of parts, declines over time. In contrast, *visuospatial abilities (object perception example* household items or faces,
and *spatial perception example where one parked one's car)* remain intact.

Executive Functioning:
Ability of a person to successfully engage in independent, appropriate, purposeful, and self-serving behaviour. This includes a combination of different cognitive abilities such as the ability to self-monitor, plan, organize, reason, be mentally flexible, and problem-solve. *Concept formation, abstraction, and mental flexibility* decline with age, especially after 70 years. Older adults are found to be more concrete in their thinking than younger adults.
Response inhibition- the ability to prevent an automatic response and produce a novel response, is affected negatively by aging. *Example:* taking a different or new route than a familiar route.
Executive abilities requiring a fast motor response is affected by age *Example:* not as quick in completing household tasks.

CHAPTER 6

ATTENTION PROBLEMS AND AGING

With age, attention and memory decline is noted more than any other aspect of brain functioning. However, some aspects of attention and memory seem to be well preserved with age while others seem to show significant decline.

Information Processing:
With age, people are seen to become slow in processing information. Performance of complex cognitive operations is delayed by slowed processing at lower-level stages. This results in the loss of information required for higher-level stages that constitute a cognitively complex task (Salthouse & Madden, 2015). Slowing in the rate of information processing contributes to age-related changes in working memory and attention. This information processing can be simplified in the elderly by using varied environmental supports in different sensory modalities. *Example:* Reading materials can have a larger font, more pictures, present with one idea at a time.

Divided Attention and Attention Switching:
Older adults have shown significant difficulties with divided attention, particularly with complex tasks. Divided attention tasks require the processing of two or more sources of information or the performance of two or more tasks at the same time. Due to slowed information processing with age, older adults have difficulty allocating resources appropriately to different tasks of varied priority. Similarly, the performance of older adults is slowed to a greater degree when attention must be switched from one task to another, requiring a change of mental set.

Sustained Attention or Concentration:
Sustained attention refers to the ability to maintain attention over a period of time. Decline in this ability in older adults is seen much later than decline in other types of attention.
The tasks on which older adults show impairments tend to be those that require flexible control of attention, a cognitive function associated with the frontal lobes. However, training may help to improve these functions.

Implications of attentional deficits in daily life:
One important aspect of daily functioning affected by attentional problems is driving, an activity that, for many older people, is essential to independence. Driving requires a constant switching of attention in response to environmental contingencies. Attention must be divided between the task of driving, cognitive monitoring of the environment, and sorting out relevant from irrelevant stimuli all occurring simultaneously. Research has shown that divided attention deficits are significantly associated with increased automobile accidents in older adults.

CHAPTER 7

FACTORS IMPACTING BRAIN HEALTH

Apathy, depression, agitation and/or aggression, anxiety disorders (e.g., generalised anxiety disorder, panic attacks, post-traumatic stress disorder, and agoraphobia) and substance use disorders (abuse of alcohol or prescription drugs such a minor tranquillisers - benzodiazepines) affects brain health for everyone including older adults. Adjustment and sleep disorders are other minor mental health problems affecting older adults.

Apathy:
Apathy, which is characterised by a lack of motivation and diminished goal-oriented behaviour and cognition and is seen among older adults may indicate a decline in cognitive functions. It is difficult to identify apathy as in most instances it does not affect daily functioning. Early identification and treatment may be beneficial to resist further cognitive decline.

Depression:
Depression may not always be causal factor but may worsen a pre-existing cognitive impairment by reducing cognitive reserve. As old age can inevitably bring about varied losses in relation to a stressful life event (example loss of relationships brought about by death of close family or friend, loss of role, loss of purpose in life, loss of health, loss of family home – moving into supported accommodation, loss of income as in retirement and so on), and may lead to the onset of depression in older adults. In addition, some people may naturally have a depressive disposition that may can continue into old age. Suicide is one of the consequences of depression and the risk of suicide in older adults is often underestimated, underdiagnosed and poorly managed. Hence, it is imperative that depression be timely assessed and treated. Untreated depression in older adults can risk Mild Cognitive Impairment (MCI) and even progress to dementia.
Late life depression is characterised by executive dysfunction and deficits in the speed of information processing.

Anxiety:
Anxiety like depression can be a lifelong mental health issue but may become excessive and disabling with age. Despite anxiety being one of the most common mental health concerns experienced by older people, it remains unrecognised and undiagnosed as the presentation of anxiety problems among older adults is mostly physical complaints and pain and it is closely related to their depressive symptomatology.
Untreated anxiety can risk one to have Mild Cognitive Impairment and this may progress to dementia.

CHAPTER 8

COGNITIVE TRAINING AND ITS USE

Despite age-related decline in attentional abilities, the brain has the ability to compensate for these deficits. This is explained by the Scaffolding Theory of Aging and Cognition (STAC) (Park and Reuter-Lorenz 2009, 2014).

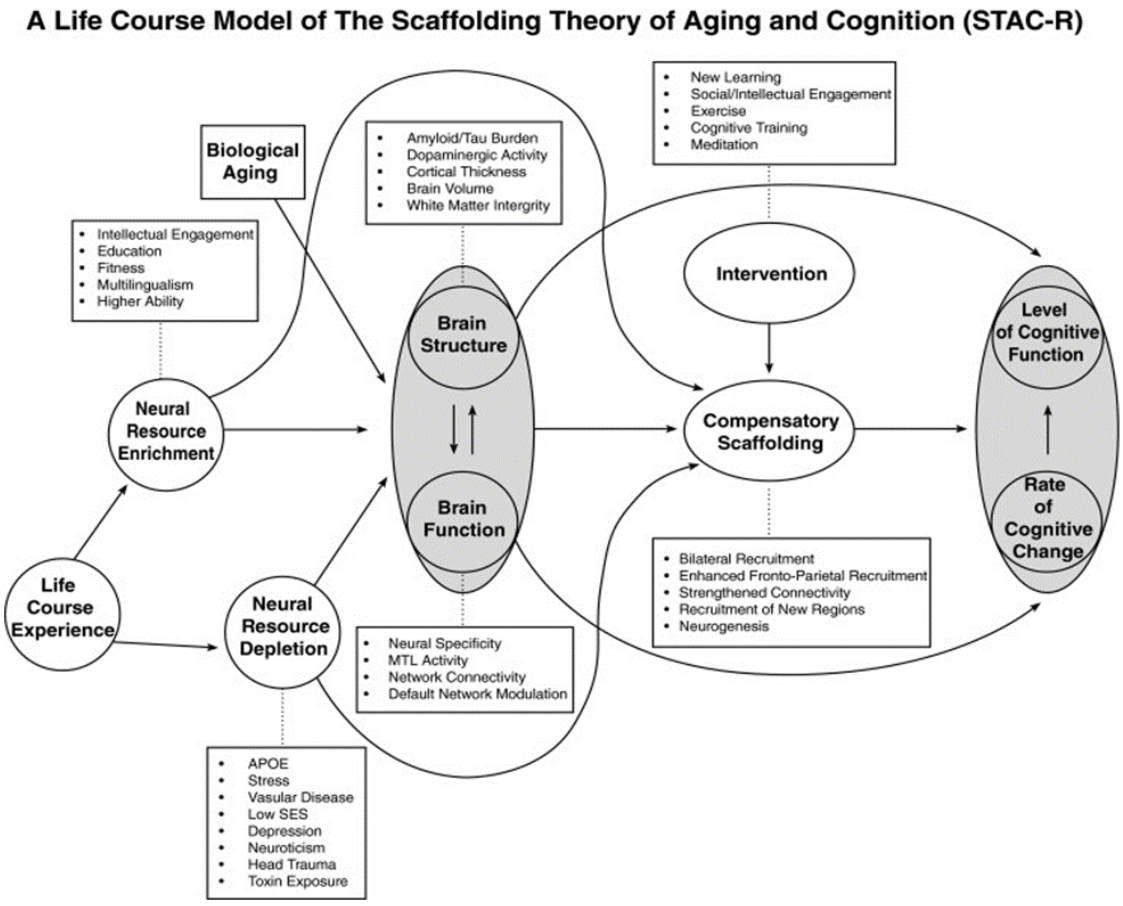


Fig 1. The Scaffolding Theory of Aging and Cognition (Park and Reuter-Lorenz 2009)

The model says that structural or neural changes and functional decline of the brain occur as a result of aging. However, compensatory scaffolding can improve brain health and functions.

Compensatory Scaffolding:
Compensatory scaffolding involves the formation of additional neural circuitry or the use of remaining circuitry differently with age to compensate for the brain's declining structures and neural circuits whose function has become noisy, inefficient, or both.

Level of cognition as we age:
The level of cognition in an individual is the combination of this negative structural and functional degradation in the brain, and

compensatory scaffolding. It is important to remember that though the basic hardware of cognition significantly deteriorates with age, knowledge and expertise are relatively protected from this age-related decline, which may enhance the level of compensatory scaffolding.

How does compensatory scaffolding occur?
The model states two pathways:
1.Enhancing and preserving brain structure and function
2. By increasing the capacity for compensatory scaffolding (Reuter-Lorenz and Park, 2014).

Can cognitive training enrich the brain structure or function?
Certainly. Cognitive training is a type of compensatory scaffolding technique and it refers to repetitive practice of a set of standard tasks with varying levels of difficulty. It is mainly restorative and targets cognitive impairment, it can be delivered in person or via technology (computerised), individually or in a group format.

CHAPTER 9

HOW CAN WE KEEP HEALTHY?

Lifestyle factors contributing to physical and mental health include the following:

Diet:
Importance of diet has been emphasized for decades. Malnutrition including vitamin deficiencies in varying degrees is common among elderly people, causing illness and disease. Malnutrition can result from factors including general malaise, lack of appetite, apathy and/or depression and lack of overall wellness and interest. Other reasons for malnutrition are financial concerns resulting in reduced food shopping budget, fear of personal safety when shopping or lack of mobility. Other causes might include hospitalisation, eating alone or lack of cooking. It is clear, that nutrition plays a crucial role in the health and quality of life.
A healthy well-balanced diet for any age group should include a combination of the following:

- Five portions of vegetables and fruit a day
- Protein from fish, meat, pulses and egg sources
- Carbohydrates such as potatoes, brown rice, whole-wheat pasta, couscous and cereals

In addition, older adults may need calcium, fat, fibre, fluids, iron, vitamin C, vitamin D and zinc that maybe lacking in their diet.

Sleep:
Sleep disturbances are common with age. Changes in sleep patterns may be a normal part of aging but certain factors including physical and mental illness, medication side effects, changes in activity or social life, absence of loved ones, may contribute to sleep problems. Sleep problems decrease quality of life causing daytime sleepiness, tiredness, and lack of energy. Lack of sleep interferes with attention and concentration and leads to poor performance on tasks. Insomnia, sleep apnoea and periodic limb movements of sleep (PLMS) are common sleep problems. Sleep hygiene may assist in reducing the problems associated with sleep.
“Improve your mental fitness:
Researchers at Stanford University (USA) found that memory loss can be improved by 30 to 50 per cent simply by doing mental exercises. The brain is like a muscle - if you don't give it regular workouts, its functions will decline. Suggestions include:

- Keep up your social life and engage in plenty of stimulating conversations.
- Read newspapers, magazines and books.
- Play 'thinking' games like scrabble, cards and trivial pursuit.

- Take a course on a subject that interests you.
- Cultivate a new hobby.
- Learn a language.
- Do crossword puzzles and word games.
- Play games that challenge the intellect and memory, such as chess.
- Watch 'question and answer' game shows on television and play along with the contestants.
- Hobbies such as woodwork can improve the brain's spatial awareness.
- Keep stress under control with meditation and regular relaxation, since an excess of stress hormones like cortisol can be harmful to neurones."

  Taken from:

https://www.betterhealth.vic.gov.au/health/healthyliving/healthy-ageing-stay-mentally-active

REMEMBER: *Long term severe deterioration can weaken the brain's ability to provide effective compensation hence engaging in a healthy lifestyle and creation of a stimulating environment for brain health should start much before one reaches old age.*

REFERENCES

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7. Reuter-Lorenz, P. A., & Park, D. C. (2014). How does it STAC up? Revisiting the scaffolding theory of aging and cognition. *Neuropsychology Review, 24,* 355-370. doi:10.1007/s11065-014-9270-9The Australian Psychological Society. (2000). *Psychology and Ageing: a position paper prepared for the Australian Psychological Society.* Retrieved from: https://www.psychology.org.au/About-Us/What-we-do/advocacy/Position-Papers-Discussion-Papers-and-Reviews/Psychology-and-Ageing
8. www.emedicinehealth.com

ATTENTION AND OLDER ADULTS

THANK YOU FOR PARTICIPATING IN THIS RESEARCH.
EACH AND EVERYONE MADE SPECIAL CONTRIBUTION TO THIS WORK

APPENDIX C

Learning to Relax CD

https://cancerqld.org.au/cancer-information/find-resources/podcasts-audio-files/#LearningtoRelaxPodcasts

APPENDIX D

Pamphlets (Community)

ATTENTION AND OLDER ADULTS

CAN WE LEARN TO BE MORE ATTENTIVE WHEN WE AGE???????

As we become older we may have problems with our attention. Some people may have more problems than others. We may become more unmindful. We may have trouble focusing on two things at the same time for example taking part in a conversation while driving. We may have trouble concentrating on things we love doing such as reading a book, watching television or knitting a cardigan. We may become more distracted and leave tasks unfinished for example forgetting to drink the remaining cup of coffee after talking with a friend on the phone who rang while we were making a cuppa.

The good news is that our brain can be trained to work better. If we are trained to attend better we may remember things better!!!

THIS STUDY WILL HELP US UNDERSTAND:

HOW WE CAN ATTEND BETTER?

IF WE LEARN TO ATTEND BETTER CAN WE REMEMBER THINGS BETTER?

If you are interested in the study and you are between 60 to 80 years of age, Please do not hesitate to contact Sumi at [redacted] mobile; [redacted]) for further information about this study and/or to obtain a Participant Information Sheet.

IMPORTANT NOTE:

ALL PRECAUTIONARY COVID SAFE PRACTICES WILL BE STRICTLY ADHERED TO. IF YOU HAVE A CHRONIC HEALTH CONDITION/S THAT MAY POSE A RISK FOR YOU, PLEASE CONSULT YOUR GP BEFORE PARTICIPATION.

APPENDIX E

Ethics Approval

Enquiries to: Deborah Wainwright
Telephone: [redacted]
Our Ref: HREC/19/QTDD/44877

Queensland Government

Medical Services

Darling Downs Hospital and Health Service

Pechey Street Toowoomba
PMB 2 Toowoomba
[redacted]
www.health.qld.gov.au/darlingdowns
ABN 64 109 516 141

Mrs Mousumi Singh
Senior Psychologist
GARSS
Toowoomba Hospital

Dear Mrs Singh

HREC Reference number: HREC/19/QTDD/44877
Project title: Exploring the impact of attention training difficulties experienced by older adults with or without Mild Cognitive Impairment (MCI).

Thank you for submitting the above project for ethical and scientific review. This project was considered by the Darling Downs Health Human Research Ethics Committee (HREC) and further information requested was reviewed by the HREC Chair.

This HREC is constituted and operates in accordance with the National Health and Medical Research Council's (NHMRC) *National Statement on Ethical Conduct in Human Research (2007), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2007)* and the *CPMP/ICH Note for Guidance on Good Clinical Practice.*

I am pleased to advise that the Human Research Ethics Committee has granted approval of this research project at the following sites:

- Memory Clinic, Toowoomba Hospital
- Psychology Clinic, University of Southern Queensland

The documents reviewed and approved include:

Document	*Version*	*Date*
HREA application		November 2018
Protocol	V 3	9 January 2019
Participant Information Sheet - MCI	V 3	9 January 2019
Participant Information Sheet – Community	V 3	9 January 2019
Reply Slip	V 2	20 November 2018
Consent Form 1 – MCI	V 2	20 November 2018
Consent Form 2 – MCI	V 2	20 November 2018
Consent Form 1 – Community	V 2	20 November 2018
Consent Form 2 - Community	V 2	20 November 2018
Withdrawal Form	V 2	20 November 2018

ihca supporting excellence CERTIFICATION
QUALITY CERTIFIED ORGANISATION

Pamphlet – MCI	V 2	20 November 2018
Pamphlet – Community	V 2	20 November 2018
Invitation for Eligibility Assessment – MCI	V 2	20 November 2018
Invitation for Eligibility Assessment – Community	V 2	20 November 2018
Invitation to participate in Treatment Groups – MCI	V 2	20 November 2018
Invitation to participate in Treatment Groups – Community	V 2	20 November 2018
Invitation to participate in Control Groups – MCI	V 2	20 November 2018
Invitation to participate in Control Groups – Community	V 2	20 November 2018
Post Training Assessment – MCI	V 2	20 November 2018
Post Training Assessment – Community	V 2	20 November 2018
Post Trial Intervention Letter 1	V 2	20 November 2018
Post Trial Intervention Letter 2 – MCI	V 2	20 November 2018
Post Trial Intervention Letter 3 - Community	V 2	20 November 2018
Line manager support email		17 September 2018
Line manager support email		23 November 2018
Finance calculation		15 January 2019
CV – M Singh		
CV – G Beccaria		
CV – B Knight		
Questionnaire – Clinical Information Sheet		
Questionnaire – RBANS (copyright)		
Questionnaire – RBANS Supplement 1 (copyright)		
Questionnaire – The Test of Everday Attention Manual (copyright)	V 4	October 2001

Please note the following conditions of approval:

1. The Principal Investigator will immediately report anything which might warrant review of ethical approval of the project in the specified format, including:
    a. Unforeseen events that might affect continued ethical acceptability of the project. Serious Adverse Events must be notified to the Committee as soon as possible. In addition, the Investigator must provide a summary of the adverse events, in the specified format, including a comment as to suspected causality and whether changes are required to the Patient Information and Consent Form. In the case of Serious Adverse Events occurring at the local site, a full report is required from the Principal Investigator, including duration of treatment and outcome of event.

2. Amendments to the research project which may affect the ongoing ethical acceptability of a project must be submitted via Ethical Review Manager to the HREC for review.

3. Amendments to the research project which only affect the ongoing site acceptability of the project are not required to be submitted to the HREC for review. These amendment requests should be submitted directly to the RGO via Ethical Review Manager (by-passing the HREC).

4. Proposed amendments to the research project which may affect both the ethical acceptability and site suitability of the project must be submitted firstly to HREC for review and, once HREC approval has been granted, then submitted to the RGO.

5. Amendments which do not affect either the ethical acceptability or site acceptability of the project (e.g. typographical errors) should be submitted via Ethical Review Manager to the HREC coordinator. These should include a cover letter from the principal investigator providing a brief description of the changes and the rationale for the changes, and accompanied by all relevant updated documents with tracked changes.

6. The HREC will be notified, giving reasons, if the project is discontinued at a site before the expected date of completion.

7. The Principal Investigator will provide an annual report to the HREC and at completion of the study in the specified format.

8. The District administration and the HREC may inquire into the conduct of any research or purported research, whether approved or not and regardless of the source of funding, being conducted on hospital premises or claiming any association with the Hospital; or which the Committee has approved if conducted outside Darling Downs Health.

HREC approval is valid for 3 years from the date of this letter.

Should you have any queries about the HREC's consideration of your project please contact the Chair of the Darling Downs Health Human Resource Ethics Committee. The HREC terms of Reference, Standard Operating Procedures, membership and standard forms are available from http://www.health.qld.gov.au/ohmr/html/regu/regu_home.asp

You are reminded that this letter constitutes ethical approval only. You must not commence this research project at a site until separate authorisation from the District CE or Delegate of that site has been obtained.

A copy of this approval must be submitted to the Research Governance Officer with a completed Site Specific Assessment (SSA) Form for authorisation from the CEO or Delegate to conduct this research at the Hospital and Health Service.

Once authorisation to conduct the research has been granted, please complete the Commencement Form and return to the office of the Human Research Ethics Committee.

The HREC wishes you every success in your research.

Yours sincerely

[redacted]

Angela O'Shea
Chair
Darling Downs Health
Human Research Ethics Committee

1/02/19.

USQ

Mousumi Singh <w0024396@umail.usq.edu.au>

[RIMS] USQ HRE Application H19REA038 - Expedited Review Outcome - Approved

1 message

human.Ethics@usq.edu.au <human.Ethics@usq.edu.au> Wed, Mar 13, 2019 at 10:30 AM

[redacted]

Dear Mousumi

Thank you for submitting your ethical review approval for the project listed below.

The University of Southern Queensland conforms to principles of minimising duplication of ethical review for research projects, in accordance with Chapter 5.3 of National Statement on Ethical Conduct in Human Research (2007).

Your project has now been administratively reviewed to ensure that USQ's role in the project has been disclosed duly approved as outlined below. As part of the approval the research team acknowledge that relevant information and advice about this ethical approval may be exchanged with relevant review body/ies. The Principal Investigator will be responsible for informing the ethical review body that reviews and approves the research at all other sites at which the research will be conducted; the name and location of any other body that will conduct an ethical review of the research; and any previous decisions made about the research by other review bodies (in Australia or elsewhere).

USQ HREC ID: H19REA038
Project title: Exploring the impact of attention training on attention difficulties experienced by older adults with or without Mild Cognitive Impairment (MCI).
Approval date: 13/03/2019
Expiry date: 01/02/2022
Project status: Approved (with conditions).

The standard conditions of this approval are:

(a) conduct the project strictly in accordance with the proposal submitted to the originating registered human research ethics committee and ethics approval, including any amendments made to the proposal required by that committee;

(b) advise the USQ HREC (via human.ethics@usq.edu.au) immediately of any complaint or other issue in relation to the conduct of this project which may warrant review of the overarching ethical approval of the project;

(c) provide advice via submission of a USQ HRE Amendment for ethical approval of any amendments or revision to the original approved project by the originating registered human research ethics committee prior to implementing any changes;

(d) complete and submit a USQ milestone (progress) report as requested, and at least for every year of approval; and

(e) complete and submit a USQ milestone (final) report when the project does not commence within the first 12 months of approval, is abandoned at any stage, or is completed (whichever is sooner).
Additional conditions of this approval are:

(a) Nil.

Failure to comply with the conditions of approval or the requirements of the National Statement on Ethical Conduct in Human Research (2007) may result in withdrawal of ethical approval for this project. If you have any questions or concerns, please contact an Ethics Officer.

Kind regards

The Human Research Ethics Team

University of Southern Queensland
Toowoomba – Queensland – 4350 – Australia
Phone: (07) 4631 2690
Email: human.ethics@usq.edu.au

Enquiries to: Deborah Wainwright
Telephone: [redacted]
Our Ref: HREC/19/QTDD/44877

Queensland Government

Allied Health Services

Darling Downs Hospital and Health Service

Mrs Mousumi Singh
Senior Psychologist
GARSS
Toowoomba Hospital

Dear Mrs Singh

HREC Reference number: HREC/19/QTDD/44877
Project title: Exploring the impact of attention training difficulties experienced by older adults with or without Mild Cognitive Impairment (MCI).

Amendment number: HREC/19/QTDD/44877/AM02 – AM03
Amendment Date: 29 January 2020

The above amendments were reviewed by the Darling Downs Health Human Research Ethics Committee.

I am pleased to advise that the following amended documents were reviewed and approved:

Document	Version	Date
Protocol	6	30 January 2020
Participant Information Sheet – MCI	3	30 January 2020
Participant Information Sheet – Community	3	30 January 2020
Participant Information Sheet – MCI, Community	3	30 January 2020

The Darling Downs Health HREC is constituted and operates in accordance with the National Health and Medical Research Council's *"National Statement on Ethical Conduct in Human Research (2007 updated 2018), NHMRC and Universities Australia Australian Code for the Responsible Conduct of Research (2018)* and the *"CPMP/ICH Note for Guidance on Good Clinical Practice".*

A copy of this letter must be forwarded to the appropriate Research Governance Officer/s.

It should be noted that all requirements of the original approval still apply.

Yours sincerely

[redacted]

Angela O'Shea
Chair
Human Research Ethics Committee
Darling Downs Health

14 / 02 / 2020

Office of the Executive Director
Allied Health Services
Cnr Hogg & Tor Streets
PO Box 405 Toowoomba
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[redacted]
www.health.qld.gov.au/darlingdowns

ABN 64 109 516 141

Enquiries to: Deborah Wainwright
Telephone: [redacted]
Our Ref: SSA/19/QTDD/44877

Queensland Government

Medical Services

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www.health.qld.gov.au/darlingdowns
ABN 64 109 516 141

Mrs Mousumi Singh
Senior Psychologist
GARSS
Toowoomba Hospital

Dear Mrs Singh

HREC Reference number: HREC/19/QTDD/44877
SSA reference number: SSA/19/QTDD/44877
Project title: Exploring the impact of attention training difficulties experienced by older adults with or without Mild Cognitive Impairment (MCI).

Thank you for submitting an application for authorisation of this project. I am pleased to inform you that authorisation of this SSA has been granted for this study to take place at the following sites:

- Toowoomba Hospital

The following conditions apply to this research proposal. These are additional to those conditions imposed by the Human Research Ethics Committee that granted ethical approval.

1. Proposed amendments to the research protocol or conduct of the research which may affect the ethical acceptability of the project are to be submitted to the HREC for review. A copy of the HREC approval/rejection letter must be submitted to the RGO;
2. Proposed amendments to the research protocol or conduct of the research which only affects the ongoing site acceptability of the project, are to be submitted to the RGO;
3. Proposed amendments to the research protocol or conduct of the research which may affect both the going ethical acceptability of the project and the site acceptability of the project are to be submitted firstly to the HREC for review and then to the RGO after a HREC decision is made.

Should you have any questions or concerns regarding this correspondence, please contact this office.

Yours sincerely

[redacted]

Dr Martin Byrne
BAppSc MBBS FRACMA FRACGP FARGP FACRRM MHM DRANZCOG GAICD
Executive Director Medical Services
Darling Downs Health

11/3/19

APPENDIX F

Australian and New Zealand Clinical Trial Registry (Trial ID- ACTRN12619000820101)

Update Approved

ANZCTR Admin actr@ctc.usyd.edu.au
To [redacted]
Cc [redacted]

Updated Successfully

Dear: Mousumi Singh,
Re: Exploring the impact of attention training experienced by older adults with or without MCI

MCI- Mild cognitive impairment

Thank you for updating the trial information of the above trial registered with the Australian New Zealand Clinical Trials Registry (ANZCTR): 12619000820101

All your updated trial information has now been approved and successfully updated on the website.

Please be reminded that the quality and accuracy of the trial information submitted for registration is the responsibility of the trial's Primary Sponsor or their representative (the Registrant). The ANZCTR allows you to update trial data, but please note that the original data lodged at the time of trial registration and the tracked history of any changes made will remain publicly available.

The ANZCTR is recognised as an ICMJE acceptable registry (http://www.icmje.org/about-icmje/faqs/clinical-trials-registration/) and a Primary Registry in the WHO registry network (https://www.who.int/ictrp/network/primary/en/index.html).

If you have any enquiries or have received this email by mistake please contact the ANZCTR Admin.
Thank you,
ANZCTR Staff

[redacted]
Email: info@actr.org.au
Website: www.ANZCTR.org.au

From: info@actr.org.au <info@actr.org.au>
Sent: Thursday, June 6, 2019 4:22:54 PM
To: [redacted]
Subject: Your ACTRN (registration number): ACTRN12619000820101

Dear Mousumi Singh,

Re: Exploring the impact of attention training experienced by older adults with or without MCI

MCI- Mild cognitive impairment

Thank you for submitting the above trial for inclusion in the Australian New Zealand Clinical Trials Registry (ANZCTR).

Your trial has now been successfully registered and allocated the ACTRN: ACTRN12619000820101

Web address of your trial: http://www.ANZCTR.org.au/ACTRN12619000820101.aspx
Date submitted: 17/05/2019 9:53:49 AM
Date registered: 6/06/2019 4:22:48 PM
Registered by: Mousumi Singh
Principal Investigator: Mousumi Singh

****Please note that as your trial was registered after the first participant was enrolled, it does not fulfil the criteria for prospective registration and will therefore be marked as being Retrospectively Registered on our website.****

If you have already obtained Ethics approval for your trial, please send a copy of at least one Ethics Committee approval letter to info@actr.org.au or by fax to [redacted] attention to ANZCTR.

Note that updates should be made to the registration record as soon as any trial information changes or new information becomes available. Updates can be made at any time and the quality and accuracy of the information provided is the responsibility of the trial's primary sponsor or their representative (the registrant). For instructions on how to update please see http://www.anzctr.org.au/Support/HowToUpdate.aspx.

Please also note that the original data lodged at the time of trial registration and the tracked history of any changes made as updates will remain publicly available on the ANZCTR website.

The ANZCTR is recognised as an ICMJE acceptable registry (http://www.icmje.org/about-icmje/faqs/clinical-trials-registration/) and a Primary Registry in the WHO registry network (http://www.who.int/ictrp/network/primary/en/index.html).

If you have any enquiries please send a message to info@actr.org.au or telephone [redacted]

Kind regards,
ANZCTR Staff
[redacted]
E: info@actr.org.au
W: www.ANZCTR.org.au

ANZCTR
Australian New Zealand Clinical Trials Registry

APPENDIX G

Participant Information Sheet and Reply Slip (Community)

Attention and Older Adults

Participant Information Sheet

Location:	Psychology Clinic, University of Southern Queensland (USQ), 487-535 West Street, Toowoomba Qld 4350, Australia.
Researchers:	Ms Mousumi Singh, Toowoomba Hospital, Darling Downs Hospital and Health Service (DDHHS). Professor Bob Knight, University of Southern Queensland (USQ) Associate Professor Gavin Beccaria, USQ.

WHAT DOES TAKING PART IN THIS RESEARCH MEAN?

1 Introduction

You are invited to take part in this study because you are between 60 and 80 years old and are living independently. The researchers would like to find out how much your attention and other mental abilities differ from people your age with memory and attention difficulties. They would also like to know whether training in attention helps you to focus better. The training used in this study is called Attention Training.

This Participant Information Sheet tells you about the study. It explains the tests and training involved. Knowing what is involved will help you decide if you want to take part in the study. Please read this information carefully. Ask questions about anything that you don't understand or want to know more about. Before deciding whether to take part, you might want to talk about it with a relative, friend or your local doctor.

This study is jointly led by the Darling Downs Hospital (DDH) and the University of Southern Queensland (USQ). The results of this study will be used by Mousumi Singh to gain a Doctor of Philosophy (PhD) degree. Ms Singh is also a senior psychologist working with Queensland Health. This research is funded by Ms Singh's PhD. There will be no commercial sponsors for this study.

Participation in this study is voluntary. You don't have to take part if you don't wish to. Your decision to take part or not, or to take part and then withdraw, will not affect your routine treatment, your relationship with those treating you or your relationship with the hospital or university. You will receive the best possible care whether you participate or not. If you decide to take part in this study, you will be asked to sign a consent form. You will be given a copy of this Participant Information Sheet and the Consent Form to keep.

2 What is the purpose of this research?

We know that aging slows down our mental abilities. However, some older adults may experience greater decline in their mental abilities than their peers. The researchers would like to know how much age affects older people's ability to pay attention and remember things. Attention is a core mental ability needed for other mental work and daily functioning. Most studies to date have shown problems with memory in older adults. Few studies have looked at whether a decline in attention affects other mental abilities in older adults. Attention training is not a common therapy for older adults with difficulties in attention and memory. There is also limited information on the effect of such training on older adults. Understanding the usefulness of attention training in older people may help in deciding whether it should be used as a regular form of therapy. Researchers would also want to know which group of participants (people with or without memory and attention difficulties) benefit more from the attention training.

3 What does participation in this study involve?

You will be taking part in a randomised controlled study. To find out whether a new type of training is useful, we compare it with other types of training. We put people into groups and give each group different training. The results are compared to see if one is better than the other. To make sure the groups are the same, each person will be put into a group by chance (at random). In this study researchers would like to examine whether Attention Training is useful. Therefore, it is compared with Relaxation Training in this study. So, each person has an equal chance of being assigned to the Attention Training group or the Relaxation Training group. If you are assigned to the Relaxation Training group, you can still receive the Attention Training, once the study ends.

At the first study appointment, we will discuss the study and you can decide whether you wish to take part. If you do, we will invite you to sign a consent form, complete a short survey and take a 30 minutes test to determine whether you are eligible to be in this study.

If you qualify for this study, we will invite you to sign the second consent form for participating in the study. At this point, we will also invite you to complete another test that will take a further 60 minutes of your time. All this will be done on the same day and will take a maximum of 2 hours.

Within 2 weeks of completing your initial tests, you will receive a letter informing you which training group (Attention or Relaxation training) you have been assigned to. This letter will detail the dates and time of the 10 weekly sessions of training that you will be invited to participate in. Each weekly session will be for 2 hours. You will be part of a group of 8 participants maximum. During the 2 hours of weekly training, you will learn about how the brain works and what helps to maintain brain health. You will also participate in different activities and discussions. If you are in the Relaxation Training group, apart from learning about the brain and brain health, you will also participate in relaxation exercise during the two hours weekly session. You will get a short break in between the 2 hours weekly session. All tests and group activities may not be easy for you, but we will help you to reach your goals at your own pace. If you have to miss a session for some reason, we will arrange a catch-up session with you.

After completing all the 10 weekly group training sessions, you will be asked to complete some further tests. These tests are a different version of the same tests you completed at the beginning. This will take 90 minutes of your time.

Some participants may be asked to take the eligibility test more than once. This is to make sure that all participants qualify for the study. If you do not qualify for this study, you will be given a letter to

take to your GP if you wish. Your GP may then want to discuss options for further help with you or your family member.

The training and tests for this study will be provided free of cost. We will also provide you free resources to take home. You will not be paid for your participation.

If you are assigned to the Relaxation Training group and would like to get the Attention Training, please let the researcher know of this after the last test session. Once, request is received from 8 participants, you will be contacted and provided the same Attention training (10 weekly sessions- 2 hours weekly) by the principal researcher. You will then be re-assessed by the same tests upon completion of the Attention training. If you do not want to be re-assessed at the completion of the Attention Training, then please inform the Principal Researcher. The data obtained from your participation in the Attention Training will be removed from the research and you will not be re-assessed as desired by you. You will still receive the same treatment regardless of whether you want your data to be part of this research or not.

You will also have the choice to enter a lucky draw of $100.00 if you complete all tests and training sessions. You may also choose to receive a letter summarising the results of this study after it is completed.

You can continue with your other treatment whilst participating in this study. If you are receiving other therapy, it would be helpful for us to know as that may influence your results obtained from this study. You will be given the choice to answer this question through the survey you complete at the beginning of this study.

4. Relevant information about the research

Research will consist of two groups of participants. Participants with a diagnosis of Mild Cognitive Impairment (MCI) and healthy older adults. Participant group with MCI will be recruited from the Toowoomba Hospital Memory Clinic or from physicians in private practise. These participants will receive only the 10 weekly Attention Training program (2 hours weekly). Sixty-four healthy older adults will also be recruited from the community. These participants will be further assigned to two groups. Each of the 2 groups of people will receive either the Attention Training or the Relaxation Training. For this to take place efficiently, each group of 32 people will receive the weekly group training in smaller groups of maximum 8 participants at a time. This study will continue for 2 years, until all recruited participants have received training. Participants from the Memory Clinic will have all their tests and training at the Toowoomba Hospital Memory Clinic, whereas community participants will have theirs completed at the Psychology Clinic, USQ, Toowoomba.

5. What if I withdraw from this study?

Participation in this study is your choice. If you decide to take part and later change your mind, you are free to withdraw. Your decision to withdraw will not affect your treatment or your relationship with anyone at the hospital or at the university. You will receive the best possible care regardless of your decision to withdraw. You do not have to give any reasons for pulling out of this study. You may withdraw either by telling a researcher or posting us your completed withdrawal form given to you with this Participant Information Sheet. The researchers would like to keep all the information collected from you so that the results of this study can be measured correctly. If you do not wish this to happen, you should inform the researchers when you withdraw and they will remove all the information already collected about you from the study.

6. What are the alternatives to participation?

At this stage, no such groups are offered in the community.

7. What are the possible benefits of taking part?

We cannot promise you any benefits from your participation in this study. However, group participation may help you increase your confidence. It may also help to create more awareness in you about similar struggles that other people may have. You may benefit from the Attention Training. Participants in the Relaxation Training may learn ways to better manage their daily stress.

8. What are the possible risks or disadvantages of taking part?

As the training is a mental exercise there are no medical side effects from it. There are no risks from attending the Attention Training or Relaxation Training. It is possible that some participants may become upset if their test results show a decline in their mental abilities. In those situations, the researchers will be able to arrange for free counselling by trained people from the Psychology Clinic, USQ. These counsellors will not be members of the research team.

9. What will happen to the information about me?

Any information collected for this study that can identify you will remain confidential. All information collected from you will be numbered. This is called coding and is done to protect your identity. Only coded information will be examined by the study team. Your information will be used for this study only and it will only be released with your consent. Results will only discuss the results of the groups taking part and no individual will be able to be identified. The results of this study will be reported as a group in forums, scientific meetings and publications. The information collected from you will be securely stored and cannot be accessed without permission from the researchers. All community participants will have a client file created for them at the USQ Psychology Clinic. Test results will be filed in the client file.

10. Who has reviewed this study.

All research in Australia involving humans is reviewed by an independent group of people called a Human Research and Ethics Committee (HREC). The ethical aspects of this study have been approved by the HREC of Darling Down Hospital and Health Service (DDHHS) and USQ.

This study will be carried out according to the National Statement on Ethical Conduct in Human Research (2007). This statement has been developed to protect the interests of people who agree to participate in human research.

11. Further information and who to contact

The person you choose to contact will depend on the nature of your question.

If you want any further information on this study, you can contact the researcher on [redacted] or Mousumi [redacted]

If you have any complaints about any aspect of this study, the way it is being conducted or any questions about being a research participant in general, then you may contact a Human Research Ethics Coordinator. This person is not part of this research but ensures that the research is conducted in a way that protects the rights of participants.

You may contact either the Toowoomba Hospital Human Research Ethics Coordinator: Phone [redacted], email DDHHS-RESEARCH@health.qld.gov.au OR the University of Southern Queensland Human Research Ethics Coordinator: Phone: [redacted], email: [redacted]

WHAT DO I DO IF I AM INTERESTED IN TAKING PART IN THIS STUDY?

If you are interested in this study, please complete the reply slip at the end of this sheet and post it using the reply-paid envelope. Upon receipt of your reply slip, we will contact you to arrange for the first study appointment where we will talk about the study and you may provide consent and complete the first tests.

REPLY SLIP- COMMUNITY

ATTENTION AND OLDER ADULTS

Principal Researcher: Sumi, [redacted]

I _____(name) am interested in this study.

Best contact phone number: _____(landline), _____ (mobile number).

Best Days to be contacted: _____ (weekdays only).

Best Time: _____(anytime between 8:00 to 4:30pm).

My contact address is _____ (for correspondence ONLY).

Date: _____.

APPENDIX H

Invitation for Eligibility Testing and Pre-assessment (Community)

Date: 15 December 2020

Name
Toowoomba, Qld 4350

Dear

I would like to invite you to participate in the study on **Attention and Older Adults**

Firstly, I would need to know whether you qualify for the study before proceeding further.

As discussed with you during our recent phone conversation, I would like to invite you for an assessment to see whether you qualify for the study and then proceed with pre-assessment.

Details of the assessment is as follows:

Date:

Time:

Venue: Psychology Clinic, University of Southern Queensland, 487-535 West Street, Toowoomba.

Assessor:

Parking: Please note that you can park in front of the clinic for free. Please present yourself at the reception desk. If you have difficulties with parking, please do not hesitate to contact Anne on that day.

Please do not hesitate to ring me at [redacted], if you need further clarifications.

Kind Regards

Mrs Mousumi Singh
Principal Researcher (Geriatric Adult Rehabilitation and Stroke Services, Toowoomba Hospital

APPENDIX I

Clinical Questionnaire

CODE NO:

Date:

Age:

Gender: Male/ Female/indeterminate

Marital Status: Married/Divorcee/widow/never married/ in a relationship/other – please specify

Cognitive status: Healthy Older adults.

Highest educational level achieved: Primary/secondary/tertiary/trade (specify:).

Current employment status: Employed/Retired

Sensory deficits (if any):

a) Vision: Intact/using aids/ not using prescribed aids/ no prescribed aids given.
b) Hearing: Intact/using aids/ not using prescribed aids/ no prescribed aids given.

Main medical condition/s:

Prescribed medication: please specify type:

APPENDIX J

Consent Form 1 for Eligibility Assessment (Community)

Attention and Older Adults

CONSENT FORM 1

FOR ELIGIBILITY ASSESSMENT

Location: Psychology Clinic, University of Southern Queensland (USQ), 487-535 West Street, Toowoomba Qld 4350, Australia.

Researchers: Ms Mousumi Singh, Toowoomba Hospital, Darling Downs Hospital and Health Service (DDHHS).

Professor Bob Knight, University of Southern Queensland (USQ)

Associate Professor Gavin Beccaria, USQ.

Declaration by Participant

I have read the Participant Information Sheet. I understand the purposes, procedures and risks of this study.

I have had the opportunity to ask questions. I am satisfied with the answers I have received.

I freely agree to participate in this study as described.

I agree to be tested to find out whether I qualify for this study. I understand that if I do not qualify for this study, I will not be asked to take part in the rest of this study.

I agree to the results of my tests being placed in my personal file at the Psychology Clinic, USQ, Toowoomba.

I understand that I am free to withdraw from the study at any time. This will not affect my current and future health care.

I understand that I will be given a signed copy of this document to keep

Name of the Participant (please print)

_____

Signature: _____ Date: _____

Declaration by the Researcher:

I have given a verbal explanation of this study, its procedures and risks. I believe that the participant has understood the explanation.

Name of the Researcher (please print):

_____

Signature: _____Date: _____

APPENDIX K

Consent Form 2 for Participation in the Study (Community)

Attention and Older Adults

CONSENT FORM 2

FOR PARTICIPATION IN THE STUDY

Location: Psychology Clinic, University of Southern Queensland (USQ), 487-535 West Street, Toowoomba Qld 4350, Australia.

Researchers: Ms Mousumi Singh, Toowoomba Hospital, Darling Downs Hospital and Health Service (DDHHS).

Professor Bob Knight, University of Southern Queensland (USQ)

Associate Professor Gavin Beccaria, USQ.

Declaration by Participant

I have read the Participant Information Sheet. I understand the purposes, procedures and risks of this study.

I have had the opportunity to ask questions. I am satisfied with the answers I have received.

I freely agree to participate in the study as described.

I understand I am free to withdraw from the study at any time. This will not affect my current and future health care.

I agree to the results of my tests being placed in my personal file at the Psychology Clinic, USQ, Toowoomba.

I am aware of the lucky draw at the end of the study. I understand that I will qualify for the lucky draw only if I participate till the end.

I would like to take part in the lucky draw. Circle one: YES OR NO.

I wish to obtain a report on this study once it is completed. Circle one: YES OR NO

I understand that I will be given a signed copy of this document to keep

Name of the Participant (please print):

_____

Signature: _____Date: _____

Declaration by the Researcher

I have given a verbal explanation of this study, its procedures and risks. I believe that the participant has understood the explanation

Name of the Researcher (please print):

_____

Signature: _____Date: _____

APPENDIX L

Letter for Follow-up

TO WHOM IT MAY CONCERN

I refer to a recent cognitive assessment conducted on _____(name of the participant) in relation to a research on "Attention and Older Adults" that I am conducting. Attached is the Participant Information sheet that provides information on the research and its inclusion criteria. _____(Name of the participant) did not qualify for the research as his/her overall assessment score obtained from his/her completion of a comprehensive neurocognitive screen conducted as part of the research, was significantly lower than the research criteria. As such, I have advised _____(name of the participant) to further investigate this matter by discussing this with his/her general practitioner and take necessary steps (if any) as advised by his/her GP. I am not able to provide details of the assessment as it was conducted as part of the research. Please do not hesitate to refer_____(name of the participant) to appropriate public or private services, for assessments and management/treatment (if needs be).

Kind Regards

Mousumi Singh
Principal Researcher
8 December 2019.

APPENDIX M

Invitation to Training Programs

Date:

Dear

I would like to invite you to participate in the study **on Attention and Older Adults**

As confirmed during recruitment and initial intake assessments, you are assigned to the control group. Therefore, you are invited to attend 10 sessions (weekly, 2 hours each session) of **Relaxation training.**

Details are as follows:

Start Date:

Day of the week:

Time:

End Date:

Venue: Psychology Clinic, University of Southern Queensland, 487-535 West Street

Toowoomba (Map attached)

Contact Person: Mousumi Singh (Sumi)

Parking: There is a parking meter at the parking lot in front, but it is inactive, so you do not need to pay anything. Please present yourself at the reception desk and I will meet you there.
Please do not hesitate to ring me on [redacted] or email me at this email, if you need further clarifications.

Kind Regards

Mrs Mousumi Singh
Principal Researcher Geriatric Adult Rehabilitation and Stroke Services,
Toowoomba Hospital

Date:

Dear

I would like to invite you to participate in the study on **Attention and Older Adults**.

As confirmed during recruitment and initial intake assessments, you are assigned to the treatment group. Therefore, you are invited to attend 10 sessions (weekly, 2 hours each session) of **Attention training program.**

Details are as follows:

Start Date:

Time:

Day of the week:

End Date:

Venue: Psychology Clinic, USQ.

Contact Person: Mousumi Singh (Sumi)

Parking: There is a parking meter at the parking lot in front, but it is inactive, so you do not need to pay anything. Please present yourself at the reception desk and I will meet you there.

Please do not hesitate to ring me on [redacted] or email me at this email, if you need further clarifications.

Kind Regards
Mrs Mousumi Singh
Principal Researcher Geriatric Adult Rehabilitation and Stroke Services,
Toowoomba Hospital

APPENDIX N

Invitation for Post-Training Assessment

Date:

Name
Toowoomba, Qld

Dear

I would like to invite you to participate in the post assessments for the study on Attention and Older Adults

This assessment is going to take a maximum of 1.5 hours of your time.

Details are as follows:

Date:

Time:

Venue: USQ PSYCHOLOGY CLINIC

Assessor:

Attached is an USQ map for convenience. Parking is free, if you have trouble do not hesitate to contact Nicole on the day at the reception.

Please do not hesitate to ring me if you need further clarifications on [redacted]

Kind Regards

Mrs Mousumi Singh
Principal Researcher Geriatric Adult Rehabilitation and Stroke Services,
Toowoomba Hospital

APPENDIX O

Feedback on Attention Training Program

GENERAL FEEDBACK ON THE PROGRAM.

What did you find most useful?

What was least useful to you?

What were the tasks that you found easy?

What were the most challenging tasks?

Why were they challenging to you?

Would you consider implementing any strategy learned? Yes/No

What strategy/ies that you learned or became aware of in these sessions would you implement?

Overall, would you recommend anyone to this group?

If yes? Provide reasons

If not? Provide reasons

What can be done to improve the groups?

APPENDIX P

Pamphlet (MCI)

ATTENTION AND OLDER ADULTS

CAN WE LEARN TO BE MORE ATTENTIVE WHEN WE AGE???????

As we become older we may have problems with our attention. Some people may have more problems than others. We may become more unmindful. We may have trouble focusing on two things at the same time for example taking part in a conversation while driving. We may have trouble concentrating on things we love doing such as reading a book, watching television or knitting a cardigan. We may become more distracted and leave tasks unfinished for example forgetting to drink the remaining cup of coffee after talking with a friend on the phone who rang while we were making a cuppa.

The good news is that our brain can be trained to work better. If we are trained to attend better we may remember things better!!!

.

THIS STUDY WILL HELP US UNDERSTAND:

HOW WE CAN ATTEND BETTER?

IF WE LEARN TO ATTEND BETTER CAN WE REMEMBER THINGS BETTER?

If YOU WOULD LIKE TO PARTICIPATE PLEASE GET A PARTICIPANT INFORMATION PACKAGE FROM :

RECEPTION: MEMORY CLINIC (GARSS), TOOWOOMBA HOSPITAL

TELEPHONE [redacted]

APPENDIX Q

Participant Information Sheet and Reply Slip (MCI)

Attention and Older Adults

Participant Information Sheet

Location: Toowoomba Hospital Memory Clinic, Geriatric Adult and Stroke Rehabilitation Services, (GARSS).

Researchers: Ms Mousumi Singh, Toowoomba Hospital, Darling Downs Hospital and Health Service (DDHHS).
Professor Bob Knight, University of Southern Queensland (USQ)
Associate Professor Gavin Beccaria, USQ.

WHAT DOES TAKING PART IN THIS RESEARCH MEAN?

1 Introduction

You are invited to take part in this study because you are between 60 and 80 years old and you have been experiencing some difficulties with your Memory and Attention as reported by your doctor at the Toowoomba Hospital Memory Clinic. The researchers would like to find out how much your attention and other mental abilities differ from people your age who do not experience such difficulties. They would also like to know whether training in attention helps you to focus better. The training used in this study is called Attention Training.

This Participant Information Sheet tells you about the study. It explains the tests and training involved. Knowing what is involved will help you decide if you want to take part in the study. Please read this information carefully. Ask questions about anything that you don't understand or want to know more about. Before deciding whether to take part, you may want to talk about it with a relative, friend or your local doctor.

This study is jointly led by the Darling Downs Hospital (DDH) and the University of Southern Queensland (USQ). The results of this study will be used by Mousumi Singh to gain a Doctor of Philosophy (PhD) degree. Ms Singh is also a senior psychologist working with Queensland Health. This research is funded by Ms Singh's PhD. There is no commercial sponsor for this study.

Participation in this study is voluntary. You don't have to take part if you don't wish to. Your decision to take part or not, or to take part and then withdraw, will not affect your routine treatment, your relationship with those treating you or your relationship with the hospital or university. You will receive the best possible care whether you participate or not. If you decide to take part in this study, you will be asked to sign a consent form. You will be given a copy of this Participant Information Sheet and the Consent Form to keep.

2 What is the purpose of this research?

We know that aging slows down our mental abilities. However, some older adults may experience greater decline in their mental abilities than their peers. The researchers would like to know how much age affects older people's ability to pay attention and remember things. Attention is a core mental ability needed for other mental work and daily functioning. Most studies to date have shown problems with memory in older adults. Few studies have looked at whether a decline in attention affects other mental abilities in older adults. Attention training is not a common therapy for older adults with difficulties in attention and memory. There is also limited information on the effect of such training on older adults. Understanding the usefulness of attention training in older people may help in deciding whether it should be used as a regular form of therapy. Researchers would also want to know which group of participants (people with or without memory and attention difficulties) benefit more from the attention training.

3 What does participation in this study involve?

At the first study appointment, we will discuss the study and you can decide whether you wish to take part. If you do, we will invite you to sign a consent form, complete a short survey and take a 30 minutes test to determine whether you are eligible to be in this study.

If you qualify for this study, we will invite you to sign the second consent form for participating in the study. At this point, we will also ask you to complete another test that will take a further 60 minutes of your time. All this will be done on the same day and will take a maximum of 2 hours.

Within 2 weeks of completing your initial tests, you will receive a letter that will detail the dates and time of the 10 weekly sessions of Attention training that you will be invited to participate in. Each weekly session will be for 2 hours. You may receive the training one on one or with another one or 2 other participants. You will be notified whether you receive the training one on one or in a group of 2-3 participants. During the 2 hours of weekly training, you will learn about how the brain works and what helps to maintain brain health. You will also participate in different activities and discussions. All tests and group activities may not be easy for you, but we will help you to reach your goals at your own pace. We would like you to attend all the sessions. However, if you miss a session for some reason, we will arrange a catch-up session with you.

After completing all the 10 weekly training sessions, you will be asked to complete some final tests. These tests are a different version of the same tests you completed at the beginning. This will take 90 minutes of your time.

Some participants may be asked to take the eligibility test more than once. This is to make sure that all participants qualify for the study. If you do not qualify for this study, your Memory Clinic doctor will be told of your test results. Your doctor may want to discuss options for further help with you, your family member or your GP.

The training and tests for this study will be provided free of cost. We will also provide you free resources to take home. You will not be paid for your participation.

You will also have the choice to enter a lucky draw of $100.00 if you complete all tests and training sessions. You may also choose to receive a letter summarising the results of this study after it is completed.

You can continue with your other treatment whilst participating in this study. If you are receiving other therapy, it would be helpful for us to know as that may influence your results obtained from this study. You will be given the choice to answer this question through the survey you complete at the beginning of this study.

4. Relevant information about the research

Research will consist of two groups of participants. Participants with a diagnosis of Mild Cognitive Impairment (MCI) and healthy older adults. Participant group with MCI will be recruited from the Toowoomba Hospital Memory Clinic or from physicians in private practise. These participants will receive only the 10 weekly Attention Training program (2 hours weekly). Sixty-four healthy older adults will also be recruited from the community. These participants will be further assigned to two groups. Each of the 2 groups of people will receive either the Attention Training or the Relaxation Training. For this to take place efficiently, each group of 32 people will receive the weekly group training in smaller groups of maximum 8 participants at a time. This study will continue for 2 years, until all recruited participants have received training. Participants from the Memory Clinic will have all their tests and training at the Toowoomba Hospital Memory Clinic, whereas community participants will have theirs completed at the Psychology Clinic, USQ, Toowoomba.

5. What if I withdraw from this study?

Participation in this study is your choice. If you decide to take part and later change your mind, you are free to withdraw. Your decision to withdraw will not affect your treatment or your relationship with anyone at the hospital or at the university. You will receive the best possible care regardless of your decision to withdraw. You do not have to give any reasons for pulling out of this study. You may withdraw either by telling a researcher or posting us your completed withdrawal form given to you with this Participant Information Sheet. The researchers would like to keep all the information collected from you so that the results of this study can be measured correctly. If you do not wish this to happen, you should inform the researchers when you withdraw and they will remove all the information already collected about you from the study.

6. What are the alternatives to participation?

You do not have to take part in this study to receive training in attention. A training group on improving attention is run at times in GARSS, Day Therapy, Toowoomba Hospital. This group is only run for GARSS Day Therapy current clients. There are no age restrictions for this group. The tasks of this group are different from the Attention Training tasks offered as part of this study. Your Memory Clinic doctor can refer you to this GARSS Day Therapy group, if you like. Currently no such group training on attention is offered in the community.

7. What are the possible benefits of taking part?

We cannot promise you any benefits from your participation in this study. However, group participation may help you increase your confidence. It may also help to create more awareness in you about similar struggles that other people may have. You may benefit from the Attention Training. Participants in the Relaxation Training may learn ways to better manage their daily stress.

8. What are the possible risks or disadvantages of taking part?

As the training is a mental exercise there are no medical side effects from it. There are no risks from attending the Attention Training or Relaxation Training. It is possible that some participants may become upset if their test results show a decline in their mental abilities. In those situations, the researchers will be able to arrange for free counselling by trained people from the Psychology Clinic, USQ. These counsellors will not be members of the research team. The researcher will also guide these participants to seek appropriate help from their Memory Clinic doctor.

9. What will happen to the information about me?

Any information collected for this study that can identify you will remain confidential. All information collected from you will be numbered. This is called coding and is done to protect your identity. Only coded information will be examined by the study team. Your information will be used for this study only and it will only be released with your consent. The results of this study will be reported as a group in forums, scientific meetings and publications. Results will only discuss the results of the groups taking part and no individual will be able to be identified. The information collected from you will be securely stored and cannot be accessed without permission from the researchers. All your test results will be noted in your medical charts and they will form part of your health record.

10. Who has reviewed this study.

All research in Australia involving humans is reviewed by an independent group of people called a Human Research and Ethics Committee (HREC). The ethical aspects of this study have been approved by the HREC of Darling Down Hospital and Health Service (DDHHS) and USQ.

This study will be carried out according to the National Statement on Ethical Conduct in Human Research (2007). This statement has been developed to protect the interests of people who agree to participate in human research.

11. Further information and who to contact

The person you choose to contact will depend on the nature of your question.

If you want any further information on this study, you can contact the researcher on [redacted]

If you have any complaints about any aspect of this study, the way it is being conducted or any questions about being a research participant in general, then you may contact a Human Research Ethics Coordinator. This person is not part of this research but ensures that the research is conducted in a way that protects the rights of participants.

You may contact either the Toowoomba Hospital Human Research Ethics Coordinator: Phone 4616 6696, email DDHHS-RESEARCH@health.qld.gov.au OR the University of Southern Queensland Human Research Ethics Coordinator: Phone [redacted]

WHAT DO I DO IF I AM INTERESTED IN TAKING PART IN THIS STUDY?

If you are interested in this study, please complete the reply slip at the end of this sheet and post it using the reply-paid envelope. Upon receipt of your reply slip, we will contact you to arrange for the first study appointment where we will talk about the study and you may provide consent and complete the first tests.

REPLY SLIP

MEMORY CLINIC -GARSS

PRINCIPAL RESEARCHER: SUMI [redacted]

ATTENTION AND OLDER ADULTS

I _____(name) am interested in this study.

Best contact phone number: _____(landline), _____ (mobile number).

Best Days to be contacted: _____ (weekdays only). Best Time: _____(anytime between 8:00 to 4:30pm).

My contact address is _____ (for correspondence ONLY).

Date: _____.

APPENDIX R

Consent Forms (Study 2 MCI)

Attention and Older Adults

CONSENT FORM 1

FOR ELIGIBILITY ASSESSMENT

Location:	Toowoomba Hospital Memory Clinic, Geriatric Adult and Stroke Rehabilitation Services, (GARSS).
Researchers:	Ms Mousumi Singh, Toowoomba Hospital, Darling Downs Hospital and Health Service (DDHHS). Professor Bob Knight, University of Southern Queensland (USQ) Associate Professor Gavin Beccaria, USQ.

Declaration by Participant

I have read the Participant Information Sheet. I understand the purposes, procedures and risks of this study.

I have had the opportunity to ask questions. I am satisfied with the answers I have received.

I freely agree to participate in this study as described.

I agree to be tested to find out whether I qualify for this study. I understand that if I do not qualify for this study, I will not be asked to take part in the rest of this study.

I agree to the results of my tests being placed in my medical file at the hospital.

I understand that I am free to withdraw from the study at any time. This will not affect my current and future health care.

I understand that I will be given a copy of this signed document to keep

Name of the Participant (please print) _____

Signature: _____ Date: _____

Declaration by the Researcher:

I have given a verbal explanation of this study, its procedures and risks. I believe that the participant has understood the explanation.

Name of the Researcher (please print): _____

Signature: _____Date: _____

Attention and Older Adults

CONSENT FORM 2

FOR PARTICIPATION IN THE STUDY

Location:	Toowoomba Hospital Memory Clinic, Geriatric Adult and Stroke Rehabilitation Services, (GARSS).
Researchers:	Ms Mousumi Singh, Toowoomba Hospital, Darling Downs Hospital and Health Service (DDHHS). Professor Bob Knight, University of Southern Queensland (USQ) Associate Professor Gavin Beccaria, USQ.

Declaration by Participant

I have read the Participant Information Sheet. I understand the purposes, procedures and risks of this study.

I have had the opportunity to ask questions. I am satisfied with the answers I have received.

I freely agree to participate in the study as described.

I understand I am free to withdraw from the study at any time. This will not affect my current and future health care.

I am aware of the lucky draw at the end of the study. I understand that I will qualify for the lucky draw only if I participate till the end.

I agree to the results of my tests being placed in my medical file at the hospital.

I would like to take part in the lucky draw. **Circle one: YES OR NO.**

I wish to obtain a report on this study once it is completed. **Circle one: YES OR NO**

I understand that I will be given a copy of this signed document to keep

Name of the Participant (please print): _____

Signature: _____Date: _____

Declaration by the Researcher

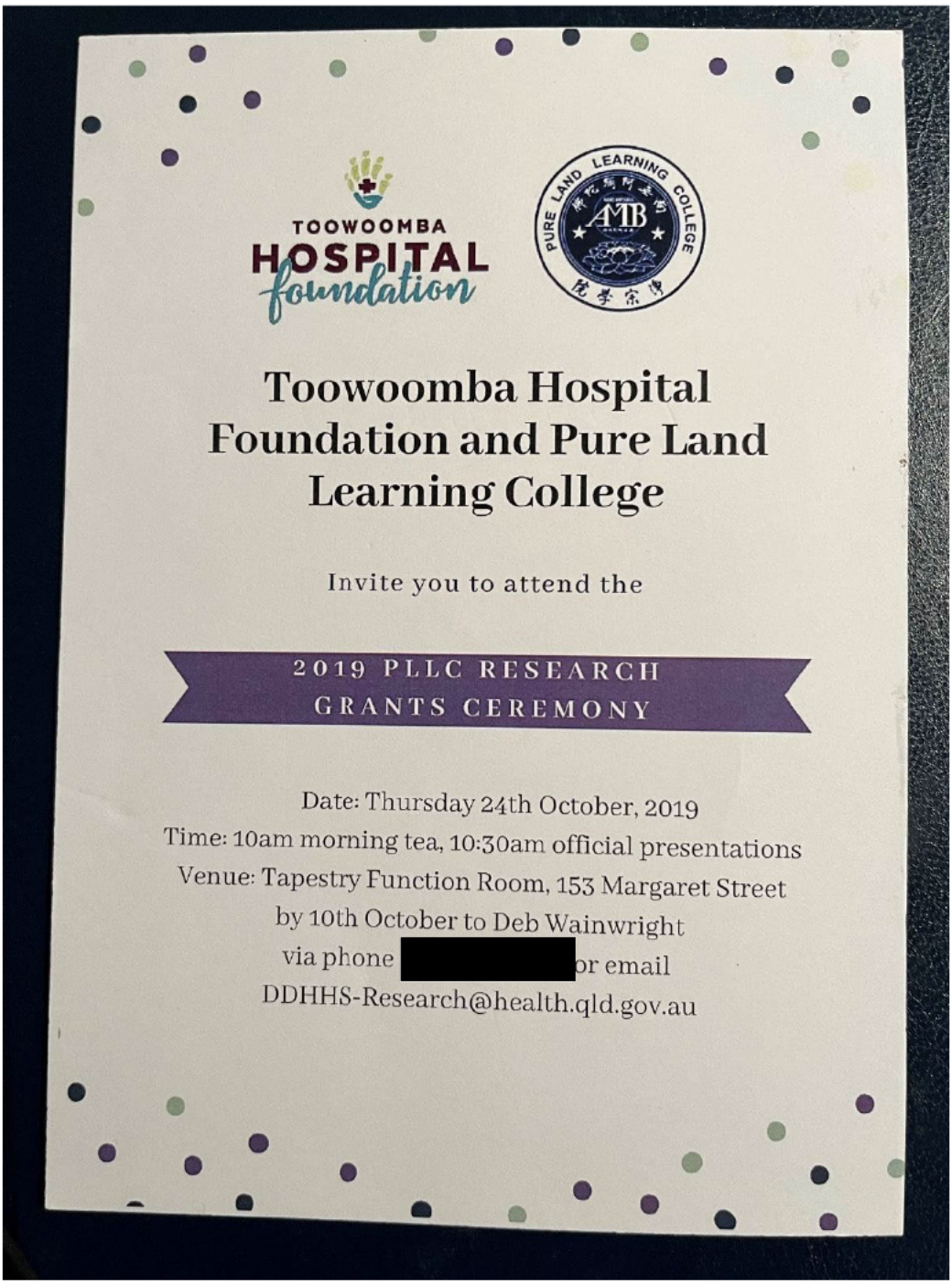
I have given a verbal explanation of this study, its procedures and risks. I believe that the participant has understood the explanation

Name of the Researcher (please print): _____

Signature: _____Date: _____

APPENDIX S

Toowoomba Hospital Foundation Grant



TOOWOOMBA HOSPITAL foundation

PURE LAND LEARNING COLLEGE

Toowoomba Hospital Foundation and Pure Land Learning College

Invite you to attend the

2019 PLLC RESEARCH GRANTS CEREMONY

Date: Thursday 24th October, 2019
Time: 10am morning tea, 10:30am official presentations
Venue: Tapestry Function Room, 153 Margaret Street
by 10th October to Deb Wainwright
via phone [redacted] or email
DDHHS-Research@health.qld.gov.au

Enquiries to: Deborah Wainwright
Telephone: [redacted]
Our Ref: THF 2019 R1 02

Queensland Government

Medical Services

Darling Downs Hospital and Health Service

Pechey Street Toowoomba
PMB 2 Toowoomba
Queensland 4350 Australia
Telephone [redacted]
Facsimile [redacted]
www.health.qld.gov.au/darlingdowns
ABN 64 109 516 141

Ms Mousumi Singh
Senior Psychologist
GARSS
Toowoomba Hospital

Dear Ms Singh

Re: Toowoomba Hospital Foundation Research Grant Application
THF 2019 R1 02 – *Exploring the impact of attention training on attention difficulties experienced by older adults with or without Mild Cognitive Impairment (MCI).*

I am pleased to advise that, on the recommendation of the THF Research Grants Committee, the Toowoomba Hospital Foundation has awarded you and your research team a Research Grant of $8,208.

Your project was extremely well received by the Committee, but they have requested further information on one point around your methodology:

- Why is it necessary to study healthy subjects as well as those with Mild Cognitive Impairment?

Please forward your response to the HREC Coordinator at DDHHS-Research@health.qld.gov.au so that your application can progress for funding approval.

Should you wish to accept this grant, please sign the enclosed *Grant Acceptance Form* and return this to the Coordinator by Friday 7th June, 2019. A fully signed copy of this document will be forwarded to you once all signatures are completed. Please retain a copy of this document for your records.

A public announcement of the Research Grants is being planned for later on in the year and you will be notified as soon as possible of arrangements for this event.

On behalf of the Toowoomba Hospital Foundation Board and the Research Grants Committee, may I offer you our warmest congratulations on being awarded a Toowoomba Hospital Foundation Research Grant for 2019.

If you have any concerns regarding the above information please contact the HREC Co-ordinator on [redacted] or DDHHS-Research@health.qld.gov.au.

Yours sincerely

[redacted]

Mr Andrew Wielandt
Chair
Toowoomba Hospital Foundation
Research Grants Committee
27 / 05 / 2019

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AS/NZS ISO 9001:2008 QUALITY CERTIFIED ORGANISATION

APPENDIX T

Invitation for Eligibility Testing and Pre-assessment (MCI)

Darling Downs Health

Date:

Name
Toowoomba, Qld 4350

Dear

I would like to invite you to participate in the study on **Attention and Older Adults**

Firstly, I would need to know whether you qualify for the study before proceeding further.

As such, as discussed with your daughter during our recent phone conversation, I would like to invite you for an assessment to see whether you qualify for the study and then proceed with pre-assessment.

Details of the assessment is as follows:

Date:

Time:

Venue: Toowoomba Hospital Memory Clinic, GARSS.
Opposite the Pharmacy, Toowoomba Hospital

Contact Person: Jan Davies /Mousumi Singh (Sumi)

Parking: Please note that you can obtain a free ticket to park near the venue. Please present yourself at the reception desk and ask for the parking ticket.

Please do not hesitate to ring me at [redacted] if you need further clarification

Kind Regards

Mrs Mousumi Singh
Principal Researcher (Geriatric Adult Rehabilitation and Stroke Services,
Toowoomba Hospital

APPENDIX U

Withdrawal Form

Attention and Older Adults

WITHDRAWAL FORM

Location: Toowoomba Hospital Memory Clinic, Geriatric Adult and Stroke Rehabilitation Services, (GARSS).

Researchers: Ms Mousumi Singh, Toowoomba Hospital, Darling Downs Hospital and Health Service (DDHHS).
Professor Bob Knight, University of Southern Queensland (USQ)
Associate Professor Gavin Beccaria, USQ.

Declaration by Participant

I wish to withdraw from this study.

I understand that withdrawing from this study will not affect my routine treatment, my relationship with those treating me or my relationship with Toowoomba Hospital or the University of Southern Queensland.

Name of the Participant (please print):

_____

Signature: _____ Date: _____

APPENDIX V

Post-Training Assessment (MCI)

Date:

Name
Toowoomba, Qld 4350

Dear

I would like to invite you to participate in the post assessments for the study on Attention and Older Adults

This assessment is going to take a maximum of 1.5 hours of your time.

Details are as follows:

Date:

Time:

Venue: Toowoomba Hospital Foundation Building

Toowoomba Hospital

Assessor: Jan Davies

Please do not hesitate to ring me if you need further clarifications on [redacted].

Kind Regards

Mrs Mousumi Singh
Principal Researcher Geriatric Adult Rehabilitation and Stroke Services,
Toowoomba Hospital