CAN BRIEF MINDFULNESS-BASED INTERVENTION IMPROVE ATTENTION IN INDIVIDUALS WITH MIXED NEUROLOGICAL DISORDERS?

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June 2015

A thesis submitted to the University of Hertfordshire in partial fulfillment of the requirements of the degree of Doctor in Clinical Psychology

Acknowledgements

I would like to say a big thank you to my supervisors, Mr Joerg Schulz and Mr Daniel Friedland, for their continuous support, guidance, expertise, assistance and encouragement with my research. I would also like to thank Melissa Lee for her help and efforts with inputting raw data and coding it. This was a tremendous help for me because it allowed me time to focus on other aspects of my research. I would also like to thank the Dclin psychology team for their support and extra time given for me to complete the project. In addition, I would like to thank Charlotte Blowers, the administrative staff at Neurological Rehabilitation service, for her help with recruitment, sending out letters and monitoring attendance to the groups. I would also like to thank all the clients who agreed to take part in this research, without whom there would be no study. Finally, the completion of this research would not have been possible without the constant support and encouragement of my family. A special thank you goes to Stephanie Schutte, thank you for your love, and on-going support throughout this process.

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Glossary of Terms and Abbreviations

ABI	Acquired Brain Injury
ACT	Acceptance and Commitment Therapy
APT-II AQ	Attention Process Training-II Attention Questionnaire
BPM	Buddhist Psychological Model
CBT	Cognitive- Behavioural Therapy
CORE-OM	Clinical Outcome in Routine Evaluation- Outcome Measure
CPT-3	Conners Continuous Performance Test 3rd Edition
DBT	Dialectical Behaviour Therapy
HRT	Hit Reaction Time
HRT SD	Hit Reaction Time Standard Deviation
MAAS	Mindful Attention Awareness Scale
MBI	Mindfulness-Based Intervention
MBCT	Mindfulness-Based Cognitive Therapy
MBSR	Mindfulness-Based Stress Reduction
MS	Multiple Sclerosis
mTBI	Mild Traumatic Brain Injury
MTBI	Moderate Traumatic Brain Injury
PD	Parkinson's disease
pTBD	Primary Traumatic Brain Injury
TBI	Traumatic Brain Injury
TMT	Trail Making Test
sTBD	Secondary Traumatic Brain Damage

Abstract

It is estimated that there are 12.5 million people in England living with neurological disorders (Neurological Alliance, 2014). People with neurological disorders as a result of acquired brain injury (ABI) are living with short and long-term disabilities. These include cognitive impairment, and physical and emotional distress. One of the most common complaints by individuals who have ABI is attention impairment. Attention difficulties can have serious ramifications for daily functioning. Although studies have explored the effects of evidence-based interventions such as mindfulness-based therapy on attention abilities, and have found that it improves individuals' attention skills (Moore et al, 2012), thus far research has been conducted mainly with non-clinical populations. This study set out to investigate whether a mindfulness-based intervention could prove beneficial for people with neurological disorders, particularly whether it could positively impact on attention impairment.

The study employed a one group pre-test post-test design. The intervention was adapted from the MBSR programme developed by Kabat-Zinn. Twenty-two participants with ABI were recruited. The Conners Continuous Performance Test 3rd Edition (CPT-3), Mindful Attention Awareness Scale (MAAS), Attention Process Training-II Attention Questionnaire (APT-II AQ) and Clinical Outcome in Routine Evaluation-Outcome Measure (CORE-OM) were utilised to measure outcomes. The results revealed that there was a clinical improvement in self reported measures of mindfulness (MAAS) (Cohen *d*=0.28), attention (APT-II AQ) (Cohen *d*=0.33), and psychological distress (CORE-OM) (Cohen *d*=0.72). This was not observed using the neuropsychological test of attention (CPT-3) for overall group scores, but further evaluation showed some individuals' scores improved. The study is promising as it indicates that mindfulness based treatment can be effective with attentional problems as well as in reducing psychological distress for individuals with ABI. This could be valuable in terms of providing treatment for this client group and adds to the expanding research base on mindfulness-based intervention with this population.

1 Introduction

1.1 Overview of the introduction

An overview of the different types of neurological disorders will be discussed, along with their definitions and how they affect individuals suffering as a result of acquiring a neurological disorder. There will be a discussion of the types of neurological disorder treatments that are available, with a focus on holistic approaches. Mindfulness, one of the holistic approaches that have recently received attention for its benefits on psychological and physical distress, will be a focus. Of specific interest in this study is how mindfulness based interventions might have benefits for individuals who have sustained neurological disorders in particular with respect to attention impairments. This study's primary focus is therefore on the question whether exercises in mindfulness help individuals suffering from a neurological disorder such as acquired brain injury (TBI/ head trauma and cerebrovascular disorders) or a neurodegenerative disease such as MS in reducing attention problems.

1.2 Neurological disorders

There are various types of neurological disorders that occur because of either damage to the brain, spinal column, or peripheral nerves. The onset of neurological disorders can be divided into four groups. These include:

- Sudden-onset: for example, acquired brain injury or spinal cord injury, often from an accident.
- Intermittent and unpredictable: for example, epilepsy, certain types of headache, or early multiple sclerosis.
- Progressive: for example, Parkinson's disease or later stage multiple sclerosis.
- Stable: for example, post-polio syndrome or cerebral palsy in adults (The National Audit Office, 2011).

1.3 Acquired Brain Injury (ABI)

The term ABI comprises all kinds of head injuries that occur after birth with Traumatic Brain Injury (TBI) being a particularly important subgroup. The range in which a head

trauma can occur varies along a continuum, going from mild, where there is a bump on the head with no lasting effects, to severe, where people are in a prolonged coma or vegetative state (Lezak, 1995). Tsao (2012) defined TBI as an injury to the intracranial structures that is caused by a physical trauma to the head. TBI falls into two categories based on the severity of the injury: Primary Traumatic Brain Damage (pTBD) and Secondary Traumatic Brain Damage (sTBD) (Moore, Jaffee & Ling, 2012; Tsao, 2010; Ponsford, 2012). If a patient with a TBI has a pTBD severity, it means that the injury is the result of mechanical forces, which produces tissue deformation at the moment of injury, thereby directly damaging the blood vessels, axons, neurons, and glia (Moore et al., 2012). If the severity is sTBD, it occurs from complications of primary damage including brain tissue hypoxia, ischemia, hydrocephalus, increased intracranial pressure (ICP), and/or central nervous system infection. The most common causes of TBIs are road traffic accidents, falls or assaults. The symptoms that people living with TBI often report are various cognitive deficits. These include slow mental processing, poor concentration, heightened distractibility, difficulty doing more than one thing at a time, and complaints of impaired memory (Lezak, Howieson, & Loring, 2004).). Other reported problem areas are; language, perceptual reasoning and physical and emotional difficulties.

1.4 Cerebrovascular disorders associated with head injuries

Cerebrovascular disorders consist of any disease of the cerebral vascular system that results in inadequate blood flow, ischemia or occlusion causing an area of necrosis or infraction of the brain (Goldstein & McNeil, 2012). There are four types of disorders that can affect the cerebral vascular system: transient ischaemic attack (TIA), stroke, ischaemic stroke and repeated ischemia, or haemorrhage (Goldstein & McNeil, 2012). Stroke is one of the most common cerebrovascular disorders. Patients who suffer from a stroke often experience problems with their cognitive functioning, such as attention regulation and memory. According to NIH (2015), stroke patients often face further challenges such as difficulties with speech.

1.5 Neurodegenerative disorders and diseases

Neurodegenerative disorders involve the progressive deterioration of brain tissue and behaviour (Lezak, et al, 2004). This investigation excludes all kinds of dementia and associated attention problems. This decision was made because the service in which this study took place did not accept referrals for dementia-related conditions; this was part of their exclusion criteria. Patients with dementia were sent to a more specialised dementia service. Neurodegenerative disorders such as Parkinson's disease and multiple sclerosis will be discussed more in this section.

1.5.1 Parkinson's disease/Parkinsonism (PD)

Parkinson's disease (PD) is a progressive neurodegenerative condition, which happens as a result of a reduction in the dopamine levels in the basal ganglia containing cells of the substantia nigra in the brain (NICE, 2006). The four primary symptoms of PD are tremor, or trembling in hands, arms, legs, jaw and face; rigidity or stiffness of limbs and trunk; bradykinesia, or slowness of movement; and postural instability, or impaired balance and coordination (NIH, 2015). Those with PD will experience their symptoms progressively worsening over time.

1.5.2 Multiple Sclerosis (MS)

Multiple sclerosis (MS) is the most common of the demyelinating diseases of the central nervous system, and it is often unpredictable when it occurs. Most people who experience MS are between the ages of 20 and 50 years, and the disease invisibly destroys muscular control and can lead to impairment in brain functioning.

1.6 Epidemiology

It is important to state that due to the wide range of neurological disorders and variety of symptoms associated with them, it is difficult to give exact figures of the prevalence of adults living with neurological disorders. Furthermore, it is hard to have exact

numbers for the onset and progression of these disorders because they all vary so widely. However, despite these challenges, there have been a number of reports that have provided some estimated prevalence figures to help illustrate and highlight the importance of knowing the effects that neurological disorders have on people and the associated services.

A considerable number of adults affected by neurological disorders are living with short and long-term disabilities. Recent prevalence data shows that there are now 12.5 million neurological cases in England (see Figure 1). In 2012/13 the NHS spent over £4.4 billion on neurological conditions (Neurological Alliance, 2014). There are four categories that make up the 12.5 million neurological cases (see figure 1). The biggest contribution is from intermittent conditions (7.4 million), such as migraine or epilepsy. The next biggest is progressive disorders (2.6. million), such as PD and MS. The third-ranked category is disorders that are stable but with changing needs (2.2 million), and these include conditions such as fibromyalgia. Finally, the fourth category is those disorders with sudden onset (350,000), which include TBI and stroke. The NHS' expenditure on neurological disorders has increased by over 200% between 2003/4 and 2012/13 (Neurological Alliance, 2014). The 12.5 million cases can be broken down to relevant neurological disorders, which will be investigated by this study. For instance, according to the Neurological Alliance (2015), the estimated prevalence of stroke in England is 316,080, while the number of people with TBI is estimated to be around 170,000 per year in England and around 106,680 people have a PD diagnosis in England, and 84,000 people have MS.

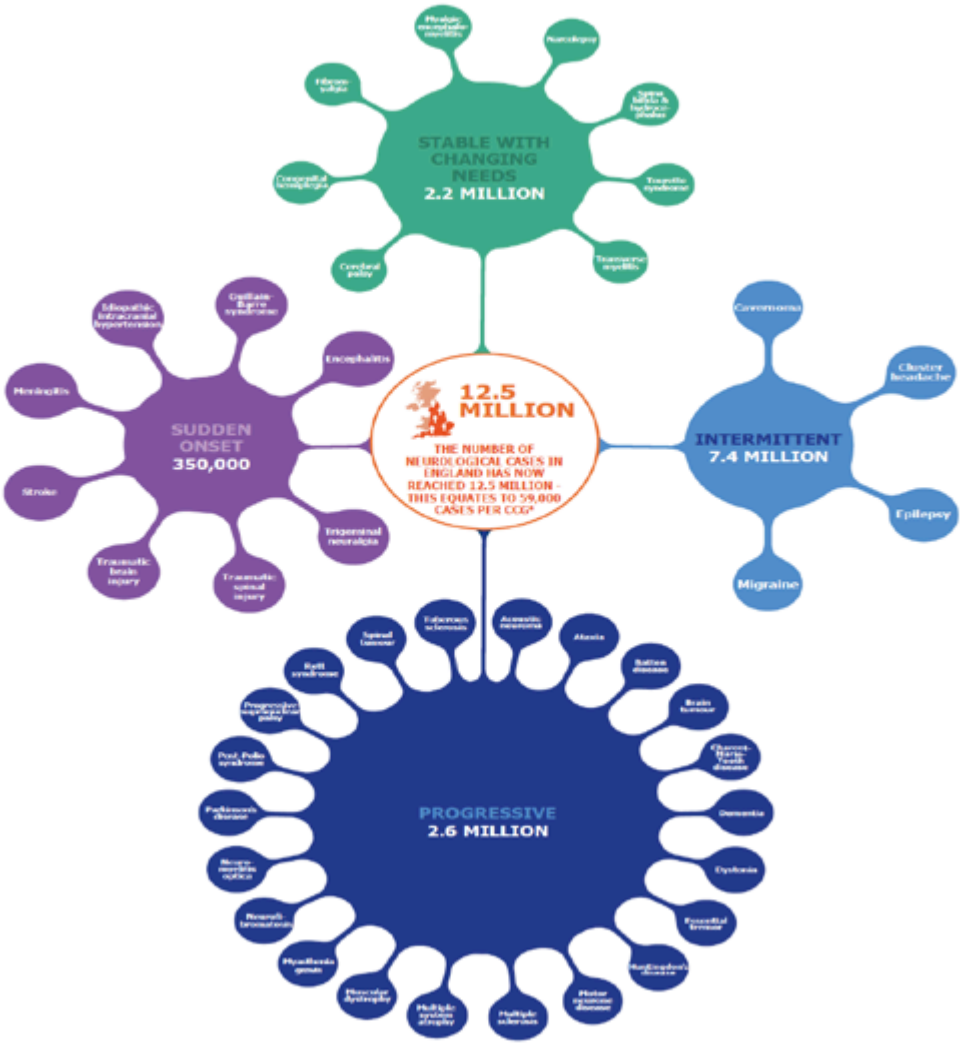

Figure 1: Neuro Numbers report (extracted from the Neurological Alliance, 2014).

1.6.1 Acquired brain injury

Stroke and TBI make up the largest proportion of acquired brain injury in the UK (RCP & BSRM, 2003). Stroke is the most common cause of death after coronary heart disease and cancer (WHO, 2006). According to the Stroke Association (2015), in the UK alone it is estimated that a stroke occurs 152,000 times a year, which is one every 3 minutes and 27 seconds. More than 900,000 people in England are living with the effects of a stroke (NICE, 2013). According to the Stroke Association, stroke mainly affects people who are over the age of 65 years. However, anyone can have a stroke including children and even babies.

TBI is one of the most common disabilities in people aged 1 to 40 years in the UK. According to the NICE guidelines, each year 1.4 million people attend emergency

departments in England and Wales with a head injury. Between approximately 33% and 50% of these are children under the age of 15 years. A minimum estimate suggests that 1 million people in the UK are said to be living with the long-term effects of brain injury (Headway, 2015). Furthermore, men are twice as likely to sustain a TBI as women. The age and gender groups that are most at risk of injuries are 15 to 24-year-old men and people over 80 years olds (Headway, 2015).

1.6.2 Neurodegenerative diseases

1.6.2.1 *Parkinson's Disease*

PD affects around 1 in 500 people, which means an estimate of 127,000 people in the UK are living with this condition (Parkinson UK, 2015). PD is most common within the older population. However, it has been known to affect a small number of younger individuals. PD has a higher prevalence amongst males (NICE, 2006).

1.6.2.2 *Multiple Sclerosis*

At present, around 100,000 people are said to be living with MS in the UK. People with MS are generally within the age band of 20 to 40 years. It is not yet understood what the causes are, but MS is three times as common in women than men (NHS Choices website, 2015).

1.7 How are people affected?

When a person receives a diagnosis of a neurological disorder it can have a profound effect on their lives. For instance, it can have financial and social repercussions for their careers, families and friends. Typically, relationships, job prospects, income and future goals are all affected. The different problems that a person suffering from a neurological disorder may experience include physical or motor, sensory, cognitive/behavioural difficulties, communication impairment and psychosocial and emotional effects (Department of Health, 2005). These problems can vary from person-to-person, as well as the severity, which can vary from mild or moderate to more severe. Moreover, it can also vary in terms of whether a person is faced with a short-term or long-term disability.

1.8 Psychological difficulties associated with neurological disorders

Having a neurological disorder can have a tremendous psychological effect on an individual. Certain types of neurological disorders have been known to elicit different emotional responses. This can vary depending on the context or stage of recovery the person may be at, post diagnosis. Soo and Tate (2007) estimate that between 30% and 70% of people who experience TBI are likely to suffer from significant psychological difficulties. A large number of studies have found that survivors of ABI (TBI, stroke) and neurodegenerative diseases (MS, PD) are more likely to suffer from apathy, depression, anxiety, post-traumatic stress disorder (PTSD), fatigue and sleep disturbance, and have a higher risk of suicide than those in the general population (Hesdorffer, Rauch, & Tamminga, 2009; Bertisch, Long, Langenbahn, Rath, Diller, & Ashman, 2013; Njomboro & Deb, 2014; Ashworth, Clarke, Jones, Jennings, & Longworth, C. 2014; Ponsford, Sloan, & Snow, 2012; Troeung, Gasson, & Egan, 2014; McGuire, Stojanovic-Radic, Strober, Chiaravalloti, DeLuca, 2015; Brown, 2012). Specific neurological disorders may impact an individuals in particular ways. For example, individuals who have a stroke may experience post stroke depression. This affects an individual's recovery after stroke (de Man-van Ginkel, 2010). It can affect a person's physical, cognitive, and social abilities, which could lead to a significant reduction in their quality of life (Ashworth et al., 2014). For example, people with MS it is estimated that those who suffer from anxiety and depression vary from 16.5% up to 46% (Simpson, Booth, Lawrence, Byrne, Mair, & Mercer, 2014).

Mental health problems associated with neurological disorders are underreported. The main reason for this is that when it comes to identifying psychological impairment following neurological diseases, it is complicated by the overlap between a psychiatric symptom and the cognitive, behavioural, and physical nature of the brain disorders, as well as the severity and duration of diagnosis (Goldstein & McNeil, 2012). However, what is known is that individuals with neurological disorders show a variety of psychological difficulties. These can have an effect on their cognitive abilities, how they cope with the disease and their overall quality of life (Brown, 2012 in Goldstein and McNeil).

1.9 Impaired cognitive functioning associated with neurological disorders

Impairment in cognitive functioning is a consequential effect of having a neurological disorder. Cognitive functioning involves several elements, which are thinking and reasoning, verbal functioning, attention, memory and executive functioning, and all of these are affected by neurological disorder (Sloan & Ponsford, 1995; Lezak, 2012). For instance, Mak, Zhou, Tan, Au, Sitoh, Kandiah (2013) found that patients with mild PD reported impairment of executive functioning and attention. Furthermore, according to Lezak (2012), individuals who sustained TBI have had problems with verbal retrieval difficulties. It is important to note that the cognitive deficits will not be the same for all neurological disorders. Often it depends on the severity, how long the patient has had their diagnosis and the type of neurological disorder that can determine what has been impaired.

1.10 Attention deficit as a result of brain injury and neurological difficulties

Attention deficit is one of the most common complaints from individuals who have suffered a neurological disorder. When attention is impaired it affects one's ability to focus and concentrate, individuals find they are easily be distracted. All of this has an impact on individuals' ability to function in their day-to-day activities. It can also hinder the recovery process of the person with the neurological disorder. In the next section we will look at what attention is, how it affects individuals with neurological disorders, assessment of attention and the current rehabilitation programmes that are available for helping with attention deficit.

1.11 What is attention?

The term 'attention' is not easy to define. For instance, in everyday use, attention is used to mean concentration, which refers to selective looking, all listening and effortful processes (Cohen, 2014). There is not a unitary definition of attention. The famous philosopher and psychologist William James once wrote, "Everyone knows what attention is. It is the taking possession by the mind in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought… It implies withdrawal from some things in order to deal effectively with others" (cited by Cohen,

2014 p.3). William James went on further to say that there are key components of attention and these include: 1) people often stating that the object of their focus is at the forefront of their consciousness when they attend to it; 2) the object or information upon which attention is focused on typically becomes clearer and more vivid relative to other possible objects or thoughts; 3) the process of attention involves the selection of one from multiple possible stimuli or thoughts at any given moment; and 4) when attention is intensely focused, other unrelated stimuli fall outside of conscious awareness and remain there until there is a disengagement from the primary focus of attention (Cohen, 2014). Although William James provides a good description of attention, this definition does not cover the complexity of what we have come to know about attention today.

1.12 Types of attention

Despite it being difficult to define attention in a unitary manner, there is some consensus. Attention is generally understood as having four specific domains. These include vigilance, arousal, divided attention and selective attention (LaBerge, 1990; Stirling & Elliott, 2010). A summary of each type of attention is described below.

Sustained or Vigilance attention: This is when attention is sustained over time. The emphasis on vigilance is about maintaining focus for duration of minutes or even hours on something that requires prolonged conscious effort (Stirling & Elliott, 2008; Lezak et al., 2012; Cohen, 2014). A task example would be that participants are given a lengthy exercise (10 minutes plus) that involves a serial presentation of stimuli from which the participants has to try and detect the occasional target from amongst a series of distractors. For instance, Rueckert and Grafman (1996) conducted a study where they looked at sustained attention deficit in patients with right frontal lesions. In their study, they used some sustained attention tasks. One exercise involved a simple vigilance task where subjects were asked to press the 'space bar' key whenever they saw the letter 'X' on a computer screen. They were asked to refrain from pressing the 'space bar' for any other letters that appeared on the screen. This exercise was a computer-based task known as the Continuous Performance Test (CPT). The outcome of their study was that those with right frontal lobe lesions got worse with time on the CPT task. Furthermore,

their reaction time was slower, as well as their ability to hit the target. In other words, they missed more targets compared to the control group.

Arousal and alertness: Arousal refers to the level of alertness, in other words how prepared one is to respond to things. It has been suggested that there are two kinds of alertness 1) the tonic element refers to day-to-day fluctuations of arousals, which are less abrupt and do not require external processing demands and 2) the phasic element concerns an individual's ability to change their level of arousal responses to warning or increased task requirements (Levitt & Johnston, 2001). A problem with tonic arousal may manifest into frequently falling asleep or poor ability to wake or alert oneself (Stinger, 1996), which can then affect motivation and interest in engaging with day-to-day activities. Individuals who experience problems with phasic arousal are not able to increase their level of arousal in response to external or internal cues, and this affects their performance on demanding tasks. The physiological states of tonic and phasic arousal may vary due to attention (Petersen & Posner, 2012). For instance, in studies on measurements of sustained vigilance, attention has been used to understand the best processes for tonic alertness (Petersen & Posner, 2012). Moreover, Cohen (2014) states that past studies have observed how attentional performance is impaired by extreme internal or external information states. For example, conditions such as organismic hyper- or hyperactivity, extreme emotions, information load, noise and physiological activity often influence attentional performance (Cohen, 2014).

Divided attention: This involves a person being able to attend to more than one task at a time or being able to do multiple elements within a task, for example, an individual who is cooking while on the telephone. Allport, Antonis, & Reynolds (1972) were able to show that skilled pianists were able to read music successfully while shadowing speech. An earlier model of divided attention was by Kahneman (1973) who suggested that we have a limited amount of processing capacity. Attention can be divided between tasks providing we have not exceeded our capacity. In other words, minimal processing capacity activities, such as routine activities, require minimal attention. It also means that because only a little processing capacity has been used there is more available for us to attend to other tasks. However, if our processing capacity is exhausted, then we would not be able to perform or attend to other tasks. For

example, when learning a new skill such as driving that will require a large quantity of processing capacity, it would be difficult to attend to anything else.

Selective (focused) attention: Day-to-day, when we are bombarded with lots of information, the selective attention mechanism allows us to give priority to some informational elements over others. An example is being able to selectively attend to what the friend is saying while ignoring all the other conversations going on in a crowded situation. An early investigation into selective auditory attention was by Cherry (1953). He presented subjects with stimuli to both ears simultaneously, with two mixed speeches recorded on a tape and they were asked to repeat one of them word-by-word or phrase by phrase. Their task was to separate one of the messages. Cherry found that the subjects' ability to select one of the messages was influenced by various physical acoustic differences between voices and the physical separation of location. He found that when he presented the messages in the same voice to both ears at once, and thus eliminated the differences of the voices, listeners found it hard to separate the two messages on the basis of meaning alone (Cherry, 1953; Eysenck, 2013).

1.13 Neuropsychology of attention

There have been many models of attention, and all have been influenced by a cognitive functioning paradigm (Cohen, 2014). Many of the early models of attention focused on selective attention and limited capacity, and these continue to serve as a foundation for some of the more recent approaches to attention. The cognitive function theory of attention has greatly influenced a neuropsychological perspective of attention. This section will focus on the neuropsychological basis of attention and how attention impairments resulting from a neurological disorder can be assessed and treated.

1.13.1 A neuropsychological model of attention

The model is made up of different systems, with each system having a functional role. These systems are known as the arousal/alerting system, orienting system and the executive attentional system, see model in figure 2 (Andrews, 2004).

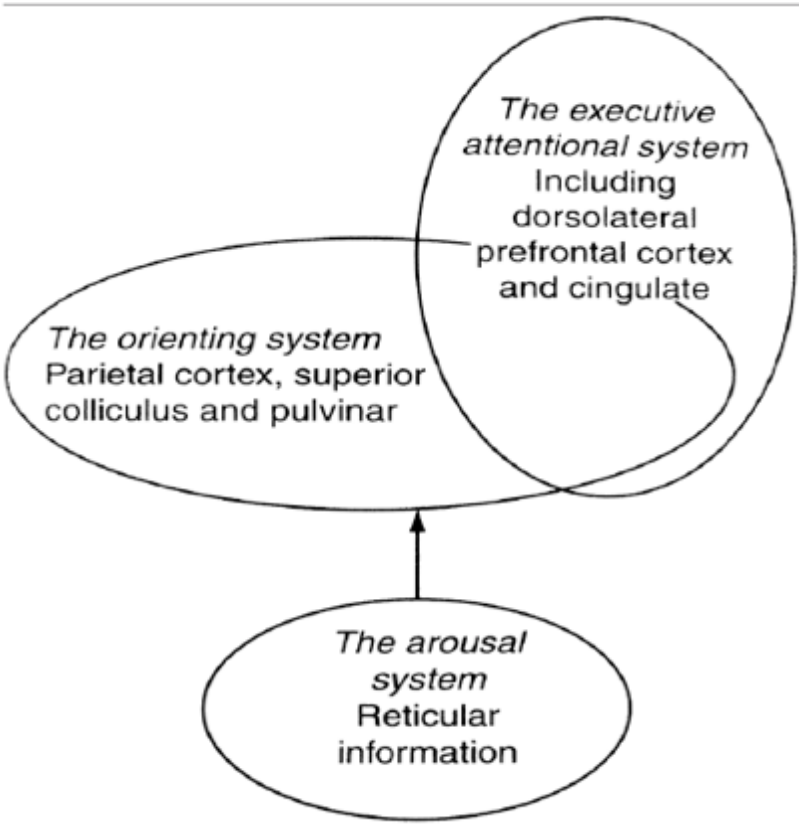

Figure 2: Neuropsychology model of attention (Posner & Petersen, 1990 cited by Andrew, 2004).

In recent years, theorists have strongly suggested that there is a relationship between physiological reactivity and attention (Cohen, 2014). Kahneman (1973) was one of the first to recognise the effect of arousal on attention. He proposed that attentional resources are readily available when we are aroused and alert, and less available when we are tired and fatigued. Some have come to believe that the arousal system is the foundation of attention, and it has been stated that for attention to occur, a certain level of alertness is required (Andrews, 2004). In other words, arousal alerts and puts us in a "ready to respond state" that triggers our attention to responding (Manly, et al., 2002). The model in figure 2 indicates that reticular formation plays a role in increasing the cortical arousal. Petersen & Posner (1990) state that initially the alerting network of attention (specifically to do with sustained vigilance) is associated with the brain stem arousal system and the right hemisphere systems. However, more recent evidence has shown that the alerting system of attention is linked with neuromodulator norepinephrine (NE). The NE pathway includes major nodes in the frontal cortex and the parietal areas relating to the dorsal area.

The orienting system in the model (figure 2) is where reflexive and eye movements are initiated as part of an attentional response (Andrew, 2004; Cohen, 2014; Posner and Petersen, 1990). The orienting system is linked to the superior and inferior areas of the parietal lobes of the brain (Posner et al., 2012; Bekken & LeSueur, 2013). The role of the orienting system is to trigger our attention rapidly to respond to startling or novel stimuli. An example would be when we are in a situation that elicits a physiological response like the fight or flight response, and the orienting system plays a significant role in determining the outcome 'fight' or 'flight' (Andrews, 2004).

The executive attentional control networks of the model overlap with the orienting system and they are associated with the frontal regions, including the lateral prefrontal cortex and anterior cingulate. Their role is to mediate behaviours such as target and error detection, conflict resolution, inhibition of automatic reactions and goal-directed actions (Chad, 2013). The executive system has an important influence on the control, organization and monitoring of behaviour (Andrews, 2004). More on the effect of the executive system will be discussed in the following executive function section.

1.13.2 Executive function

It is important to consider the executive function as a metacognitive concept, as it is often linked and used interchangeably with attention. There have been some debates as to which one is seen as more prominent over the other. Some have argued that executive function is a specific type of attention skill, while others suggest that attention is regulated and monitored by executive functioning (Bekken & LeSueur, 2013). Some have argued that executive function is one of the most important components that make up attention (Posner & Petersen, 1990), whilst others (Willcutt et al., 2005 cited by Bekken & LeSueur, 2013) see attention as being within the larger framework of executive mastery. It is difficult to untangle the two because they both play a pivotal role in the functioning of the cognitive systems. Therefore, any deficit that one might have in one area will have a knock-on effect on the other. They both can be seen as orchestrating the actions of both perceptual and cognitive processes (Callahan, 2001).

The executive function is situated in the frontal lobe regions. The frontal lobe represents a large area of the brain, approximately one-third of the cortical surface of

the brain (Scott & Schoenberg, 2011). The function of the frontal lobe involves "attention, reasoning, judgment, problem-solving, creativity, emotional regulation, impulse control and awareness of aspects of one's and other's functioning" (Scott & Schoenberg, 2013, p.219), all of which are collectively known as part of the executive function. Damage to the frontal lobe is commonly a result of acquired brain injury or illness e.g. TBI or stroke (Callahan, 2001). When the frontal lobe experiences damage, executive functioning is affected. The damage can then lead to an impairment of the functions mentioned earlier, i.e. attention deficit, poor goal-setting, planning and reasoning skills. People with neurological disorders often report having difficulties in these areas.

1.13.3 A neuropsychological framework of attention

Cohen (2014) proposed a neuropsychological framework of attention (see Figure 3) incorporating the four main components of attention processes: selective attention, focused attention, executive attention, and sustained or vigilance and the neural mechanism that underlies these components. A brief overview of the framework will be described in this section.

Sensory selection: This involves attention being able to select certain stimuli over others. The process of selective attention occurs immediately after the initial sensory trigger and perception of the stimulus. The selective attention to sensory stimuli can either occur in an automatic manner, known as exogenous selective attention, particularly for less demanding tasks, or be controlled and planned, known as endogenous selection, useful for more demanding tasks.

Executive attention: This is similar to the sensory selective attention, and it is primarily to do with ensuring that there is a response selection and control of perceived stimuli before enabling action. The goals of the executive attention are to make sure that the allocation of attention is distributed according to the task requirements, to explore the environment for important cues and to ensure one's readiness to act accordingly. The executive attention consists of five components: 1) intention, 2) initiation and generation, 3) inhibition 4) switching and 5) higher-order executive. These are said to interact with one another to influence attention.

Focused attention: This consists of how much attention is engaged in accomplishing the task at hand. This can be a high or low level of engagement, and it can vary depending on the task's demand. Focused attention is constrained by capacity limitations. There are two types of constraints: structural and energetic capacity. Important aspects that concern the structural capacity that influence attention are memory, processing speed, temporal-spatial dynamics, and global cognitive resources. The energetic capacity influences attention through components such as arousal, motivation state, and task-induced effort.

Sustained attention: This is about how attention is maintained over time. It is influenced by the interactions of all the other types of attention mentioned above. The main determinants of sustained attention are vigilance and fatigue characteristics.

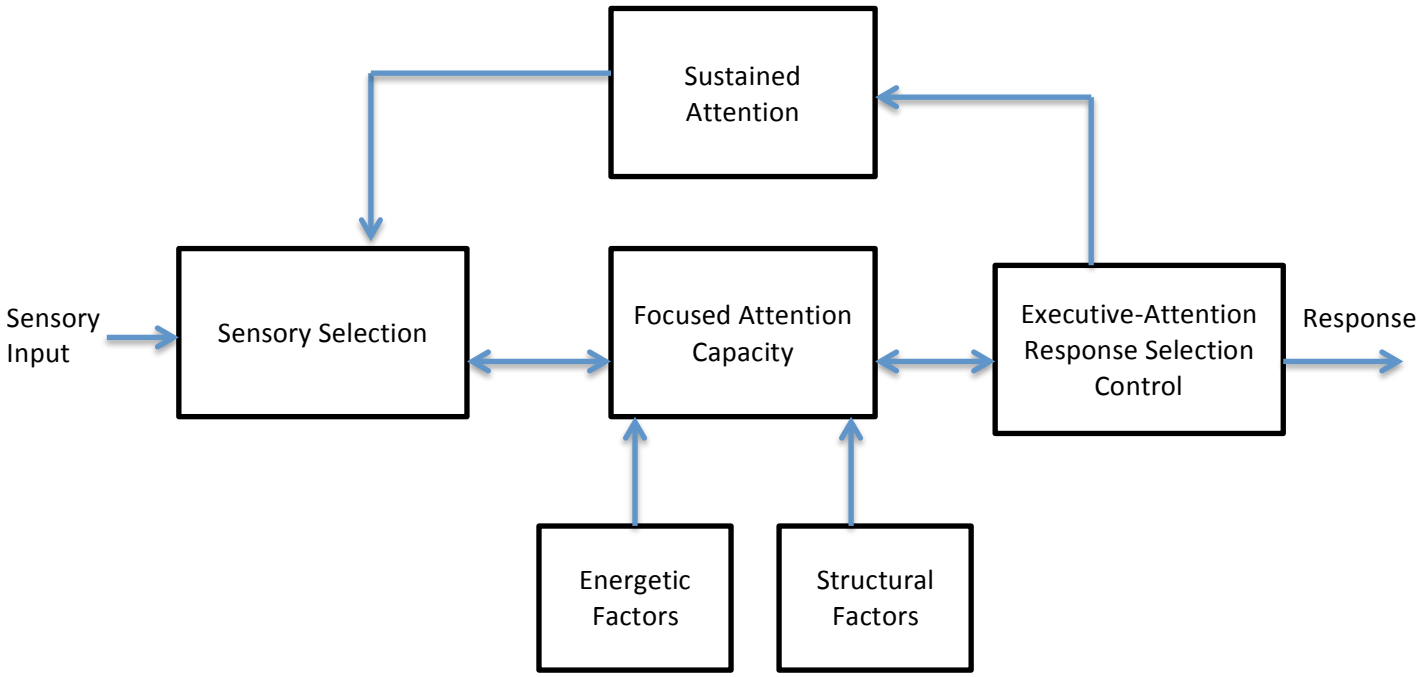

Figure 3: Schematic representation of the four primary attentional factors necessary to account for attention in humans (extracted from Cohen, 2014, p.945).

The model in Figure 3 illustrates the attentional processing of sensory information. This model indicates that all main attention components (sensory selection, focused attention, executive attention and sustained attention) interact with each other and that no one component works in isolation. "Sustained attention component is seen as a by-product of the reprocessing of previously selected information and feedback based on resulting behavioural action" (Cohen, 2014, p.945). The focused attention is

constrained by energetic and structural factors that create capacity limitations and are linked with neural mechanisms and the environment. Finally, the executive attention produces a response.

More recently, more evidence has shown that attention is now a "by-product of multiple interacting brain systems" (Cohen, 2014, p.952). The six major brain systems, including the posterior areas (parietal and temporal) and frontal system (prefrontal and anterior cingulate cortex; thalamic nuclei; midbrain reticular system; and limbic nuclei and striatum (basal ganglia)), are the underlying interacting systems of attention (Cohen, 2014).

1.14 Attention impairment associated with neurological disorders

1.14.1 Parkinson's disease

The damage to the dopamine production in the brain as a result of having PD has some ramifications for neurocognitive and behavioural symptoms associated with dopamine. These individuals often experience problems with motor control, initiation and inhibition and processing speed. These difficulties are linked with executive attention and focused attention. Baker, Rochester, & Nieuwboer, (2007) stated that patients with PD have difficulty performing dual tasks. They found that PD patients experience attentional overload. They have an executive functioning deficit and have the inability to use automatic movement control. Problems with focused attention can typically manifest in a person getting easily distracted. Furthermore, Hart, Wade, Calabrese, & Colenda (1998) conducted a study looking at vigilance attention impairment in patients with PD. They found that when comparing the performance of PD patients, major depressive patients and a normal control group using CPT, those with PD made more commission errors than the other two groups. The results suggested that PD patients had problems with effortful attentional processing as well as executive functioning.

1.14.2 Multiple Sclerosis (MS)

There is evidence to suggest that individuals with MS can develop problems with attention. A critical review by Brassington & Marsh (1998) cites multiple studies that found MS patients had impairment of visual and auditory attention. More specifically, attention capacity appeared more impaired when patients with MS conducted complex

tasks. A study by Dujardin, Donze, & Hautecoeur, (1998) found that MS patients at an early stage of the disease had an attentional deficit when the task required high attentional demands and controlled information processing was required. People with MS often report problems with fatigue, and this can have an impact on attention - in particular, sustained attention. In other words, they will experience difficulties in maintaining attention on prolonged tasks or tasks conducted over a period.

1.14.3 Traumatic Brain Injury (TBI)

One of the most common neuropsychological deficits following head injury is divided attention (King & Tyerman, 2012). Park et al. (1999) found that participants with severe TBI had impaired divided attention when the tasks required controlled processing. Problems with divided attention usually involve people having difficulty doing more than one task at a time. Patients with TBI have also reported difficulty with sustained attention (Bonnelle, Leech, Kinnunen, Ham, Beckmann, De Boissezon, & Sharp, 2011) as well as poor selective attention, which can lead to distractibility and poor attention to detail (Ponsford et al., 2012).

1.14.4 Stroke

Cognitive deficits, such as attention, executive function and visuospatial abilities, have been found in patients with stroke (Rajeswaran, Bennett, Thomas. & Rajakumari, 2013). Tatemichi, Desmond, Stern, Paik, Sano, & Bagiella (1994) found in their study (looking at cognitive impairment after stroke) that the cognitive domains that patients with stroke are most likely to be defective in when compared with the control group were memory, orientation, language and attention. Furthermore, they found that the cognitive impairments were linked with greater functional impairment. Moreover, Mok et al. (2003) found that patients complained of cognitive impairments post-stroke, and these included disorientation, slow thinking and memory problems. A further study by Keller et al. (1995) found that in patients with right cerebrovascular accidents, especially stroke patients, individuals had significant impairment in auditory attention.

1.15 Assessment of attention impairment

When assessing someone for problems in attention, it is important to begin this process by establishing whether premorbid functioning in attention is normal. This can

be achieved by either exploring with the patient or asking their carer. For more quantifiable measures of attention, neuropsychologists have used the Wisconsin Card Sorting Test and trail making B for set shifting. For planning skills, measures such as Mazes and Tower of London have been used. The Matrices (Wechsler and Raven's versions) and Booklet Category Test (BCT) are used to test for problem solving skills. In recent years, more tests have been developed or revised with improved reliability and validity for neuropsychologists to use to assess attention. For instance, all versions of the Wechsler scales now offer tests measuring attention and executive function (i.e. Letter-Number Sequencing, Matrices, Digit Span). In addition the Delis-Kaplan Executive Function System (D-KEFS) (i.e. Trail Making, Verbal fluency, Tower Test) consists of nine tests that are capable of measuring attention and executive function. Some tests that assess attention use computer-based exercises, such as the Paced Serial Addition Test (PASAT), Test of Variables of Attention (TOVA), and Conners' Continuous Performance Test (CPT-III). They can be administered in children as well as adults. This list is by no means exhaustive, but it provides an overview of some of the tests that are available. Levitt and Johnstone (2001) devised a list of some of the neuropsychology psychometric tests associated with each attention type. They suggested that measures to be administered for focused attention would be the Stroop Color Word Test or other Cancellation tests as required. Measures for divided attention ideally would include the Trail-making Part B, Wisconsin Card Sorting test, Letter Number Sequencing, or Digit Span Backwards. Lastly, for sustained attention, tests such as the Continuous Performance Test or Cancellation Test can be used to identify impairment.

1.16 Recovery protocol for neurological disorders

For disorders such as ABI, it is difficult to determine how much recovery is possible as people are affected in different ways. After a person has sustained an ABI, a specifically tailored rehabilitation programme is typically offered to the patient. Professionals working in rehabilitation teams encourage patients to explore alternative ways of managing their daily life or work and support them in minimising the long-term effect of the brain injury (Headway, 2015). Recovery from ABI can be a slow process, ranging from a few months to years. With regards to both PD and MS, both are progressive disorders and the main treatment, particularly with PD, is drugs. Drugs are used to

manage the symptoms of PD and to reduce the frequency and severity of relapses in MS. For both PD and MS, no cure to eradicate these disorders has been identified. Presently, the focus is on managing patients' symptoms so that they continue to live their lives as best they can.

1.17 NICE guidelines for neurological disorders

The NICE guidelines (2006) make generic recommendations for people who suffer from PD. They focus on supportive therapies consisting of speech and language therapy, occupational therapy and physiotherapy. There is awareness that PD patients may show signs of depression. It is estimated that 40% of patients are affected by mood problems, which has a major impact on their quality of life. NICE (2006) states that some of the mental health difficulties that might arise as a consequence of PD are depression and psychotic symptoms. The guidelines state that antipsychotic medication may be considered as a treatment of psychotic symptoms in people with PD, although the evidence base for their efficacy and safety is limited. Clozapine may be used in the treatment of psychotic symptoms, but carers who administer the drug must register with the mandatory monitoring scheme.

NICE guidelines (2008) give clearer recommendations for people who have suffered from stroke. The guidelines recommend that all stroke patients who have cognitive deficits be screened and assessed in order to design an appropriate treatment program. Memory difficulties in stroke patients should be supported through techniques, which enhance their learning skills by using external aids. Attention impairments after stroke can be treated through interventions that target the particular performance of functional tasks.

The NICE guidelines (2014) for MS recommend mindfulness-based training, cognitive behavioural therapy, or fatigue management for treating MS-related fatigue. Furthermore, they suggest that, for persistent cognitive or memory problems, a referral needs to be made to an occupational therapist or neuropsychologist to help manage these symptoms.

With regards to head injury, the NICE guidelines (2014) primarily focus on the initial assessment and early management. The recommended rehabilitation program for TBI

includes neuropsychological therapy, CBT, occupational therapy, physiotherapy, speech & language therapy, family intervention and vocational intervention (NICE quality standards).

1.18 Rehabilitation for attention impairments

The NICE guidelines recognise that cognitive difficulties, such as attention deficit, are likely to occur as an aftermath of a neurological condition. It is important to establish how to treat patients who have reported complaints of attention difficulties. There have been several studies investigating how to improve attention in those who have neurological disorders. Many have developed rehabilitation programmes that primarily focus on cognitive and physical functioning. Some have used computerised exercises to sustain concentration and memory. For example, Strum & Wilmes (1991) found that seven hours of computer-based training for attention was effective in a group treatment for stroke patients. Others have focused on the benefits of applying external aids and behavioural models. Exercises have also been developed that can re-train the damaged cognitive function. The main idea is to get individuals to practice carefully selected exercises that enable the recovery of damaged neural circuits and restore the function of the impaired attentional processes (Mateer & Mapou, 1996; Park & Ingles, 2001). Parks & Ingles (2001) developed exercises for specific components of attention, for example, sustained, selective, alternating, divided and shifting attention. By administering the appropriate task, some recovery of the damaged component might be possible. There is an established attention-training programme available to help individuals with impaired attention. For example, Sohlberg & Mateer (1987) devised the Attention Process Training (APT) that involves tasks that target sustained, selective, alternating and divided attention, and in order for improvement to occur, specific components of attention require specific training elements (Park & Ingles, 2001). APT appears to be one of the most successful restorative methods after ABI (Bartfai, Markovic, Landahl, & Schult, 2014) and it also has beneficial effects on complex tasks (Cicerone, Langenbahn, Braden, Malec, Kalmar, Fraas, & Ashman, (2011). In some cases, a meta-cognitive strategy has proven effective with TBI patients in terms of remediating functional daily activities (Kennedy et al., 2008). More recently, there seems to be interest in a more holistic rehabilitation approach to improving attention deficits. Mindfulness meditation has recently (Azulay, Smart, Mott, & Cicerone, 2013;

Posner et al., 2015) been suggested as a novel approach to enhance a person's attention function. The following section will explore the concept of 'mindfulness' and examine the link between mindfulness and attention.

1.19 What is mindfulness?

"Mindfulness can be thought of as moment-to-moment, non-judgemental awareness, cultivated by paying attention in a specific way, that is, in the present moment, and as non-reactivity, as non-judgementally, and as openheartedly as possible."

Jon Kabat-Zinn, 2005 p108

Mindfulness roots itself in ancient Eastern spiritual traditions and is mostly associated with Buddhism (Grabovac, Lau, & Willett, 2011; Keng, Smoski, & Robins, 2011). Buddhism's conceptualisation of mindfulness was traditionally viewed as "one factor of an interconnected system of practices that are necessary for attaining liberation from suffering, the ultimate state or end goal prescribed to spiritual practitioners in the tradition" (Keng et al., 2011, pg.3). The Western conceptualisation of mindfulness differs from the Buddhist view, and some have stated that mindfulness is a "form of awareness that encompasses all forms of objects in one's internal and external experience, including features of external sensory objects like sight and smell" (Keng et al., 2011, pg.3). The interest in mindfulness and its integration into Western medicine and psychology can be traced back to the 1950s and 1960s. Jon Kabat-Zinn began to explore the use of mindfulness meditation in treating patients with chronic pain and developed the Mindfulness–Based Stress Reduction (MBSR) intervention (Kabat-Zinn, 1982) now widely used. Since then many more interventions that incorporate mindfulness principles have been developed, such as Mindfulness-Based Cognitive Therapy (MBCT; Segal, Williams, & Teasdale, 2002), Dialectical Behaviour Therapy (DBT; Linehan, 1993a), and Acceptance and Commitment Therapy (ACT; Hayes, Strosahl, & Wilson, 1999), all of which have had significant success in improving the wellbeing of those with psychological and medical distress.

It has been proposed that mindfulness interventions can lead to increased awareness, higher levels of acceptance, better memory and enhanced attention control, and more effective behavioural self-regulation (Keng et al., 2011). Mindfulness has been regarded as an effective antidote to psychological distress and many problematic conditions, including pain, stress, depression and eating disorders (Baer, 2003). Furthermore,

mindfulness-based therapies have been found to have significant effects on mood disorders (Teasdale, Segal, Williams, Ridgeway, Soulsby, & Lau, 2000), anxiety disorders and substance & alcohol abuse (Bowen et al., 2006) as well as on physical disorders, such as fibromyalgia (Grossman, Niemann, Schmidt, & Walach, 2004), chronic pain (Morone, Greco, & Weiner, 2008) and heart disease (Ospina, Bond, Karkhaneh, Buscemi, Dryden, Barnes, & Khalsa, 2008). Overall mindfulness has been adopted as an approach to increase awareness and to respond skilfully to the mental processes that contribute to emotional distress and maladaptive behaviour (Bishop, Lau, Shapiro, Carlson, Anderson, Carmody, Segal, Abbey, Speca, Velting, et al. 2004),

1.20 Models of mindfulness

Historically, the 'classic' description of mindfulness has either been too vague or abstract. More recently there has been a need to give mindfulness an operational definition so that it becomes less vague and abstract and amenable to empirical research. There is no general agreement about the conceptualisation and operationalisation of mindfulness in Western science (Holas & Jankowski, 2013). Currently, mindfulness approaches are used as a mental training exercise to aid the reduction of cognitive deficits, which affect the mind (Bishop et al., 2004). One of the earliest definitions of mindfulness was by Kabat-Zinn (1994), who stated that mindfulness was "paying attention in a particular way: on purpose, in the present moment, and nonjudgmentally" (p. 4). Mindfulness can be conceptualised as being a non-elaborative, non-judgemental and person-centred practice during which each thought, feeling or sensation that arises in the attentional field is acknowledged and accepted as it is (Segal et al., 2002; Kabat-Zinn, 1990).

1.20.1 Operational definition of mindfulness

Bishop et al. (2004), propose a two-component model of mindfulness. Self-regulation of attention is one component, and orientation of experience is the other component. Self-regulation of attention involves sustained attention. For example, one can activate sustained attention during mindfulness practice by focusing on one's breath as this

allows one to keep the attention anchored in the current experience of breathing. In this state of heightened attention one can become aware of thoughts, feelings or sensations in the present moment and fully acknowledge them. During mindfulness practice the self-regulation of attention is adopting a stance of non-elaborative awareness of thoughts, feelings and sensations as they arise. These thoughts, feelings and sensations are observed and not suppressed. The idea of 'non-elaborative processing' is to reduce the chances for rumination, distractions or memories associated with actual experiences to interfere with being present.

The second component of this model concerns how one relates to their experiences and is referred to as the 'orientation of experience'. This is linked to the attitudes a person adopts when she/he are aware of the stream of different objects that arises in their moment-to-moment experience. One of the stances that the client is encouraged to take is one of acceptance of each experience as it arises moment by moment. Therefore, it is not about changing the thoughts, feelings and sensations that arise, but instead actively adopting an attitude of openness and receptivity to whatever happens to occur in the field of awareness. Bishop et al. (2004) explained that an orientation of experience involves mindfulness being used as an investigative process, whereby the individual is intentionally observing and gaining greater understanding of their own thoughts and feelings.

In conclusion, Bishop et al. (2004) state that the proposed operational definition of mindfulness should be 'self-focused attention' on one's present experiences in an open and accepting stance free from rumination, judgments and distractions. With this as the definition of mindfulness, relevant measures can be developed to quantify the ability and performance in self-focused attention. One way that Bishop and colleagues (2004) suggest to examine mindfulness training is to see if increased mindfulness corresponds with performance in a task that entails skills in sustained attention, switching and inhibition of elaborative processing. Elaborative processing is attending and attaching to rumination and streams of thoughts versus being present in the moment.

1.20.2 Mechanisms of mindfulness: Three axioms: Intention, attention, and attitude (IAA)

Another model of mindfulness was devised by Shapiro, Carlson, Astin and Freedman (2006). who theorised that mindfulness contains mechanisms involving three axioms, which are considered the fundamental components of mindfulness. These axioms are called intention (I), attention (A), and attitude (A).

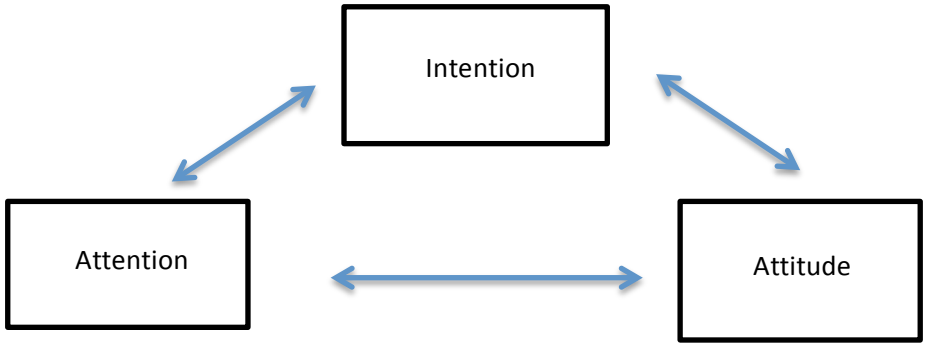

Figure 4: Three axioms of mindfulness according to Shapiro et al. 2006.

Intention (I): The idea of intention is to explore the reasons a person embarks on mindfulness practice. Shapiro (1992) stated that, historically, mindfulness practice derived from religious and spiritual traditions. The goal and intention for engaging in meditative practices was to rid the egoic self and reach self-liberation (Shapiro, 1992). This was done through developing "a sense of harmony with the universe; and the ability to increase one's compassion, sensitivity, and service to others" (Shapiro, 1992, p.24). However, when Western psychology tried to extract mindfulness and used it in clinical practice, the tradition and intentions to liberate the self was lost, and more emphasis was put on self-regulation. Shapiro et al, (2006) believe that intention is needed and should not be extracted.

Attention (A): The second axiom is attention, requiring the person to pay attention to the contents of consciousness moment-by-moment, internal and external experience. According to Shapiro and colleagues, attention is the core of mindfulness. Bishop et al. (2004) support the notion that attention is critical to the practice of mindfulness. Without attention, mindfulness would cease.

Attitude (A): This axiom requires an exploration into how we attend to things that arise from the practice of mindfulness. The qualities that a person brings to the act of paying

attention such as if they have a sense of openhearted, friendly presence and interest or if they are cold, or critical are crucial during the practice of mindfulness. Mindfulness is about a person learning to attend to internal and external experiences with acceptance, kindness and openness.

1.20.3 The IAA theory

Shapiro et al (2006) state that the three axioms are the vital components of mindfulness. Any observed changes that occur as a result of mindfulness practice can be linked with these three axioms. Shapiro et al, (2006) propose the mechanisms of mindfulness involve one "intentionally (I) attending (A) with openness and non-judgmentalness (A)" (p.377), which can lead to change in one's perspective. They call the process 'reperceiving'. They state that re-perceiving is a meta-mechanism of action that can lead to change and positive outcomes. It involves a fundamental shift in perspective. In other words, through mindfulness one can attend to moment-by-moment experiences. By doing so, one is developing a deeper and greater clarity. Being able to shift perspective enables one to not get caught up in the challenges or conflicts of personal narrative or life story because one can be objective by standing back and observing. Furthermore, Shapiro et al. (2006) assert that the fostering of re-perceiving leads to additional mechanisms that also contribute to the positive outcome of engaging in mindfulness practice. They highlighted 1) self-regulation, 2) emotional, cognition and behavioural flexibility, 3) value clarification and 4) exposure, as additional mechanisms which are all facilitated and supported by re-perceiving. In each of these mechanisms, the axioms of intention, attention and attitude are present.

1.20.4 Buddhist Psychological Model (BPM)

Mindfulness techniques have been adapted from Buddhist contemplative traditions. The BPM tries to identify the mechanisms involved in the change process, particularly in the cognitive processes, that occur in mindfulness. It attempts this by linking the relationship between mindfulness and cognitive processes (Grabovac et al., 2011). The BPM consists of three characteristics that are the core of mindfulness practice and are common to all sense impressions and mental events.

1) *Impermanence:* Consists of the discrete sense impressions and mental events (that make up an individuals' continuous stream of consciousness), 'which' or 'that' or 'but' are transient (that rise and pass away).
2) *Suffering:* This occurs as a direct response to habitual reactions (attachment and aversion to pleasant, unpleasant and neutral feelings) to feelings, mental events and lack of awareness that leads to suffering.
3) *Not-self:* These mental events and sense impressions do not contain any lasting or separate entity that could be called a self.

The BPM suggests that the reduction of suffering and improvement in well-being occurs when sensory and mental events are allowed to arise and fall away naturally without the cognitive processing arising from either attachment or aversion. In other words, if individuals allow pleasant, unpleasant or neutral experiences to occur, but without having an attachment and aversion to them, then suffering is not experienced (Grabovac et al., 2011).

1.21 Mindfulness based therapies

The introduction of mindfulness practices into therapeutic settings has attracted a lot of attention in recent years. The use of mindfulness in therapy is about building awareness, paying attention and developing acceptance to unpleasant physical and psychological experiences. Through the use of mindfulness individuals can learn to be less reactive to what is happening in the moment (Germer, 2005). Germer (2005) asserts that being able to relate to experiences, whether positive, negative or neutral, in a mindful way enables a person to reduce the overall level of suffering and increase their overall sense of well-being.

The majority of the models that have incorporated mindfulness techniques tend to use three key interdependent elements of mindfulness (Germer, 2005). These are (1) awareness, which is the intention of being mindfully aware by stopping, observing and returning (being aware that one has been distracted from the focal point, making a note of that, and returning back to the focal object); (2) present experience: allowing one's attention to focus on the present moment by moment experience; and finally (3) acceptance, which involves receiving all of our experiences without judgment or

preference. When practising mindfulness with clients, these are the common elements that are taught regardless of the model of mindfulness used.

Over the past 15 years, there appears to have been an interest in mindfulness techniques because of the benefits it offers in managing physical and psychological suffering. Models incorporating mindfulness techniques with existing therapeutic theories have been created and applied to treat problems encountered within clinical psychology.

1.22 Mindfulness-based interventions

1.22.1 Mindfulness-Based Stress Reduction (MBSR)

One of the earliest mindfulness-based interventions was by Jon Kabat-Zinn, who developed the mindfulness-based stress reduction (MBSR) program. It was initially developed to help people suffering from chronic pain, and over the years it has been used to help people with various physical health and emotional difficulties. The program taught practices such as body scan meditation. This involves observing the sensations that occur throughout the body, bringing affectionate, openhearted, interested attention to various regions of the body, starting from one's toes and sweeping and scanning all the way up to the head (Kabat-Zinn, 2005). Other practices involved yoga, sitting, standing and walking meditations. As part of the program, clients are encouraged to perform these practices daily over eight weeks, using a tape or CD for guidance (Kabat-Zinn, 2005).

1.22.2 Mindfulness-based Cognitive Therapy (MBCT)

Segal et al. (2013) devised this approach and were originally going to call it "Attentional Control Training," but were not convinced that this would capture the essence of the approach. They felt that the term MBCT was better suited as it was a model that integrated both cognitive therapy principles and mindfulness practice. They closely modelled it on MBSR but added some new features. The main differences between MBSR and MBCT are that MBCT focuses more on using cognitive therapy techniques, with an emphasis on thoughts and feelings (Germer, 2005). By teaching people to be aware of their thoughts and feelings, they can learn to decentre and focus these thoughts and feelings onto the present through adopting a non-judgemental stance is

at the key (Grabovac et al., 2011). Another element of MBCT is to help clients learn to also exit from automatic, depression-linked patterns of thought (Segal, Williams & Teasdale, 2013). For example, the treatment aims to help individuals to understand that “thoughts are not facts” and they can be can accepted and then let go (Segal et al., 2013; Germer, 2005).

1.22.3 Acceptance and Commitment Therapy (ACT)

Acceptance and Commitment Therapy (ACT) was developed by Steven Hayes. ACT is a behavioural approach that integrates acceptance and mindfulness to help people overcome difficult thoughts and feelings by encouraging them to engage with their behavioural patterns, which are guided by their personal values (Oliver et al., 2013). ACT is based on the Relational Frame Theory (RFT), whereby the importance of analysing language is taken into account as well as the effect language has on one’s behavioural patterns. The overarching goal of ACT is towards increasing psychological flexibility or “the ability to contact the present moment more fully as a conscious human being, and to change or persist in behaviour when doing so serves valued ends” (Hayes et al., 2006, p.7). The main aim of ACT is to create a meaningful life while accepting that suffering is inevitable (Harris, 2009). One of the ways ACT helps people to learn to manage pain is through the use of mindfulness skills. Harris (2009), states “Mindfulness means paying attention with flexibility, openness and curiosity” (p. 8). ACT teaches individuals to be more mindful of the values that enable them to live a rich and fulfilled life.

The ACT model comprises six core psychological processes leading to an increase in psychological flexibility. This is illustrated in a diagram in figure 6.

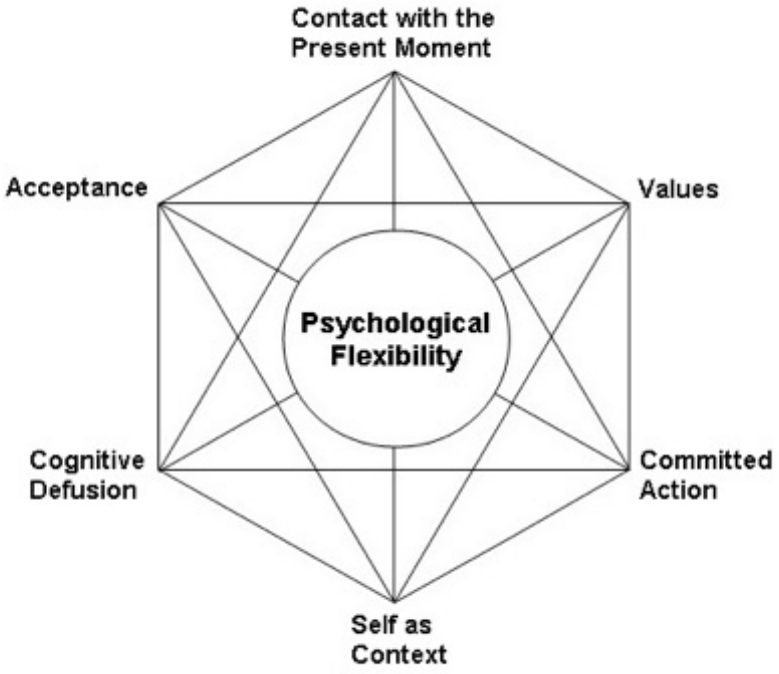

Figure 5: ACT Hexaflex

1) *Contact with the present moment (be here now):* This is about learning to be engaged with whatever is happening in the present moment. "Contacting the present moment means to flexibly bring our awareness to either the physical world around us or the psychological world within us, or to both simultaneously" (Harris, 2009, p.9).
2) *Defusion (watch your thinking):* Learning to step back, detach and let go from thoughts, emotions, images and memories when they arise.
3) *Acceptance (open up):* Not struggling or fighting the painful feelings or emotions that come up. Allowing them to come and go.
4) *Self-as-context (pure awareness):* Being aware that there is a continuous sense of self that is able to observe the changes that happen in one's life.
5) *Values (know what matters):* Knowing what is important to one's self and how these values can be used to create a meaningful life.
6) *Committed action (do what it takes):* This is about living life by one's values even if it brings up pain and discomfort.

According to ACT theory, these processes are interrelated and they also overlap and influence one another to evoke psychological flexibility.

1.22.4 Dialectical Behaviour Therapy (DBT)

Dialectical Behaviour Therapy (DBT) was created by Marsha Linehan, and is a therapeutic treatment particularly for clients with borderline personality disorder (BPD; Linehan, 1993). DBT contains four modules: mindfulness, interpersonal effectiveness, emotion regulation and distress tolerance. Mindfulness is the core skill that is spread out throughout the four modules. Some of the mindfulness practices involve counting breaths, focusing awareness on present activity and practicing radical acceptance of feelings (Gremer, 2005). The purpose of DBT is to encourage clients with BPD to develop better interpersonal skills that would help enrich their lives and to learn to do so in spite of how they may feel.

1.23 Literature review

Mindfulness based-interventions have been found to be of benefit to those with various clinical problems. Recent studies have looked at the links between mindfulness, attention and brain activity. This section will start by exploring studies investigating the effects of mindfulness on attention in non-clinical samples. Following on from this discussion, studies examining the effects of mindfulness particularly on those with neurological conditions will be reviewed. Finally, this literature review will aim to highlight the limited number of studies which have explored the effectiveness of mindfulness based interventions on attention impairment in those who have sustained neurological disorders and examine their strengths and limitations.

1.23.1 Mindfulness-based interventions linked with attention performance

Mindfulness meditation has emerged as a recent phenomenon over the last 10 to 15 years that is used in improving the executive attention network (Tang et al., 2007). “Mindfulness has to do with particular qualities of attention and awareness that can be cultivated and developed through meditation” (Kabat-Zinn, 2003). There have been various studies that have supported the idea that mindfulness can improve attentional performance (Valentine & Sweet, 1999; Jha, Krompinger, & Baime, 2007; Moore & Malinowski, 2009). All the studies mentioned in this literature review have been conducted on non-clinical subjects. Chambers et al. (2008) studied two groups that

were either assigned to a controlled waiting-list group or a group who had attended a 10-day meditation course. Both groups were given five self-reporting questionnaires and two performance measures that were administered at T1 and T2 to explore the potential relationship between measures of mindful awareness, rumination, affect and executive cognition. Their results revealed that mindfulness training had benefits for psychological functioning. Furthermore, people in the mindfulness training reported a reduction in rumination, depressive symptoms and negative affects as well as an improvement in some of the indices of executive functioning compared with the control group.

In another study by Moore et al. (2012), it was hypothesised that "brief mindfulness training would result in improvement in the self-regulation of attention" (p.1). Moore et al. (2012) compared randomly assigned individuals who were in either a meditation group or on the waiting list as a control group. Participants were asked to complete self-reported measures and an experimental task (Stroop task). In the experimental task, participants were instructed to respond as fast and accurately as possible and to indicate the colour of each word presented, whilst ignoring the semantic meaning of the word. The outcome of their study indicated that brief mindfulness training did improve self-regulation of attention (Moore et al., 2012). Those in the meditation group performed significantly better on the attention measures when compared to the control group.

Other studies have found that intensive meditation training produced an improvement in a visual discrimination task that was linked to increased perceptual sensitivity and improved vigilance during sustained visual attention (MacLean et al., 2010). Moreover, a study by Zeidan, Johnson, Diamond, David & Goolkasian (2010) found that brief mindfulness training (four sessions) had an improvement on cognitive tasks that measured sustained attention and executive processing efficiency.

Despite some encouraging evidence with non-clinical populations there have also been some studies that have found mindfulness not to enhance attention. MacCoon et al. (2014) conducted a study in which they assigned participants to either a MBSR eight week programme or a Health Enhancement Programme (HEP). All participants were

assessed on a continuous performance task (CPT), similar to the MacLean et al. (2010) study mentioned earlier. Participants performed the task before and after the MBSR or HEP programs. The effect of mindfulness training on sustained attention was investigated. MacCoon et al. (2014) found that MBSR training did not improve sustained attention performance. They reported that even though attentional sensitivity was not affected by mindfulness practice, it is possible that it might have affected other aspects of attention, such as vigilance, but they were unclear on this. Semple (2010) hypothesised that mindfulness practice would enhance the four components of attention: sustained vigilance, concentration, inhibition of distraction and executive control. Semple (2010) study used a randomised three-group design with: 1) a mindfulness mediation group, 2) a progressive muscle relaxation group and 3) a waiting-list control group. Semple (2010) found that mindfulness meditation resulted in a significant improvement in sustained attention but not in measures of concentration and inhibition of distraction. It was concluded that the outcome of the study only partially supported the notion that mindfulness training can enhance attention.

1.23.2 Mindfulness and attention impairment

Much of the research that has been mentioned thus far has focused mainly on non-clinical samples with no cognitive impairments or any brain alterations (structural or functional) (Zylowska, Ackerman, Yang, Futrell, Horton, Hale, & Smalley, 2008). Some research has looked into the question of how mindfulness affects brain functions and certain regions of the brain and whether meditation causes changes in EEG activity (Cahn & Polich, 2006; Murata et al., 1994; Moore et al., 2012). Others have linked mindfulness with certain areas of the brain, for example Manna et al. (2010) have found that focused attention meditation was associated with brain activity patterns in the medial frontal and lateral prefontal part of the brain, and mindfulness-based meditation showed higher levels of activity in the fronto-parietal and insular areas of the left hemisphere. Furthermore, meditation exercises targeting focused attention have been linked to the activation of multiple brain regions. For instance, one study on focused attention meditation with expert and novice meditators used functional magnetic resonance imaging (fMRI) to study neural activities. The authors found that multiple brain regions were activated during this type of meditation. The study

theorised that certain forms of attention were linked with particular brain regions. For example, monitoring attention was linked with activity in the dorsolateral prefrontal cortex, attentional orienting activated the superior frontal sulcus and the intraparietal sulcus and engaging attention was associated with the visual cortex (Lutz, Slagter, Dunne, & Davidson (2008). The authors concluded that there was a notable parallel between the processes involved in focused attention meditation and the cognitive neuroscience conceptualisation of attention. Considering the research so far about how mindfulness may regulate attention, it is no surprise that mindfulness-meditative practice has been deemed to have potential benefits for individuals with an attentional deficit.

1.23.3 Mindfulness and neurological conditions

Current cognitive neuroscience research indicate that to mindfulness may potentially lead to significant improvements in patients' cognitive functions, such as attention and recovery in regards to other symptoms (e.g. memory, speech) that are a result of neurological disorders.

1.23.3.1 Mindfulness and MS

Studies on MS have focused mainly either on physical symptom control, such as pain, standing balance (Mills & Allen, 2000) or fatigue; mental health symptoms (e.g. anxiety and depression) (Grossman et al., 2010); or psychosocial, such as quality of life (Senders, Wahbeh, Spain, & Shinto, 2012; Tavee, Rensel, Planchon, Butler, & Stone (2011). There is some evidence to suggest that meditation practice offers benefits to those with MS in any of these three problem areas (Simpson, Booth, Lawrence, Byrne, Mair, & Mercer, 2014; Levin, Hadgkiss, Weiland, & Jelinek, 2014).

1.23.3.2 Mindfulness and Parkinson's disease

A qualitative study conducted by Fitzpatrick et al. (2010) reported that participants with PD who attended a MBCT group experienced MBCT as beneficial and found it contributed to various changes in patterns of coping with PD as well as the consolidation of existing coping strategies.

1.23.3.3 Mindfulness and Stroke

Most studies that have been done on the effects of mindfulness and stroke patients have focused on psychological, psychosocial and physical outcomes. A recent systematic review by Lazaridou et al. (2014) found that of the nine articles they reviewed which involved mindfulness therapy, it appeared to be effective for assisting depression, anxiety and psychosocial stress. However, the outcome on physical wellbeing was less clear.

1.23.3.4 Mindfulness and TBI

Bedard et al. (2013) have conducted several studies looking at mindfulness based intervention in improving the quality of life for clients with TBI. Their first study in 2003 revealed that participants reported an improvement in their quality of life after receiving mindfulness training compared with the control group. They conducted a follow-up study a year later in 2005, in which they concluded that the gains they had observed in the first study were maintained after one year. This supports the notion that improvements gained as a result of having taken part in a MBSR programme can be maintained over time. Bedard et al. (2013) report that in their randomized controlled trial to evaluate whether MBCT could reduce symptoms of depression in people with TBI, it was found that there was a greater reduction of BDI-II scores for those who had MBCT compared to the control group.

Limited research has been conducted to explore whether mindfulness based intervention is also effective for attention impairment in individuals with neurological disorders such as TBI, PD, MS or stroke. A further literature review will focus on these particular studies.

1.23.4 Mindfulness and attention in clients with neurological disorders

An early study by McMillan, Robertson, Brock, & Chorlton (2002) conducted a randomised controlled treatment trial looking at brief mindfulness training for attentional problems after TBI. McMillan et al. (2002) randomly assigned participants into three treatment groups: physical exercise group, control group and Attentional Control Training (ACT) (which involved mindfulness practice). The ACT group received five 45 minutes sessions of supervised practice over a four week period using an ACT audiotape acquired from Kabat-Zinn. The physical exercise group received the same

amount of therapist contact as the ACT group, and they received an audio-tape based training, which focused on physical exercise fitness training. A control group was not led by a therapist, but was assessed at the same time as the experimental groups pre-treatment and post-treatment. A total of 130 TBI patients completed the study. The outcome of the study indicated no significant differences between the pre and post or follow-up therapeutic outcomes or self-reported measures of cognitive function. The only significant outcome was on the Cognitive Failures Questionnaires, whereby at the pre-treatment time both the treatment groups scored significantly more than the control group. However, at the 12-month follow-up, both treatment groups had a significantly greater reduction on the self-reported Cognitive Failure questionnaire compared to the control group (McMillan et al., 2002). Some of the limitations of this study may be to do with how the ACT training was delivered. The authors suggested that the therapist contact was relatively low and perhaps a more intensive ACT programme that was delivered by an expert may have led to an improvement in attention problems.

However, more recently, some studies have found evidence to support the efficacy of mindfulness on cognitive function after TBI. Johansson et al. (2012) found that when they measured the effect of MBSR for long-term mental fatigue after stroke and TBI, those who attended the MBSR group reported a decline in their self-assessment of mental fatigue, whilst the control group was unchanged after eight weeks. Mental fatigue is characterised by a mental exhaustion, which affects a person's concentration and attention functioning. Moreover, when the control group completed the MBSR at a later date, they too showed a significant decline in their self-assessment of mental fatigue. In regards to the outcome of the cognitive testing, it was found that on the Trail Making Tests (TMT) B & C after eight weeks, the MBSR group was reported to have completed it much faster than the control group. TMT B is considered to be a divided attention test.

A follow-up study was conducted by Johansson et al. (2013) that evaluated the effect of an advanced mindfulness-based programme on 14 participants suffering from mental fatigue after ABI, who had attended the first mindfulness practice intervention study mentioned above, plus an advanced mindfulness programme. They found in their study

that an advanced mindfulness programme showed a significant and sustained positive effect on participants' mental fatigue and information processing speed and attention. The participants were offered an eight-month programme with a monthly group meeting (2.5 hours) and the programme concluded with an all-day retreat. Their results indicated that mindfulness might be of potential benefit for those suffering from mental fatigue after ABI. A significant difference between pre and post measures was found for MFS, and cognitive measures, such as TMT B and C, which measure processing speed and divided attention, and which showed improvement after the MBSR program. However, this was not the case for TMT D, which is a more demanding task. Therefore, Johansson et al. (2013) they could only conclude that mindfulness practice improved attention to some degree but not when it came to more demanding tasks. Some limitations of this study were that the sample size was small and the study did not include a control group.

In another study by Azulay, et al. (2013), the authors conducted research looking at the effect of MBSR on the symptoms of mild Traumatic Brain Injury (mTBI)/postconcussive syndrome. The common symptoms identified with this syndrome can be divided into four elements: 1) cognitive symptoms, which include attention reduction, mental control, executive dysfunction and recall deficits of secondary to reduced attention; 2) physical symptoms; 3) psychiatric sequelae and 4) emotional regulation. In their study, Azulay et al. (2013) had a sample of 22 participants suffering from mTBI/postconcussion syndrome who attended a 10-week group program (a 2 hour session per week) modelled on Kabat-Zinn's MBSR program. Azulay et al. (2013) modified the program to focus more on cognitive difficulties. The outcome of their study was measured with both self-reported questionnaires and neuropsychological measures. On the self-reported measures, they found significant pre/post-test changes. There was an improvement on perceived self-efficacy on managing cognitive (d = 0.55) and emotional symptoms (d = 56). Furthermore, participants self-reported a reduction in cognitive symptoms (d = 0.36) and emotional symptoms (d = 0.36), but this was not reported for somatic/sensory symptoms (d = 0.22). In terms of the neuropsychological testing, they discovered that tests measuring attention showed significant improvement from baseline to post intervention. However, when they observed the outcome of the Continuous Performance Test of Attention (CPT) and Paced Auditory

Serial Addition Test (PASAT), they only noticed small effects for improvement: CPT (d = 0.31) and PASAT (d = 0.32). They also noticed that the majority of participants showed a significant change in the functioning of attention, going from a lower level of functioning category to a higher level of functioning on either or both of the attention measures. Improvement in problem-solving skills from pre to post-intervention were not statistically significant. However, participants did exhibit more positive problem-solving orientation. There was no significant effect on verbal learning or memory. The outcome of this study proves promising in terms of how mindfulness could provide an alternative intervention for individuals recovering from TBI. One of the limitations of this study was that it failed to find statistically significant effects from mindfulness training on attention functions (on the CPT and PASAT). This may be due to how the MBSR was presented, as participants self-administered it at home via an audio recording of the mindfulness practice. In addition, the mindfulness training was delivered for a shorter duration than is typical. Therefore, the participants may have not had enough opportunities to practise. Another limitation was that all the participants were receiving concurrent rehabilitation so it was difficult for them to determine if the MBSR was the sole reason for the participants to show signs of improvement or whether there were other factors related to the rehabilitation that might have contributed. Finally, there was no control group in this study.

McHugh and Wood (2013) also conducted a study looking at attention impairment in ABI individuals. They were interested in reducing the amount of over-selectivity in individuals after ABI. Over-selectivity is linked with poor decision making and poor attention control. This occurs when “one aspect of the environment exerts a disproportional influence over behaviour, at the expense of other equally salient events within the environment” (p. 1595). When people over-select, they are not able to attend to relevant stimuli, and they have less control of their behaviour. McHugh and Wood (2013) had 24 participants who were assigned either to a mindfulness intervention or no intervention control group. The intervention for those in the mindfulness intervention group lasted for 10 minutes. They were instructed to listen to an exercise on an audio recording. The outcome of their study showed that the group who received mindfulness intervention had a reduced level of emergent over-selectivity when compared with the control group who had no intervention. They

reported that those in the control group made more incorrect selections in the over-selectivity task compared to those who were in the mindfulness group. They found that a mindfulness intervention as short as 10 minutes in duration could result in improved attention control. One of the limitations of this study was that it had no active control group. This means that this group did not receive any input at all in terms of other comparative treatments. McHugh and Wood (2013) wondered if the extra time and attention given to those in the mindfulness group also could have been a contributing factor to the lower levels of over-selectivity. Another limitation was that this study did not have a post-intervention measure of mindfulness to establish the long-term benefits of this intervention.

The literature review suggests that mindfulness based interventions may be linked to significant improvement in attentional performance. Although these results are positive, research thus far has primarily been conducted with non-clinical populations and therefore cannot be generalised to clinical populations such as those with neurological conditions. The limited research focussing on mindfulness and individuals with neurological conditions suggests that it may be beneficial to this client group. More specifically, published studies on the effectiveness of MBI on attention impairment with ABI clients suggest that there is some evidence MBI improves attention impairment. However, there are significant limitations in these studies, including that many have not included a control group (Johansson et al, 2013; Azulay et al, 2013, McHugh & Wood, 2013); the studies appear to focus more on ABI clients rather than clients with other neurological conditions such as MS and PD; and studies use varying attention measures and MBI treatments, making it difficult to compare results and determine which MBI treatment is more beneficial in improving attention impairment.

1.24 Summary of key points of the literature review

- There is very little research into the effects of mindfulness-based intervention on attention impairment, especially in patients with neurological disorders who report problems with attention.
- Attention impairment can have a hindering effect in the recovery process - it is therefore important that more research is conducted to further understand

the nature of attention impairment and how it can best be treated to improve the lives of those afflicted by those problems.

- There have been very few studies that evaluated the impact of MBI on attention using standardised test procedures, particularly neuropsychological tests of attention. It is important to try to understand how the process of MBI could affect attention and if the neuropsychological tests are able to produce reliable findings.

1.25 Rationale for this research

MBI has long been proven to have many benefits on mental health (Gremer et al., 2005; Segal et al., 2002) and coping with physical health problems (Carlson et al., 2013; Kabat-Zinn, 1982; 1992). More recently some authors have looked at the benefits of using mindfulness techniques in patients suffering from neurological disorders to alleviate negative consequences of specific cognitive impairments, such as attention. There is much evidence to suggest that attention is one of the worst affected cognitive functions after neurological disorders. Impairments in attention can have a long-lasting negative effect on the recovery and decrease the overall ability to function and cope with day-to-day life. Therefore, the overall aim of this study is to investigate the effectiveness of MBI as psychological intervention in a group of patients with neurological conditions who are currently accessing the neuro-rehabilitation service, specifically focussing on any improvements in their attention.

1.26 Hypotheses

Based on the literature review, the following three specific hypotheses will be investigated:

1. Clients with neurological disorders taking part in the adapted MBI programme will significantly improve their mindfulness skills and become more mindful. This will be shown in clients scores on the relevant outcome measure will be significantly higher after receiving MBI treatment compared with their baseline scores.

2. After receiving the MBI programme clients will report lower levels of attention related problems.

3. Clients will show a reduced level of psychological distress at the end of the MBI programme.

In addition, it will be investigated whether the intervention has any positive effects on attention related problems using a neuro-psychological test (i.e. Conners Continuous Performance Test (CPT3) as an objective measure of the evaluation.

2. Method

2.1 Study design

This study employed a one-group pre-test, post-test design to evaluate the effectiveness of a mindfulness-based intervention in reducing attention problems in individuals with an ABI. Participants completed a neuropsychological assessment as a baseline before starting the mindfulness group, which lasted for 4 weeks and comprised 4 sessions. At post-intervention, the neuro-psychological assessment was repeated.

2.2 Participants

The number of participants who took part in this study was 18. Participants' demographic and clinical status is presented in the results chapter (see Table 2). The participants were patients who had received or were receiving neuro-rehabilitation treatment from the Hertfordshire Neurological Service as part of their ABI and associated attention problems.

2.3 Selection criteria

The inclusion and exclusion criteria are outlined below.

2.3.1 Inclusion criteria

1. Individuals who have a diagnosis of a neurological condition (e.g. stroke, TBI, viral infection, tumour, PD, MS) associated with attention problems, which have been established via a neurological assessment.
2. Individuals who have been identified by their healthcare team as potentially benefitting from mindfulness based psychological intervention as part of their on-going care and rehabilitation package.
3. Aged 18+ (the service in question does not have an upper age limit).
4. Adequate level of physical and cognitive functioning as determined by standardised measures and clinical assessment by qualified staff prior to referral.

5. Good level of fluency in English language and good level of communication skills.

2.3.2 Exclusion criteria

1. Significant comorbidity, including current diagnosis of psychiatric disorder.
2. Significant cognitive impairment (as regards to memory and processing ability e.g. dementia).
3. Significant physical impairment/disability or mobility issues.
4. Severely limited or reduced fluency in written/spoken English.
5. Individual experiencing severe pain difficulties.

2.4 Recruitment

Participants who were referred to the mindfulness group were on a neuro-rehabilitation programme or had had treatment from the Hertfordshire Community NHS Trust's Neurology Service. Their allocated clinicians, who they had been working with in the service, referred the participants. Participants on the waiting list for the mindfulness group had acquired neurological conditions such as MS, PD, stroke and TBI. There were 53 participants on the waiting list for the mindfulness group. They had been deemed appropriate for the group and their referring clinicians felt that they would benefit from taking part in a mindfulness training group. The length of time that participants had been waiting for a referral to the mindfulness group was approximately between 3 to 12 months.

All 53 participants were contacted initially by telephone and asked if they wished to participate in the study. After initial contact with the patients, five out of 53 of them did not meet the inclusion criteria, and they were re-referred back to their clinical teams for further support. Some participants who did not answer the initial calls were contacted a second time, and a message was left for them to contact the service. There were some participants who were on the list and contacted, but they had relocated since the referral was made, and so they were given information about mindfulness groups within their local area. There were some participants who asked to attend the group but not to participate in the study. As this was just three participants the facilitator was happy for them to attend the group. However, once the group began these individuals dropped out.

All participants who consented to this study had neurological disorders such as PD, stroke and MS. As they had difficulties with attention, their clinicians had identified them to take part in the study.

2.5 Description of the mindfulness intervention

The intervention was an adapted version of the traditional MBSR programme originally established by Kabat-Zinn (1982, 1992). Kabat-Zinn's MBSR version was normally conducted over eight weekly sessions of two hours each, as well as a day-long session of practice, which often takes place after the sixth session. The adapted mindfulness-based intervention programme, which was undertaken in this investigation, has been reduced from eight sessions to four sessions of one hour each week. This programme has been running for two years. The programme involved participants attending weekly sessions and after each session they are encouraged to practice daily exercises that they had learnt in the group session. In the session, feedback/discussion takes place about how people have done in the week with their between-session practice (for similar studies that have used short-form mindfulness programme see McMillian et al., 2002; Zeidan et al., 2010).

The brief adapted version of MBSR was delivered in a group format. Two groups of 11 participants were run on a weekly basis for four weeks.

2.6 Session breakdown

In this section, a breakdown of the information covered in each session is presented in chronological order (see appendix 1 for a copy of the PowerPoint presentation of the four sessions).

2.6.1 Session one

The first session covered the aims of the group (focus on teaching mindfulness meditation skills), participants' goals and any prior knowledge of meditation. Furthermore, the facilitator's personal experience of meditation/mindfulness practice, group rules (i.e. respecting what people say in the group), confidentiality, goals and what to expect from the mindfulness programme. In this session, participants were given handouts - these included 'how to meditate guidelines' (see appendix 2),

‘meditation diary’ (appendix 3), ‘articles on mindfulness meditation,’ and ‘information on Jon Kabat-Zinn’. During this session participants were given an overview of the historical background of mindfulness, and they were guided by the facilitator to participate in two meditation exercises (they were encouraged to record the exercises) and encouraged to give feedback after each exercise. After the session, participants were given homework to practise the meditation exercise, which they completed in the session (‘how to meditate guidelines’).

2.6.2 Session two

The early part of this session involved a quick introduction and feedback from the participants’ mindfulness diaries. The participants then took part in a mindfulness practice and were asked to give feedback about the practice. The rest of the session focused on how mindfulness was applied to everyday living, particularly about difficult experiences such as attention and concentration difficulties as well as anxious or depressive thoughts. At the end of the session, participants were asked to apply the new ‘mindfulness thinking’ they had learned to their day-to-day life and record it in their meditation diary, along with continuing the meditation practice.

2.6.3 Session three

The session began with a quick introduction and participants giving feedback from their meditation diaries. This was followed by a mindfulness practice and feedback about the practice. The main focus of this session was on how to best apply mindfulness techniques to everyday living, particularly to experiences that are perceived as challenging, for example negative thoughts about their condition, or to situations they respond to with avoidance or fear. Furthermore, participants were encouraged to explore any triggers to a downward spiral of avoidance or negative thinking affecting their ability to function day to day. They were encouraged to apply the mindfulness stance of letting go of these and being present in their moment-by-moment experiences, rather than being caught up in spiralling negative thoughts/feelings. Finally, participants were asked to continue with the mindfulness practice over the course of the week outside of the group and complete their meditation diary.

2.6.4 Session four

The last session involved introductions, feedback from the mindfulness diaries and one guided mindfulness practice and feedback. The aim of this session was to learn how to take care of oneself, minimising rumination and avoidance, and to use mindfulness practice to notice negative experiences and emotions and let them go. The teaching focused on learning to face thoughts/feelings/sensations that one is in danger of avoiding rather than confronting. Participants were encouraged to continue to apply mindful thinking to daily living activities, and to become more aware that one cannot always change events, but can change the way they respond to those events.

2.7 Measures

The independent variable (IV), which is the mindfulness intervention, was assessed using the Mindful Attention Awareness Scale, MAAS (see appendix 4). Relevant outcome measures representing the dependent variables (DVs) of the study were: attention performance (Conners Continuous Performance Test 3rd Edition (CPT-3), the Attention Process Training: Attention Questionnaire (APT-II AQ) (appendix 5), and psychological distress (CORE-OM) (appendix 6). All these variables will be described in more detail later in this chapter.

2.7.1 Conners Continuous Performance Test 3rd Edition (CPT 3) (Conners, 2014)

The Conners Continuous Performance Test 3rd Edition (Conners CPT 3) is a computerised test which assesses attention-related problems in adults. The reason for choosing this test was for its ability to assess different types of attention deficits (e.g. inattentiveness, impulsivity, sustained attention and vigilance). This is a task-oriented computerised assessment of attention-related problems in individuals aged eight years and older. By indexing the respondent's performance in areas of inattentiveness, impulsivity, sustained attention and vigilance, the Conners CPT 3 can be useful in the process of diagnosing Attention Deficit/Hyperactive Disorder (ADHD) and other neurological conditions related to attention. The test provides objective information about an individual's performance in attention tasks. Furthermore, its norms are based on a large representative sample and it has very good accuracy for assessing attention

deficits. The Conners CPT 2, which precedes CPT 3, has had several studies testing its reliability and validity. Soreni et al. (2009) conducted a study testing ADHD children using the CPT 2 and found the test to be reliable. A study was completed using the CPT-3 between October 2011 and February 2013. 2500 individuals completed the CPT-3, these included a normative sample (N= 1400) and individuals with a clinical diagnosis (N=494). The participants completed the CPT-3 twice during 1 to 5 week interval between testing. As a result of this study the CPT-3 demonstrates an internal consistency for normative sample from .92 to .93 and clinical samples at from .92 to.95 (all correlations were significant, p<.001). The test-retest reliability is .67, with a means of the differences between administration being small (*Cohen's d=0.15)* (Conners, 2015).

2.7.1.1 How is attention scored?

The CPT-3 measures four types of attention (inattentiveness, impulsivity, sustained attention and vigilance). These will be briefly described (see Table 2), but a full description can be found in appendix 10.

Table 1: Summary description of variables in CPT 3 and their link to different types of attention.

Measure	**Description**	**Type of attention**
C	This involves the participant's response style, which involves speed versus accuracy. A participant could be responding in three ways: *conservative style*, focused on accuracy rather than speed; *a liberal style,* this has an emphasis on speed rather than accuracy; and finally a *balanced style*, which reflects speed and accuracy and has no preference on one over the other.	
D-prime-detectability	This looks at detectability and it focuses on whether participants are able to discriminate non-targets (in this case the letter 'X') from the target (all the other letters).	Inattentiveness
Omissions	Looks at missed targets. A high omission error indicates that the respondent was not responding to the target. This may be due to difficulty with focusing, or linked with inattentiveness.	Inattentiveness

Commissions	This is when participants are incorrectly responding to non-targets. High commission would reflect impulsivity.	Inattentiveness or Impulsivity
Perseverations	Participants' responses that are made in less than 100 milliseconds following the presentation of a stimulus.	Impulsivity
Hit Reaction Time (HRT)	It is the mean response speed, which is measured in milliseconds for all non-perseverative responses made during the entire administration. Slow HRT is linked with inattentiveness. Very fast HRT is linked with impulsivity.	Inattentiveness or impulsivity
Hit Reaction Time Standard Deviation (HRT SD)	This measures consistency of the response speed to targets for the entire administration.	
Variability	Looks at response consistency, which is within the respondent measure. In other words, the amount of variability the participant showed in 18 separate sub-blocks of the administration in relation to his or her overall HRT SD score.	Inattentiveness
HRT Block Change	This is the slope of change in the HRT across six blocks of the administration. A positive slope suggests decelerating HRT, a negative slope indicates accelerating HRT and a flat slope indicates no change in the HRT.	Sustained attention
HRT Inter-Stimulus Interval (ISI) Change	This is the slope of change in reaction time across the three ISIs (1, 2 and 4 seconds).	Vigilance

2.7.1.2 Administrative procedure

The administration time for the Conners CPT 3 is 14 minutes. Before the administration, clients are given a one-minute practice test to acclimatise to the stimuli. The clients are provided with information about what the test involves. Below is the script presented to all clients:

"In a moment, I am going to press 'OK' to start the computer program. When the program starts, some letters will flash very quickly on the screen, one at a time. You have to press the space bar (or click the mouse) each time you see a letter, except when it's the letter X. When you see the letter X, don't press anything; just wait for the next letter. If you make a mistake it's OK. Don't worry about it and just keep going. Respond as fast and as accurately as you can. Let's practice these rules. Place your finger on the space bar and get ready." (Conners' manual, 2014 p. 13) (See appendix 9, for a screen shot of the instructions.)

At the end of the test, the scores are automatically generated by the computer and two reports are produced (assessment and progress reports) and an Excel data output file (see appendices for an example of a report and Excel data output). The assessment report provides information about a single administration, including all of the scores obtained by the client and how they compare to the scores of other respondents in the normative sample. The progress report combines the results of up to four Conners CPT 3 administrations conducted on the same client, and indicates whether the clients' scores have increased or decreased significantly over time.

2.7.2 Mindful Attention Awareness Scale (MAAS; Brown & Ryan, 2003)

The MAAS is a 15 item self-report instrument, which assesses individual differences in the frequency of mindful states over time. The MAAS looks at the presence or absence of attention to and awareness of what is occurring in the present (Brown & Ryan, 2003). It does not focus on attributes such as acceptance, trust, empathy, gratitude or other attributes linked with mindfulness. The scale has been validated through a series of studies looking at undergraduates, working adults and cancer patient populations (Brown & Ryan, 2003; MacKillop & Anderson, 2007). These studies have indicated strong psychometric properties, including both convergent and divergent validity along with a correlational relationship with psychological well-being measures (Brown & Ryan, 2003). Furthermore, the psychometric properties have demonstrated a theoretically consistent relationship to brain activity (Creswell et al., 2007) and treatment outcome of mindfulness-based interventions (Michalak et al., 2008). Clinical studies using the MAAS found that it can predict well-being as well as the temporal and situational dynamic of self-regulated behaviour (Brown & Ryan, 2003). The MAAS has

demonstrated high test-retest reliability, and convergent and discriminant validity correlations. The reported internal consistency levels (coefficient alpha) is .82. Higher MAAS scores represent greater mindfulness.

2.7.3 Attention Process Training-II: Attention Questionnaire (APT-II AQ) (Sohlberg et al., 2001)

This is a self-report measure, whereby participants rate how good they are at attending to day-to-day tasks. The questionnaire has been used to monitor how clients perceive their attention difficulties after Attention Process Training (Sohlberg et al., 2001). It has been used in studies looking at attention deficits: ADD (Sohlberg & Mateer, 2001) and ABI (Sohlberg, McLauglin, Pavese, Heidrich & Posner, 2000). The questionnaire measures the participants' perceived attention difficulties (Sohlberg et al., 1994) based in part on Ponsford and Kinsella's (1991) rating scale of attentional behaviour. This rating scale was used to identify attentional difficulties that occur throughout the day. The scale has a high level of internal consistency coefficients (using Cronbach's Alpha) of .92. The authors also found a correlation significant at p= 0.05 between the rating scale scores and scores on neuropsychological tests measuring attentional behaviour (Ponsford & Kinsella, 1991). Clients are asked to rate the frequency of the occurrence of different attention problems.

The adapted questionnaire (APT-II AQ) looks at difficulties with different types of attention, such as sustaining, switching and divided attention, and screens out distractions. In terms of scoring, a numerical indicator is used to help summarise the overall frequency of the clients' perceived attention problems (see appendix 6) (Sohlberg & Mateer, 2001). The APT-II AQ consists of 12 items on the questionnaire. Clients have to rate each problem using the following scale "not a problem or no change from before," "only gets in the way on occasion (less than once a week)," "sometimes gets in the way (about 1-3 times per week)," "frequently gets in the way (is a problem most days)," or "is a problem all the time (affects most activities)."

The scoring is calculated using the following sequence:
a) Total number of items ticked in second column multiplied by (1)

b) Total number of items ticked in third column multiplied by (2)

c) Total number of items ticked in fourth column multiplied by (3)

d) Total number of items ticked in fifth column multiplied by (4)

e) Total score: add a through d

The clinical cut-off point scores are 0-12 (little-mild disruption); 13-24 (moderate disruption); 25-36 (severe disruption), and 37-48 (Profound disruption). Higher scores indicate increased attentional problems.

2.7.4 Clinical Outcomes in Routine Evaluation – Outcome Measure (CORE-OM) (Evans et al., 2002)

The CORE-OM is a 34 item self-report questionnaire used to measure overall psychological wellbeing. The measure fits on two sides of A4 and the 34 items are answered on a five-point scale ranging from 'not at all' to 'most or all the time' (Evans et al., 2002). The questionnaire is broken down into four domains, these include: subjective wellbeing, problems/symptoms, life functioning and risk (see appendix 6). The symptom domain 'item clusters' addresses anxiety (four items), depression (four items), physical problems (two items) and trauma (two items). The functioning domain item clusters address general functioning (four items), close relationships (four items) and social relationships (four items). The scoring of the CORE-OM is problem scored, so higher scores suggest more problems (Barkham et al., 2005). The CORE-OM has good convergent validity as well as internal and test-retest reliability (0.75-0.95) with a good sensitivity to change (Evans et al., 2002). It has been tested on both clinical and non-clinical samples. The CORE-OM has been seen as a suitable assessment tool for severity of presenting problems in psychological services (Barkham et al., 2005).

2.8 Procedure

2.8.1 Recruiting participants

A total of 22 participants gave their consent to participate in this study. There were two groups and each group had 11 participants. The second group ran one week after the first group had completed the mindfulness treatment. At the end of the intervention,

both groups had two participants each who dropped out, four in total. Participants dropped out for a number of reasons: some participants were hospitalised during the time the group was running and others had family and personal emergencies, and therefore could not continue with the group. The data and accompanying analysis will be presented for the remaining sample of 18 participants who completed the intervention.

Participants who were on the waiting list were initially contacted via telephone and asked if they wished to attend the mindfulness treatment group. They were sent information about the study and were given a week to decide if they wanted to take part. Participants were contacted a week after they were sent the letter, to see if they were going to consent to take part. Once we received confirmation from those who wished to take part, and due to the number of people who showed interest in taking part in the study, two groups had to be created. The participants were allocated to the groups based on how long they had been on the waiting list. Those who had been on the waiting for a long period (10 months or more) were assigned to the first group, while those who had recently been put on the waiting list were assigned to the second group.

2.8.2 Where did the groups take place?

The mindfulness groups in this study took place at the Hertfordshire Neurological Service. The participants who attended the group came from Hertfordshire; for some, transport had to be arranged because they could not drive or were not able to drive due to their neurological condition. The mindfulness group was delivered over four consecutive sessions, lasting approximately an hour each. The group facilitator was an experienced consultant clinical neuropsychologist who has been practicing mindfulness on a personal level for some years and has been running the mindfulness group for over two years.

2.8.3 Administering the measures

The procedure in which the measures were administered was as follows:

- *Baseline*

When clients had given consent to attend the group, they were sent a package containing the questionnaires (MAAS, APT-II AQ, CORE-OM, and CPT-3) and they were asked to complete them. The majority of participants completed the CPT-3 at the neurological centre. However, some participants were not able to make it to the centre and required a home visit. The hardware and software that contains the CPT 3 exercise and MHS scoring software programme is all on a laptop not a desktop computer. This made the test portable and accessible to those who were not able to make it in to the centre. The baseline assessments were administered to all participants before the first group began their session.

- *Post-intervention*

After the last intervention session, the first group were given a package, which contained the post-assessment measures (MAAS, APT-II AQ, and CORE-OM) to take home with them. They had an appointment booked where they could come back to the centre or a home-visit was organised where they could complete the post-assessment CPT 3. During those sessions, there was also an opportunity for the participants to give their feedback on how they found the group and what they felt was unhelpful for future groups. The same also happened after the second group had completed their four sessions.

2.9 Determining the sample size and power calculation

Because the intervention could only be delivered to two groups, the sample size was limited to around 20 participants. The power calculation (using Faul, Erdfelder, Lang, & Buchner, (2007) online software) was conducted to reveal the level of power the study had in detecting a mean change in the outcome measures corresponding to a large, medium and small effect size. The results showed that the power of the paired t-test to detect a large effect size (Cohen's dz = .80) was high (β = .96), to detect a medium effect size (Cohen's dz = .50) acceptable, but to detect a small effect size (Cohen's dz = .30) insufficient (β = .21). These calculations were conducted with an alpha level of 5% (one-tailed).

2.10 Statistical analyses

Descriptive statistics and boxplots were used to investigate the distribution of the measures for anomalies and normality. The main data analysis was conducted with SPSS® (SPSS INc, 2012). Benchmarks for Skewness and Kurtosis (± 1) were used following recommendations by Lomax and Hahs-Vaughn (2012). Mean differences between the baseline and post-assessment measures were tested for statistical significance using the paired samples t-test with one-tailed p-values set at 5% if the normality assumption of the test was not violated, otherwise the non-parametric Wilcoxon test was used. Raw mean differences were also converted into an effect size (i.e. Cohen's d) to allow a comparison of the intervention effect between different outcome measures.

2.11 Ethical considerations

One of the ethical issues that was encountered in this study was whether there would be any psychological distress that could potentially occur as a result of the mindfulness intervention. All participants were made aware before attending the group that if they noticed any discomfort during any of the sessions that they must approach the facilitator, who would support them to manage the discomfort. Furthermore, participants were also made aware that they could withdraw from the group and/or study at any point, and that even after they had completed the groups they could withdraw their data from the study.

In the first sessions (for each group), participants created group rules, and one of the important group rules was around confidentiality. Participants were aware that anything that was discussed in the group was confidential and could not be discussed outside of the group setting. This was to ensure that people felt safe to talk in the session without worrying that others may take what was said and share it outside of the room. On one of the questionnaires (CORE-OM), one of the domains looked at risk (risk to self or others). Participants were made aware during the assessment and group stage that should they report any risk to self or others, confidentiality would need to be broken, whereby the necessary professionals would be notified (e.g. their GP and referring clinician).

Another ethical consideration was around the computer testing procedures in this study. Prior to completing the computer testing clients were verbally asked for their consent about whether they wished to participate in the test and they were asked generic questions about their mood and sleep pattern the night before, in order to establish each client's comfort level. They were made aware that during testing if they felt uncomfortable, tired or distressed, they could withdraw at any time. Clients were encouraged to ask questions and to inform the chief investigator of any concerns they had regarding the computer testing procedures.

In addition, all the data collected was anonymised so that participants who took part in the study could not be identified. All data concerning who attended the group was locked away at the neurological centre, and was only accessible to the neurological service and chief investigator.

Finally, the protocol of this study was examined and reviewed by Essex NHS ethics committee. They gave it a full-review, deemed it as having minimal risk to participants, and therefore gave a full approval for the study to be carried out. The approval letter is located in appendix 15.

3. Results

This chapter will begin with a description of the demographic variables of the sample, along with the clinical status of the participants. Descriptive statistics will then be provided for the distribution of the scores on the key outcome variables. These are organised according to the three main hypotheses, which focus on mindfulness, attention and psychological symptoms. The effectiveness of the intervention will be evaluated by examining the amount of change in the means of the outcome measures from baseline to the post. In addition to examining the amount of improvement for the group overall, the individual responses to the intervention will also be explored.

3.1 Sample Description

3.1.1 Demographic information

Gender: As shown in Table 2 (below), the final sample comprised of a much larger proportion of female (61%) than male participants (39%).

Ethnicity: The majority of participants were White British (78%). This is perhaps due to the area in which this study took place, which is a predominately White British populated area and therefore reflective of the type of referrals that would be expected to be seen at the service

Age: The mean age was 59.5, with SD = 10.45, minimum 41 years old and maximum 80 years old. This reflects the typical age of people who are diagnosed with degenerative neurological disorders (see clinical status).

Employment: Only 39% of the final sample was employed and 28% was classed as unemployed. Amongst the unemployed were many individuals who were signed off on long-term sickness leave, which reflected the seriousness of their medical condition. A third of the sample was retired. *Marital status:* Most of the participants were married (83%), with a small number being single (17%).

Table 2: Frequencies and percentages relating to demographic information for the sample (N=18).

Variable	Category	Frequency	Percentage
Gender	Male	7	39%
	Female	11	61%
Ethnicity	White British	14	78%
	White Other	2	11%
	Kenyan	1	6%
	Indian	1	6%
Employment	Employed	7	39%
	Unemployed	5	28%
	Retired	6	33%
Marital Status	Single	3	17%
	Married	15	83%
Sample	Total	18	100%

3.2 Neurological disorders

Diagnoses: Table 3 below presents the participants' type of neurological disorder. Because the participants had to meet psychological and medical selection criteria to be admitted to the intervention, only three main types of diagnoses are represented in this sample of which MS (39%) was the largest group. It is important to note that the study does not distinguish between different diagnoses of MS or the duration or severity of each type of diagnosis. This information was not routinely collected or held in the patient record system, as this was not the requirement of the service. The notable point here is that within each disorder category there were no obvious gender differences regarding any type of neurological disorder.

Table 3: Frequencies and percentages of type of neurological diagnosis (N=18).

Type of Neurological disorder	Frequency	Percentage
Multiple Sclerosis (MS) (Female=4; Male =3)	7	39%
Parkinson's Disease (PD) (Female= 4; Male=2)	6	33%
Stroke (Female=3; Male=2)	5	28%
Sample Total (Female=11; Male=7)	18	100%

3.3 Findings of the main outcome variables

Descriptive statistics for the main variables will be presented in this section, followed by the outcomes from the paired sample t-tests, which compare the mean differences of the main variables (MAAS, APT-II AQ, CORE-OM and CPT-3) between pre and post intervention.

3.4 Hypothesis One: Clients with neurological disorders taking part in the adapted MBI programme will significantly improve their mindfulness skills and become more mindful. It is predicted that their scores on the relevant outcome measure will be significantly higher after receiving MBI treatment compared with their baseline scores.

3.4.1 Mindfulness Attention Awareness Scale (MAAS)

The key concepts of mindfulness, on attentional focus and awareness of present-moment experiences, were measured using the 15-item Mindful Attention Awareness Scale (MAAS). The scoring involves calculating an overall mean score across the 15 MAAS items with higher scores indicating greater mindfulness. Descriptive statistics for the MAAS total measure is provided in Table 4 (below). The Boxplots for the MAAS can be found in Figure 6. The boxplot displays symmetrical distribution as the whiskers are

roughly of equal length for both baseline and post-intervention, with no outliers. Correspondingly the values for skewness (see table 4) deviated only very little from zero, which indicates that the distributions were approximately symmetrical. On the MAAS post intervention measure the kurtosis was larger than -1 suggesting a somewhat flatter distribution compared to normal distribution.

Table 4: Descriptive statistics of the pre and post measure for Mindfulness Attention Awareness Scale (MAAS) (N-18).

Measure	Min	Max	Mean	SD	Median	Skewness	Kurtosis
Baseline	2	6	3.88	1.04	3.73	0.28	-0.79
Post intervention	2	6	4.18	1.10	4.30	-0.21	-1.18

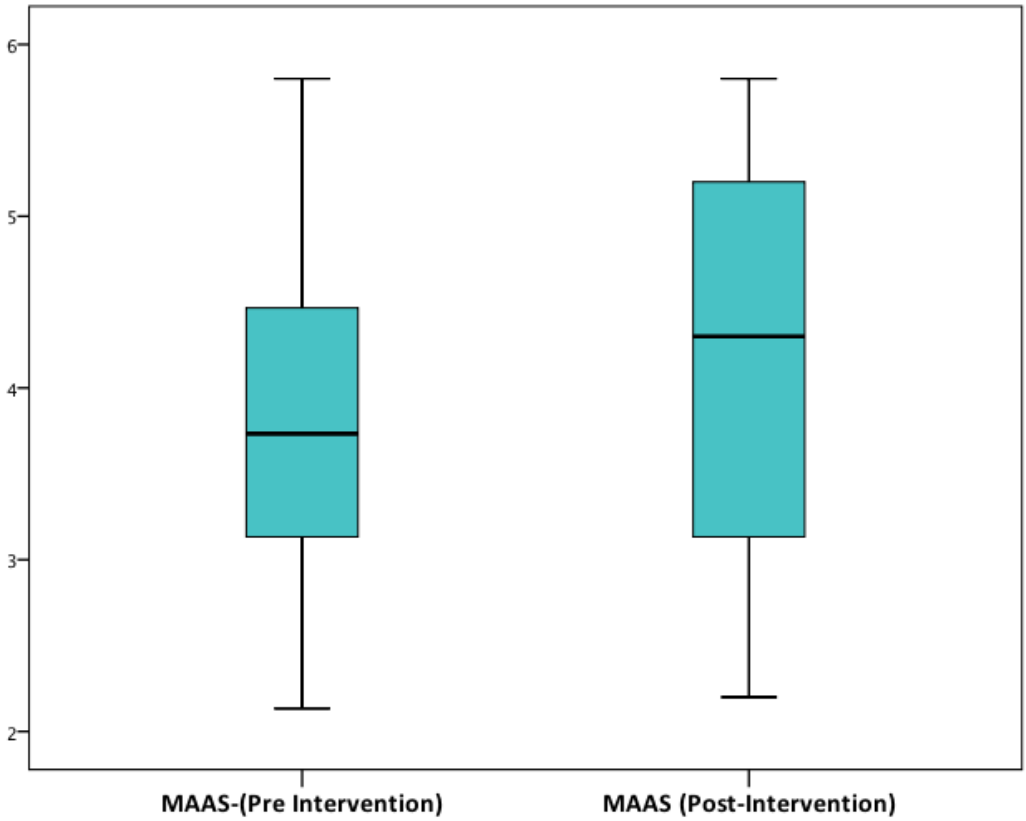

Figure 6: Boxplots showing the distribution of the MASS at pre and post scores N = 18.

3.4.1.1 A paired sample t-test to compare means scores for MAAS

A paired-samples t-test was conducted to test if there was a reliable improvement in mindfulness at the end of the intervention. Results indicated that the observed mean difference of 0.30 was only marginally significant *t (17) = - 1.59, p = .065, one tailed.* The effect size corresponding to the mean difference was *Cohen's d=0.28,* which suggests a modest effect. Finally, considering the very modest deviation from normality, the statistical results appear to be robust. Based on the outcome of this finding it can be stated with some caution that participants reported being slightly more mindful after receiving the mindfulness-based intervention (see paired samples t-test table in appendix 11).

3.5 Hypothesis Two: It is predicted that after receiving the MBI programme clients will report lower levels of attention related problems.

3.5.1 Attention Process Training-II Attention Questionnaire (APT-II AQ)

The Attention Questionnaire (APT-II AQ) measures various attentional domains such as sustained, switching and divided, whilst also screening out any distractions. A total score for the APT-II AQ was computed as described in the methods section, with higher scores reflecting increased attentional problems. Table 5 below displays descriptive statistics for the distributions of the baseline and post-intervention scores and the skewness and kurtosis figures suggest normality of the distributions. The boxplots shown in Figure 7 also confirm the normality of the distributions. At the post assessment there was only one outlier, but upon further examination of the data it was revealed that this was a legitimate score as the participant did not feel that there was enough time for her to benefit from the intervention.

Table 5: Descriptive statistics for the pre and post intervention outcome of the Attention Process Training-II Attention Questionnaire (N=18).

Measure	Min	Max	Mean	SD	Median	Skewness	Kurtosis
Baseline	0	46	20.72	12.35	19.00	0.39	0.05
Post intervention	0	40	16.89	10.91	15.00	0.73	0.16

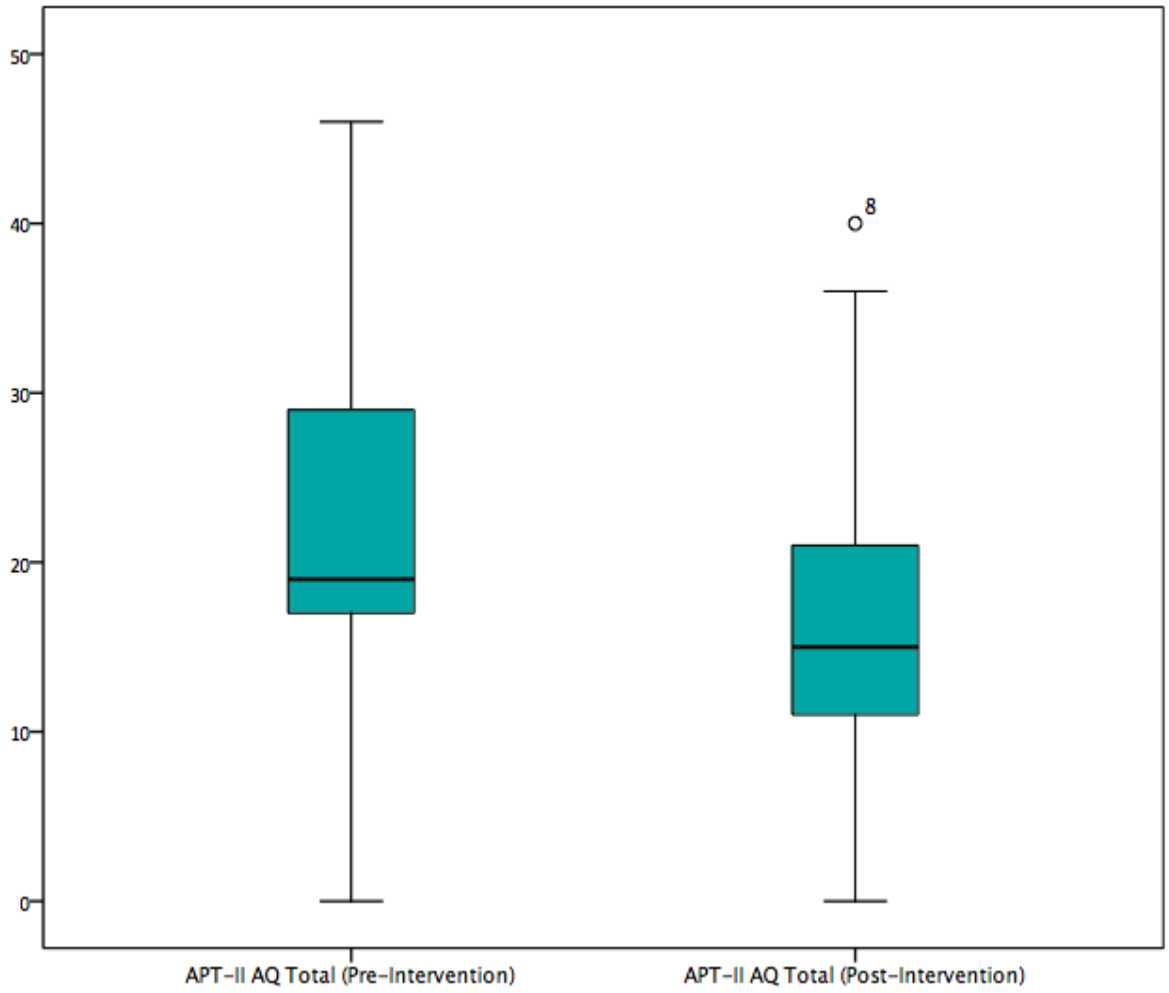

Figure 7: Boxplots showing the distribution of APT-II AQ baseline and post-intervention across all sample group (N=18). Outliers are marked accordingly (O;).*

3.5.1.1 A paired sample t-test to compare means scores for APT-II AQ

As before, a paired sample t-test was used to test hypothesis two. The observable mean difference between baseline and post-intervention was 3.83 and this was statistically significant, *t (17) = 2.180, p=.022, one-tailed.* The effect size of the mean difference was *Cohen's d= 0.33*, indicating a modest reduction in self-reported attention problems.

3.5.2 Computerised Test: Conners Continuous Performance Test 3rd Edition (CPT-3)

The raw scores that were generated from CPT-3 were automatically converted into T-scores, which have been used for this analysis.

3.5.2.1 Group statistics for CPT-3

Descriptive statistics (see Table 6) are reported for the main outcome variables of the CPT-3, which are linked to different types of attention, (a description of these variables can be found in appendix 10). In addition, a graphical data analysis was conducted using boxplots (see Figure 8 and Figure 9) to explore these distributions for anomalies.

Response style: The response style measures participants' natural way of responding based on the presented task. In other words, this measure determines whether an individual is responding to the task at hand in terms of how accurately they can identify the target stimulus or how quickly one can respond to the target stimulus. Also, it is possible to gauge whether one is responding in a balanced way whereby both accuracy and speed style are taken into consideration. The baseline for the response style shows that the skewness and kurtosis both exceeded 1, revealing that there was a modest positive skew and that the distribution was peaked, therefore violating the assumption of a normal distribution. The post intervention assessment scores on response style showed that skewness and kurtosis were somewhat closer to zero, which means that the distribution was approximately normal and symmetrical. The T-scores for this variable was calculated by the CPT-3 software and T-scores which fall between the cut-off points of 41 -59 indicate a balanced response style, in other words no speed or accuracy bias was present. Both the mean scores at baseline (53.28) and post-intervention (51.78) scores are within these cut-off points. The boxplot in Figure 10 for the baseline shows that the distribution was skewed because the lengths of the whiskers on either end were not equal. The post intervention boxplot (Figure 9) revealed that the length of the whiskers on each end were relatively equal in length, therefore the scores were symmetrical.

Detectability: This measures how participants are able to discriminate between non-targets and targets. As the skewness and kurtosis for baseline and post assessment were close to zero, the distributions of these scores were close to normality. The boxplots did not reveal any outliers. The T-scores on the detectability variable are defined in various categories. Scores between 45-54 indicate participants' performance falls within the average range category.

Omissions: This measure detects the number of missed targets. Participants who scored between 45-54 were performing within the average range. The skewness and kurtosis exceeded 2 for both baseline assessment and post-assessments, revealing that there was a noticeable positive skew and that the distributions were also rather leptokurtic and more non-normal in shape. The boxplot (Figure 8 & 9) revealed outliers and an extreme case at the higher end of the scores, which will have contributed to the skewness of the distribution.

Commissions: Participants' incorrect response to non-targets is recorded, and lower scores indicate less incorrect responses are made. The distribution of the baseline scores was symmetrical in shape but somewhat flatter compared with a normal distribution The skewness and kurtosis figures for the post assessment was close to zero, which means that the distribution of the scores was approximately normal. The boxplots did not reveal any anomalous cases (Figure 8 and Figure 9)

Perseverations: This test measures how quickly participants respond to a stimulus after it has been presented. Both baseline and post intervention, the skewness and kurtosis figures (see Table 6) suggest that these distributions are positively skewed with a considerable peak and so not-normally distributed. Furthermore, the boxplots at baseline and post intervention (Figure 8 & 9) reveal an extreme case and outliers, which may have accounted for the positive skew. The validity of these extreme observations was checked and so they were kept in the data set.

Hit Reaction Time (HRT): This test assesses the mean response speed. As is typical for reaction time measures, the pre and the post scores were slightly positively skewed. The baseline scores also had a pronounced peak and so deviated considerably from the shape of a normal distribution. The means of the baseline and post T-scores fell between cut-off points of 55-59, revealing a slightly slow response speed.

Hit Reaction Time Standard Deviation (HRT SD): This measure indicates how consistent a participant's response speed to a target stimulus is. The mean T-score calculated by CPT-3 software for both baseline and post assessments reveal that they fell within the

average performance range, which is scores between 45 and 54. The skewness and kurtosis for both baseline and post measures indicate that the distribution of the scores deviate from a normal distribution, in particular at baseline, as they have a modest positive skew and the baseline scores are also leptokurtic. The boxplots reveal one outlier for the pre and the post assessment relating to different participants (Figure 8 and Figure 9)

Variability: This test measures a subject's response speed consistency across a number of speed tasks. The boxplot did not reveal any unusual cases and the figures for skewness kurtosis indicate only a modest deviation from the normal distribution.

Hit Reaction Time Block Change: This measures the change in mean response speed across blocks. A high t-score means a slower reaction time across all blocks. Scores between 45 and 54 indicate an average response speed. The pre-assessment skewness and kurtosis were close to zero, which suggests that a distribution of normality had occurred. The boxplot (Figure 8) for pre-assessment scores revealed approximately normal distribution with no outliers and extreme cases. The post assessment t-scores skewness and kurtosis both exceeded 1, which indicates that there was a positive skew and the distribution was platykurtic. The boxplot (Figure 9) on the post-assessment revealed that there was one outlier (Figure 9).

Hit Reaction Time Inter-Stimulus Interval (ISI) Change: This tests changes in response speed across ISIs. A high t-score suggests a slower reaction time across trials with longer ISIs. The boxplot as well as the skewness and kurtosis revealed a normal distribution was obtained at baseline assessment. After intervention the skewness score was almost symmetrical but with a modest leptokurtic (kurtosis =1.45) appearance. The boxplot (Figure 9) revealed that there was one outlier. When explored further, this was a legitimate score.

Table 6: Descriptive statistics for the distributions of the CPT-3 scores (N = 18)

Measures	Baseline or Post Intervention	Min	Max	Mean	SD	Median	Skewness	Kurtosis
Response Style	Baseline T-score	33	89	53.28	13.47	52.00	1.13	2.15
	Post T-score	41	64	51.78	6.80	53.50	-0.24	-0.86
Detectability	Baseline T-scores	28	70	51.28	11.79	54.00	-0.57	-0.37
	Post T-score	30	67	49.33	8.97	49.00	-0.18	0.19
Omissions (%)	Baseline T-Score	44	79	51.06	8.65	48.00	2.28	6.03
	Post T-score	44	70	48.89	6.08	47.50	2.68	8.79
Commissions (%)	Baseline T-score	35	72	51.22	11.77	51.50	0.09	-1.11
	Post T-score	36	60	48.11	7.15	48.00	0.11	-0.48
Perseveratio ns (%)	Baseline T-score	44	87	52.33	11.27	47.00	2.14	4.62
	Post T-score	44	73	50.11	7.29	47.00	2.08	4.93
HRT	Baseline T-Score	44	90	55.50	11.03	55.50	1.86	4.88
	Post T-score	47	76	56.61	7.99	54.00	1.00	0.43
HRT SD (ms)	Baseline T-score	38	76	50.50	9.16	47.50	1.35	2.22
	Post T-score	40	66	49.44	6.57	48.50	0.99	1.07
Variability (ms)	Baseline T-score	36	74	49.44	10.32	47.00	1.01	0.55
	Post T-score	40	56	46.00	5.34	45.00	0.88	-0.40
HRT Block Change (ms)	Baseline T-score	35	62	50.89	7.74	50.50	-0.18	-0.49
	Post T-score	38	90	54.06	12.45	51.50	1.43	2.91
HRT ISI (ms)	Baseline T-score	29	68	47.89	10.12	47.50	0.04	0.28
	Post T-score	34	74	49.33	9.55	50.00	0.59	1.45

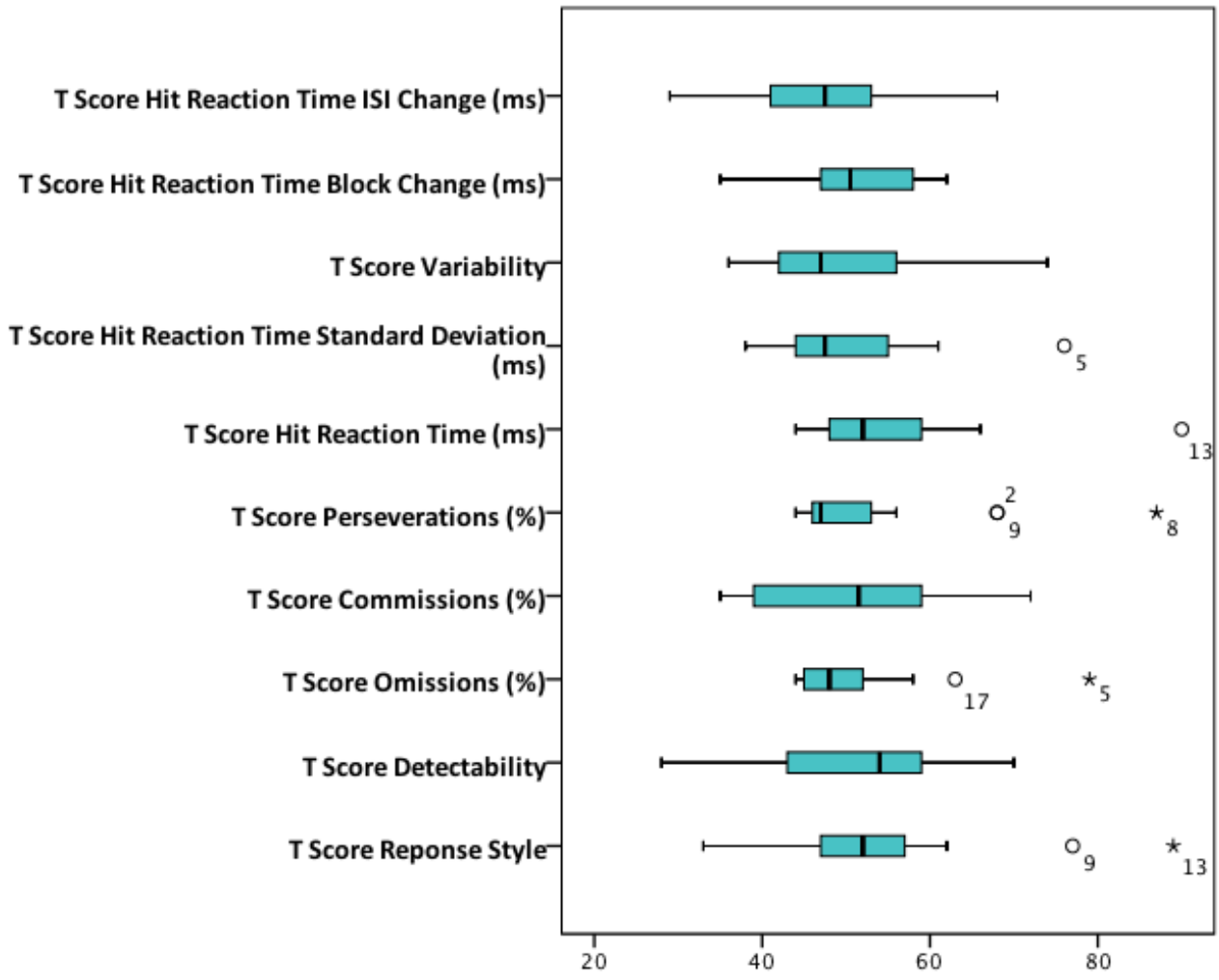

Figure 8: Boxplots showing the distribution of CPT-3 baseline scores across all sample groups (N=18). Outliers are marked accordingly (O;).*

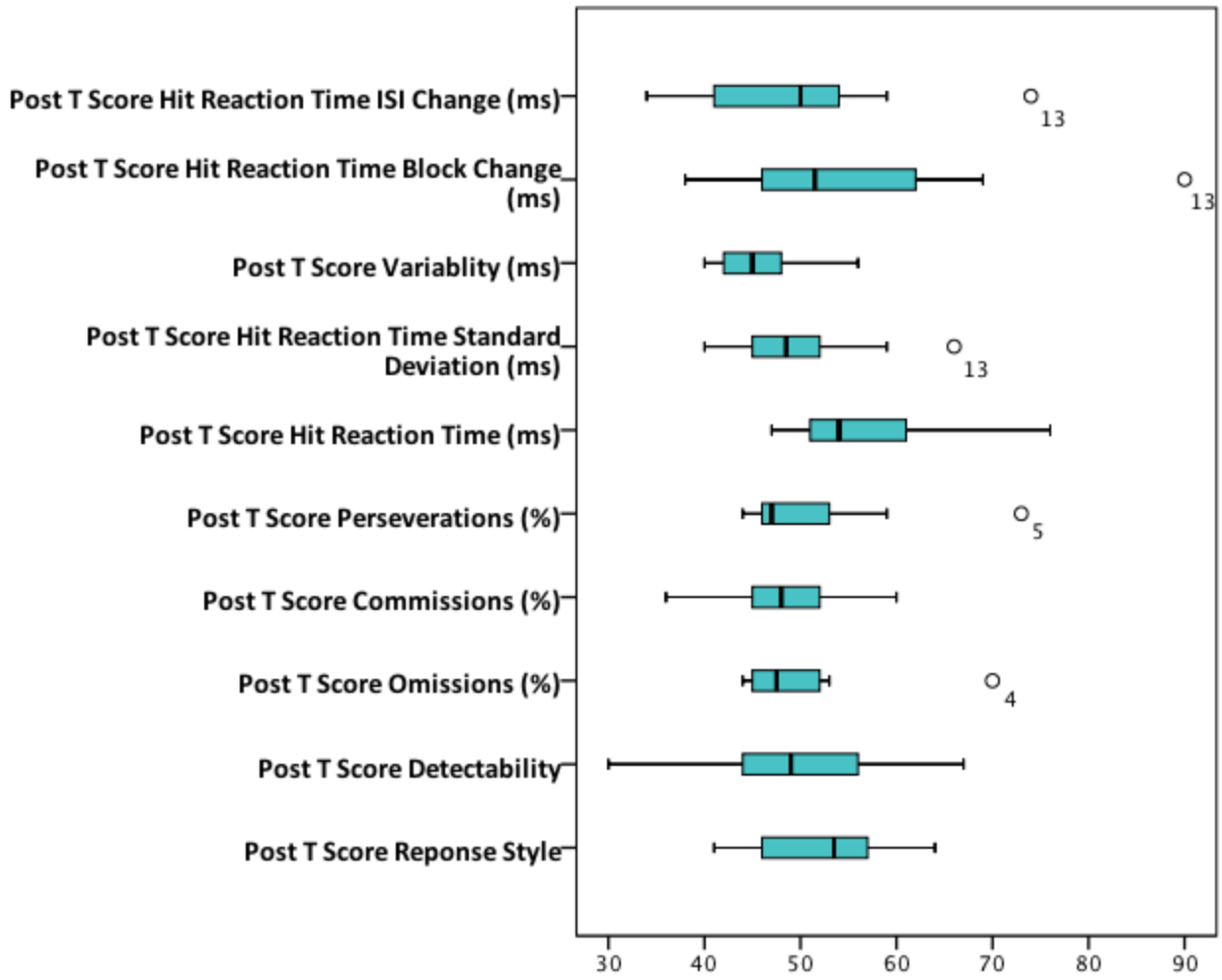

Figure 9: Boxplots showing the distribution of CPT-3 post-intervention scores across all sample groups (N=18). Outliers are marked accordingly (O;).*

3.5.2.2 Investigating whether there be any improvements on the specific tests of the CPT-3

Because of non-normal distributions and outliers on some of the CPT-3 measures, it was decided to test the Null-hypothesis of no mean change for all 10 measures by using a non-parametric statistical test for dependent samples. The results of the Wilcoxon test are displayed in Table 7 and the test was conducted two-tailed as no specific predictions regarding the direction of change were made. As all p-values were above a p-value of .10, no borderline significant result was found and none of the null-hypotheses were rejected.

Table 7: Results of the Wilcoxon test for change in means from baseline to post-intervention on the CPT-3 test scores.

Measure	**Z**	***p***
Response Style	-.12	.91
Detectability	-1.07	.29
Omissions (%)	-.81	.42
Commissions (%)	-1.48	.14
Perseverations (%)	-1.15	.25
Reaction Time (ms)	-1.25	.21
Reaction Time Standard Deviation (ms)	-.19	.85
Variability (ms)	-.133	.18
Reaction Time Block Change (ms)	-.81	.42
Reaction Time ISI Change (ms)	-.57	.57

3.5.2.3 Further analysis: An investigation of the improvement of individual participants

Given that there was no evidence for a significant change of the means on any CPT-3 test at group level, it was decided to carry out a frequency analysis of important change on the CPT-3 measures using the individual performance records that are produced by the CPT-3 computer programme and presented as individual progress reports (see Table 8) (see appendix 7, for an example of an example of a progress report) which reveal each participant's performance over time. One of the factors, which the report collates, is whether the participants had problems with any of the four attention domains (inattentiveness, impulsivity, sustained attention and vigilance). The baseline assessment report indicates problem for a specific domain. Similarly, the post-intervention assessment report also classifies the test performance of an individual in terms of 'no indication', 'some indication' or 'strong indication' of a problem. The progress report, however, flags up any significant change over time for that person in any of the four areas using a specific statistical index.

Inattentiveness: The majority (56%) of the participants had no problems with inattentiveness at both baseline and post-intervention. At baseline for those who had some (22%) and strong (22%) indication of problems with inattentiveness the numbers were even. However, at post-intervention the number of those with some indication of problems increased (39%) and those with strong indication of a problem decreased (6%). In other words there appears to have been a shift in inattentiveness that those who had a strong indication of a problem improved their performances after the intervention and moved up the next level to only some indication of a problem.

Impulsivity: At baseline most of the participants (94%) had no indication of having problems with impulsivity. There were none at some indication and only one (6%) at strong indication of having on impulsivity problem. The post-intervention outcome shows that the one with strong indication of a problem improved and moved to no indication of a problem.

Sustained Attention: The results show that at the baseline assessment 61% had no problem with their sustained attention, whilst 39% had some problem with sustained attention and no one had strong indication of a problem. At post-intervention the outcome had changed and the number of people who had no problem with sustained attention increased (83%), whilst the number of participants who had some problems with sustained attention had fallen (17%). The strong indication of a problem remained unchanged.

Vigilance: The baseline assessment report revealed that the majority of the participants (72%) had no problems with vigilance. There were participants who had some indication of a problem in vigilance (22%) and 6% who had strong indication of a problem. After completing the intervention, the no indication category had increased to 79%, whilst some indication of a problem remained the same. As for the strong indication of a problem category, no participant remained in this category.

Table 8: Frequency and percentages of individual progress reports comparing pre assessment and post intervention scores.

Type of attention	Any indication of a problem	Frequency Pre assessment	Percentage %	Frequency Post intervention assessment	Percentage %
Inattentiveness	• No Indication of a problem	10	56%	10	56%
	• Some indication of a problem	4	22%	7	39%
	• Strong indication of a problem	4	22%	1	6%
Impulsivity	• No Indication of a problem	17	94%	18	100%
	• Some indication of a problem	0	0	0	0
	• Strong indication of a problem	1	6%	0	0
Sustained attention	• No Indication of a problem	11	61%	15	83%
	• Some indication of a problem	7	39%	3	17%
	• Strong indication of a problem	0	0%	0	0%
Vigilance	• No Indication of a problem	13	72%	14	79%
	• Some indication of a problem	4	22%	4	22%
	• Strong indication of a problem	1	6%	0	0%
Total		18	100%	18	100%

The progress report flags up significant individual changes on the CPT-3 test scores. Table 9 shows the frequency and percentages of change in the test scores from baseline assessment to post-intervention for individual participants for each specific CBT-3 measure. This was extracted from the individuals' progress reports, calculated by the CPT-3 software.

3.5.2.4 Measures of detectability and errors

Detectability: The outcome when baseline scores were compared with post assessment scores shows that 72% experienced *No change*. A small number of participants had experienced change, 6% decreased their error rate and 22% increased their ability rate. Both results indicate a slight improvement after intervention.

Omissions: The majority of participants (72%) showed no change after intervention. It did, however, highlight that for one individual (6%) there was a slight change in performance whereby they had an increased error rate where they missed more targets.

Commissions: For a third of the participants there was some indication that change had happened, whereby they were able to decrease the number of incorrect responses after receiving mindfulness-based intervention.

Perseverations: 78% of participants experienced no change post-intervention. There was one individual (6%) who had an increased error rate whilst 17% of participants had decreased their error rate after intervention.

3.5.2.5 Measures involving reaction times

The majority of participants showed no sign of change in HRT *(78%)*, HRT SD *(78%),* Variability *(72%),* HRT Block Change *(67%)* and HRT ISI *(67%)* after receiving intervention. Some participants had changes in their reaction time consistency whereby 22% appeared to be more consistent (HRT SD) in their reaction time throughout the administration. Interestingly, 22% of participants had less variability in their response consistency. In terms of speed response, it appears that some participants seem to be much slower at the speed in which they responded in HRT (22%), HRT Block Change (11%) and HRT ISIs (28%) after intervention.

Table 9: An overview of individual change in CPT-3 test scores based on the CPT-3 progress reports.

Variables measuring attention	Measures		Frequency	Percentage %
Measures of Detectability and Errors Detectability	Detectability	No Change	13	72%
		Decreased error rate	1	6%
		Increased ability	4	22%
	Omissions	No Change	13	72%
		Increased error rate	1	6%
		Decreased error rate	4	22%
	Commissions	No Change	12	67%
		Decreased error rate	6	33%
	Perseverations	No Change	14	78%
		Increased error rate	1	6%
		Decreased error rate	3	17%
		Total	18	100%
Measures Involving Reaction Times	HRT	No Change	14	78%
		Slower	4	22%
	HRT SD	No Change	14	78%
		More Consistent	4	22%
	Variability	No change	13	72%
		Less variability	4	22%
		More variability	1	6%
	HRT Block Change	No Change	12	67%
		Less slowing across blocks	4	22%
		More slowing across blocks	2	11%
		No Change		
	HRT ISI	Less slowing at longer ISIs	12	67%
		More slowing at longer ISIs	1	6%
			5	28%
		Total	18	100%

3.6 Hypothesis Three: Clients will show reduced level of psychological distress at the end of the MBI programme.

3.6.1 Clinical Outcomes in Routine Evaluation – Outcome Measure (CORE-OM)

The CORE-OM was used to assess the participants' overall level of psychological distress. The boxplots in figure 10 indicate symmetrically distributed scores as the whiskers are roughly of equal length and there are no outliers or extreme cases. Table 10 shows relevant descriptive statistics for the distributions of the total scores. The skewness confirms the symmetry of the distributions and the kurtosis figures suggest slightly flatter distributions compared to the normal distribution. There was a noticeable reduction of the mean at the end of the intervention.

Table 10: Descriptive statistics for the CORE total score pre and post intervention (N=18)

Measure	Min	Max	Mean	SD	Median	Skewness	Kurtosis
Baseline	8	82	43.78	22.52	38.00	0.31	-1.14
Post intervention	3	63	28.89	18.38	28.00	0.29	-1.09

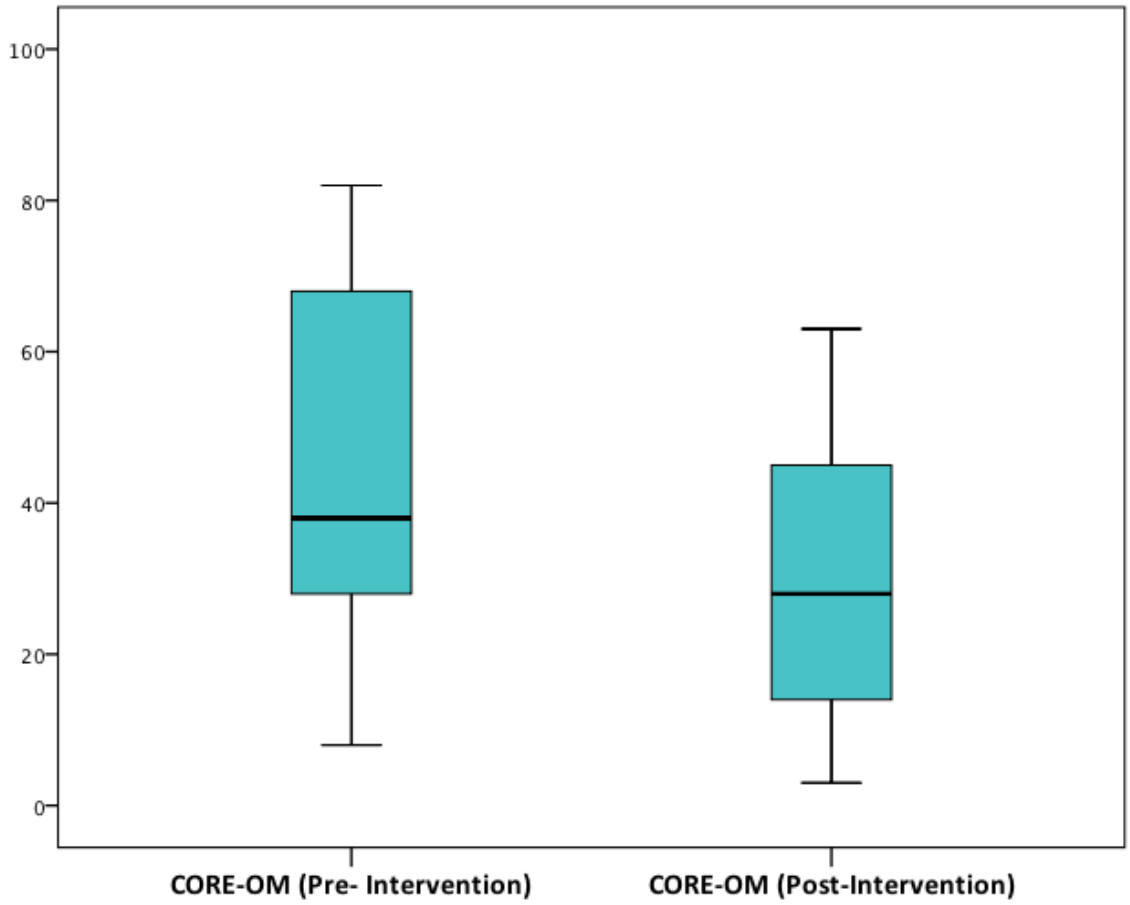

Figure 10: Boxplots showing the distribution of CORE-OM baseline and post-intervention across all sample group (N=18).

3.6.1.1 A paired sample t-test to compare means scores for CORE-OM

A paired-samples t-test was conducted to compare the mean differences between baseline scores and post-intervention scores. The mean difference was 14.88 and statistically highly significant, *t (17) = - 4.46, p < .001, one-tailed.* The average reduction on the CORE amounted to a substantial effect size, Cohen's *d = 0.*72. This result therefore suggests that participants' scores on psychological distress decreased considerably post intervention.

3.6.1.2 Further Examination of the CORE-OM domain scores

A further analysis was conducted to explore whether reliable improvement occurred in all four domains of the CORE-OM. Table 11 shows the descriptive statistics, which was generated for the pre-assessment and post-assessment CORE subscales relating to

wellbeing, symptoms, life functioning and risk.

Wellbeing: The boxplots for the pre and post assessment scores, as well as the skewness and kurtosis figures, suggest approximately normal distributions with no outliers or extreme scores.

Physical/Symptoms: The distribution of the symptom scores at baseline was approximately normal yet slightly flatter in shape indicated by a modest kurtosis of -.76 (see Table 11). At the end of the intervention the distribution appeared even more platykurtic (kurtosis: -1.30), but was otherwise symmetrical. The boxplots (see Fig 11) did not reveal any anomalous cases.

Life Functioning: At baseline, the distribution of the scores was almost perfectly symmetrical, but with a modest platykurtic (kurtosis = -1.13) appearance. At the end of the intervention, the scores resembled a normal distribution. Again, the boxplots (see Fig. 11) did not reveal any outliers or extreme cases.

Risk: The boxplots (see Figure 9) as well as the skewness and kurtosis figures (see Table 11) suggest a non-normal distribution with a considerable positive skew and a pronounced peak. The positive skew can be accounted for by the outliers and extreme cases. Further examination of the data revealed that these were valid scores that can be expected in this particular sample. The risk domain looks at suicidal ideations or risk factors linked to harming self or other, and there is evidence that those with neurological disorders have a higher risk of suicide compared to the general population (Hesdorffer et al., 2009).

Table 11: Descriptive statistics for the distributions of the 4 CORE domain scales (N = 18) with lower scores indicating improvement.

Domain	Measure	Min	Max	Mean	SD	Median	Skewness	Kurtosis
Wellbeing	Baseline	0	16	6.94	4.18	7.00	0.31	-0.27
	Post intervention	0	11	4.00	3.24	3.00	0.68	-0.41
Symptoms	Baseline	7	42	20.94	10.45	17.50	0.67	-0.76
	Post-Intervention	2	24	13.61	7.41	13.00	0.03	-1.30
Life Functioning	Baseline	0	29	15.00	8.35	12.00	0.09	-1.18
	Post Intervention	0	27	10.78	8.43	10.00	0.55	-0.43
Risk	Baseline	0	5	0.89	1.53	0.00	1.87	2.60
	Post Intervention	0	5	0.50	1.20	0.00	3.44	12.98

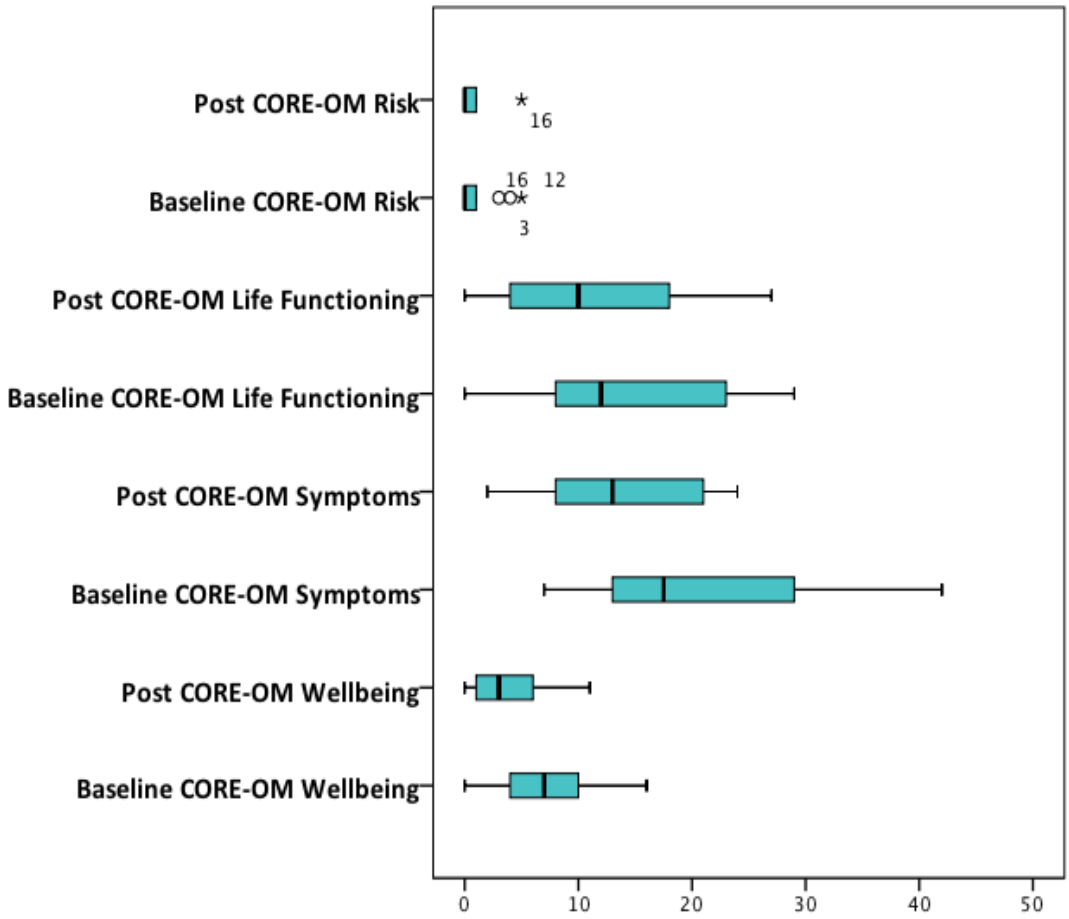

Figure 11: Boxplots showing the distribution of CORE-OM baseline and post-intervention across four domains.

3.6.1.3 Determining significant changes on the CORE-OM domain scales at baseline and post-intervention.

Wellbeing: The mean difference between baseline and post intervention was 2.94. Using a paired sample t-test for dependent samples, this amount of improvement was found to be highly statistically significant, *t (17) = 4.98, p <, .001 one-tailed,* indicating that participants reported lower levels of problems with their wellbeing. The corresponding effect size of *Cohen's d= 0.79* suggested a large effect size.

Physical/Symptoms: A paired sample t-test for dependent samples also confirmed that the mean difference of 7.33 between the symptoms baseline and symptoms post intervention was found to be statistically significant *t (17) = 4.23, p <.001, one-tailed* suggesting that participants felt that their symptoms had improved after intervention. This amount of change towards improvement corresponded to a large effect size *Cohen's d= -0.81.*

Life Functioning: The mean difference of 4.22 between the life functioning baseline and post intervention was tested for statistical significance using a paired samples t-test. The results, *t (17) = 3.07, p= 007*, one-tailed, indicated to reject the Null-hypothesis of no improvement and to conclude that problems with life functioning had decreased after having attended the mindfulness based intervention. The corresponding effect size *Cohen's d= 0.50* was of medium size.

Risk: Because of the non-normal distribution of the risk scores, the nonparametric Wilcoxon test was used to evaluate whether the small mean difference of 0.39 between the risk baseline scores and post intervention scores was statistically reliable. The result, Z = -.96, *p* = .18, one-tailed, indicated that there was no reliable mean change.

4. Discussion

4.1 Outline of discussion section

This study evaluated the effectiveness of a brief mindfulness-based intervention (MBI) on attention impairment and psychological problems found in a mixed clinical population presenting with neurological disorders. The aim of the study was to determine whether the MBI in question had brought about any improvements in attention problems, which were assessed through a questionnaire (APT-II AQ) as well as a neuropsychological test (CPT-3). The study also sought to explore whether a brief MBI enhanced participants' mindfulness skills as measured by the MAAS and reduced their psychological distress as measured by CORE-OM. In the next section, the main findings relating to the study's hypotheses will be discussed and implications for clinical practice will be presented.

4.2 Overview of results: main findings

The majority of the participants in this study were female. In regards to the clinical status, most of the participants who completed the intervention had MS and these were mainly women. This reflects national statistics which indicate that females are three times more likely to have MS than men (NHS choice, 2015). The remaining participants had a diagnosis of stroke (28%) and PD (33%). The participants were recruited from a typical NHS neuro-rehabilitation centre and although no random sampling was used, the larger number of females in this sample might reflect the recent statistics showing the rising number of females being admitted to hospital as a result of ABI. This number has risen to 24% since 2005-6 (Headway, 2015).
Other demographic information revealed that most of the participants were White British (78%). This was to be expected, given the location of the neuro-rehabilitation centre in which the study took place, which is in a predominantly White British residential area. Other demographic details revealed that over half of the participants reported being married (83%). Only around one third of the participants were in employment. Remaining individuals in the study were either unemployed or retired. This data indicating a high level of unemployment in this sample reflects the serious impact of ABI on individuals' ability to work

4.3 Outcome of predictive hypotheses

4.3.1 Hypothesis One: Clients with neurological disorders taking part in the adapted MBI programme will significantly improve their mindfulness skills and become more mindful. It is predicted that their scores on the relevant outcome measure will be significantly higher after receiving MBI treatment compared with their baseline scores.

This study found that the observed mean differences from baseline to post-intervention were of marginal significance and the treatment effect size was modest. This suggests that participants' mindfulness skills increased after attending the MBI programme. However, the results indicate a slight increase in scores and therefore should be treated with caution.

A fairly obvious explanation for this outcome is that participants began the group with very little knowledge of mindfulness and over the course of the intervention gained confidence and understanding of mindfulness and its application. In other words, participation in the group led to increased mindfulness skills.

A specific feature of the group that may have led to increased mindfulness skills was the home practice of mindfulness exercises. As mentioned earlier, a key part of mindfulness-based interventions is the practice of mindfulness exercises outside of the group. Participants are encouraged to integrate these into their daily lives. Carmody and Baer (2007) found that there was a relationship between home practices of mindfulness exercises with increased mindfulness and wellbeing in a non-clinical sample. The results in this study, although marginal, appear to support Carmody and Baer's (2007) findings.

4.3.2 Hypothesis Two: It is predicted that after receiving the MBI programme client will report lower levels of attention related problems.

- *Self-reported measures of attention (APT-II- AQ)*

The results on self-reported attention measures showed that there was a significant reduction in attention problems between baseline and post-intervention, with a modest treatment effect size. Such a result suggests that participants found that their attention problems had decreased after receiving MBI treatment. This is in line with

Moore et al (2012) who found that participants who received meditation treatment showed a significant improvement in attention compared to a control group. Findings in this study also confirm the results found by Azulay et al, (2013), who report that mindfulness training had a significant effect on central executive aspects of attention. Both of the measures used in Azulay et al (2013) study showed a significant improvement from baseline to post-intervention.

One explanation for participants' reported improved attention problems could be to do with the links between attention and mood. Zeidan et al. (2010) have explored the link between cognition components (i.e. attention) and emotions. Zeidan et al (2010) states "the ability to self-regulate emotions has been found to be the key component in enhancing cognition" (p.603). The authors found that brief mindfulness intervention had an immediate effect not only on participants' mood but also on cognitive processing, particularly in regards to reducing lapses in attention (Zeidan et al, 2010). Similarly, in this study participants may have experienced a concurrent improvement in their affect and attention after as a result of the MBI.

Another explanation is that the MBI exercises may have affected particular areas of the brain involved in certain aspects of attention. Studies have found that mindfulness-based interventions have impacted activities in different parts of the brain (Lutz et al, 2008; Manna et al. 2010; Moore et al. 2012). As there is still a lot to learn about attention, it is unclear whether activities in the brain could have had an impact on participants' perception of attention. As part of a meta-analysis Chisea & Serretti (2009), reported that Vipassana meditation, which involves training in awareness of bodily sensations, may enhance cerebral activity in the brain areas related to interoception and attention (i.e. right anterior insula and cerebral areas related to attention).

One further explanation could be that improved attention was linked to improved mental fatigue. Mental fatigue "is characterized by pronounced and rapid mental exhaustion even after moderate mental activity which involves a demand on the person's concentration and attention" (Johansson et al, 2012 p.1). Johnansson et al. (2012) found that MBSR treatment improved participants' mental fatigue, which resulted in further improvement of information processing and divided attention. It is known that individuals who have sustained a neurological disorder often have problems with mental fatigue (Johnansson et al, 2014). This study's findings may

indicate that mental fatigue improved with the MBI, having a knock on effect on attention related difficulties.

It is promising, no matter the mechanism of change, that participants perceived a positive change in attention post MBI.

- *Computerised Neuropsychological test (CPT-3)*

Despite the positive indications found in participants' self-reported attention and psychological wellbeing from pre to post intervention, these changes were not observed in the psychometric tests of attention (CPT-3) for the overall group result. Further exploration was conducted, examining each individual progress report from baseline to post-assessment. On the four attention domains, the results revealed that at baseline the CPT-3 did not detect problems with attention, on all four domains for the majority of participants. Furthermore, an investigation into whether there had been a noticeable change from pre-assessment to post-assessment on all ten variables for each participant's progress report revealed that the majority of participants reported 'no change' on all ten variables. An explanation for this may be that the type of attention that is measured by the CPT-3 did not match with the attentional problems that were reported by participants in this study. The CPT measures tend to require alertness, accurate observation and attentional skill (Semple, 2010) and the ability to do any of these may not have been a problem for the participants recruited in this study.

An even further exploration of individual changes after MBI was conducted. As stated earlier, each participant has a progress report compiled by the CPT-3 software after completing the test at baseline and post-intervention. The report consisted of a summary of individuals' performances on the four types of attention. The report highlights any problem areas with the four attention domains (inattentiveness, impulsivity, sustained attention and vigilance). Furthermore, it identifies any changes in performance over a period. This study revealed that the majority of participants showed no indication of a problem at baseline assessment and post intervention. There were various changes amongst the scores, whereby some had moved from strong indication of having a problem with one of the attention types at baseline to no indication of a problem at post-assessment. There were some participants who showed a greater change in their performance than others. For example on the inattentiveness type of attention, at pre-assessment there were four individuals who showed a strong

indication of having a problem with inattentiveness. However, after the MBI, the number had decreased, and three out of four had moved into the some indication of a problem category. This suggests that for these individuals their inattentiveness problem had decreased slightly, implying that the improvement had occurred after completing MBI.

Another noticeable outcome was in the sustained attention category. At baseline, the majority of people had no signs of a problem with sustained attention, but there were some individuals who had been identified as having some problem with sustained attention. After intervention, the number of people who had some problem of sustained attention decreased and moved to no problem with sustained attention. This outcome suggests an improvement occurred for sustained attention after completing MBI for these individuals. This is in line with the findings by Zeidan et al. (2010) who discovered that sustained attention can be enhanced by having brief mindfulness training.

Moreover, the individual progress reports also provided a summary of individuals' performance on all ten variables. The ten variables are split into two categories, which are the measures of detectability and errors and measures involving reaction times. In all the variables, the majority of participants' performances remained the same from baseline assessment to post-intervention assessment. For the majority of participants, having MBI had no effect on their performance on all ten variables. There were some participants who showed some improvement in their performances after the intervention. For example, on the Commission variable, 33% of participants had managed to decrease their error rate. In other variables, some participants' performances did not appear to have improved, instead they showed to have worsened after the intervention - for example, 22% of participants' performances on the Hit Reaction Time (HRT) scores became slower at responding to the stimuli after completing the intervention. A slower HRT is linked with inattentiveness. This is similar to the findings of Rueckert and Grafman (1996) which indicated that participants with an acquired brain injury were slower and missed targets on their performances on the CPT exercise. They found that participants' reaction time was much slower than those in the control group (Rueckert and Grafman 1996). It could be that despite the MBI intervention certain areas of attention were not affected due to the specific nature of participants' neurological difficulties, but this needs further exploration.

A study by Semple (2010) found that CPT was able to detect attentional changes after mindfulness practice. Even though there was no indication of attention problems at baseline, this study had hoped for changes to occur between pre-assessment to post assessment. One explanation for that could be that the course of the mindfulness intervention was too brief. The MBI in this study consisted of four sessions lasting for one hour each. The rationale for the brief MBI was mainly about not leaving the participants more tired and overwhelmed by the programme's agenda and tapering the MBI to fit for the population. However, it is possible that the lack of significant findings on the neuropsychological test for attention (CPT-3) may have been due to the shorter sessions having had little impact in terms of attention deficit. Perhaps for improvement to be significant enough to be detected by a neuropsychological test such as CPT-3, the programme of intervention would need to stick more closely to the original MBSR programme of 8 sessions or more.

4.3.3 Hypothesis Three: Clients will show reduced level of psychological distress at the end of the MBI programme.

A further investigation was conducted looking into changes in the levels of psychological distress after having an MBI programme. The CORE-OM which looks at four main domains, including subjective well-being, problems/symptoms, life functioning and risk/harm was used. An analysis was conducted and revealed that participants showed statistically significant improvements in mean score differences for subjective wellbeing, problems/symptoms and life functioning domain, after completing the mindfulness intervention. A treatment effect size was computed and obtained for the three domains, and it was found that subjective wellbeing and problems/symptoms had significantly large effect sizes and the life functioning domain had a medium effect size. The risk domain showed that there was a decrease in mean scores after the intervention, but these were not statistically significant.
These results support previous studies which found mindfulness treatment beneficial in terms of psychological wellbeing and improved mood for participants with TBI (Bedard et al., 2013; Teasdale et al, 2000; Bowen et al, 2006, Bishop et al, 2004; Anderson et al., 2007). For instance, the study conducted by Chambers et al (2008) consisted of participants who attended a 10-day meditation course, reported a reduction in

depressive symptoms and negative affect across participants. McHugh and Wood (2013) found that mindfulness training had an impact on emotional regulation. They discovered that participants who had mindfulness intervention showed lower negative affect when they viewed negative images compared with the control group, who were not able to lower their negative affect. This finding on improved psychological wellbeing is important because it has been reported that those who have sustained neurological disorders tend to report having psychological and emotional problems (Soo & Tate, 2007; Ponsford et al., 2013; Brown, 2012) and their quality of life is often affected (Ashworth et al, 2014). Brown and Ryan (2003) found that correlational studies using MAAS found it was correlated with a number of well-being indicators including depression, anxiety, angry hostility and self-esteem.

There are several reasons as to why participants may report a reduction in psychological distress after having had a MBI. One explanation is that perhaps participants learn to shift their attention and attitudes during the course of MBI. Shapiro et al, (2006) call this shift re-perceiving. They state that re-perceiving is a meta-mechanism of action, which consists of being able to view moment-by-moment experiences with greater clarity and objectivity. This can lead to fundamental positive changes, such as a reduction in judgements of one's experiences, being less caught up with personal dramas and becoming less attached to internal and external states that cause negative effects. Bishop et al, (2004) state along a similar line that mindfulness practice allows participants to be able to disengage from elaborative processing, which is engaging and attaching to negative effects, thoughts and feelings (Bishop et al, 2004). Elaborative processing can often have an impact on individuals' psychological functioning and can lead to distress. Learning how to be in more mindful state (and practicing this during the intervention) that consists of re-perceiving or non-elaborative processing may be the reason for participants' reported reduced levels of psychological distress. Fitzpatrick et al. (2010) found that participants felt able to cope with their stress and emotions when they were more accepting and tolerating of negative experiences rather than acting on getting rid of them.

Another factor impacting positively on individuals' psychological distress in this study may have been to do with being part of a group. At the feedback session, the participants described some of what many reported that they found most valuable about being in a group. One of the most powerful aspects had been peer support, and

reassurance of having contact with others who also had similar experiences. Participants reported that the group validated their experiences of what is like living with a neurological condition. It is possible that group effect may have led to participants' improved mood and attention, as opposed to the actual MBI treatment. In a study by Fitzpatrick et al. (2010), one of the many findings was around how positive the support of the group was and that it was an important part of participants' experience.

Although it is difficult to determine the exact mechanisms for change in participants' level of psychological distress, what is promising is that such a significant change was found after a brief MBI group intervention.

4.4 Clinical relevance and implications

The NHS expenditure for treating neurological disorders is rising (Neurological Alliance, 2014). The number of people living with neurological disorder is extremely high. The impact of having a neurological disorder on individuals as well as wider families and the health care system is profound. Having a neurological disorder not only poses challenges to the individual but also to the entire family/social systems and causes stress and disruption to normal life functioning. Furthermore, there are emotional, social, cognitive and psychological changes which occur as a result of having the neurological disorder and which often require treatment or intervention. In particular, individuals with neurological disorders are impeded by attentional problems which affect various aspects of life and, as a result, send individuals into rehabilitation services.

There is little research looking at alternative treatments for neurological disorders especially given the burden it has on the health care system. This study has contributed further to findings in this area, which suggest that mindfulness based group interventions can be seen as beneficial to an ABI client group. One implication of this is that it may perhaps influence and encourage rehabilitation services to adopt a more holistic approach including MBIs. In doing so, MBI can be added to the care packages available for people with neurological conditions.

A benefit of having a brief mindfulness course is that it can be made accessible to everyone, and people do not need to access an extensive or expensive course to reap the benefits. Furthermore, from a service point of view, it could be offered to clients on the waiting list, reducing the waiting list and offering clients intervention. Moreover, as it may be beneficial as a short treatment, it is a cost effective option. People are likely to be seen quicker, preventing a delay in treatment and the recovery process and services are able to effectively manage waiting lists. Particularly for those with ABI, immediate action is often seen as much more beneficial and effective because it can help people to recover quicker rather than to prolong difficulties linked to their condition while on a waiting list. Another benefit of mindfulness training is that it is part of the 'third wave' CBT. This means that it can be manualised and often requires little training to be able to administer it. Therefore, it could prove cost effective for services where staff can be trained and it could be integrated into the neuro-rehabilitation care packages already on offer. In other words, clients would not have to be referred to another service to receive the MBI, but instead could receive it from the service which they are currently under, and familiar with.

We have seen how evidence-based practices have influenced national guidelines and service policies. The number of studies conducted on the effectiveness of MBI with other health conditions, which has changed service provisions and policies is vast (NICE, 2011) compared to the limited studies available on neurological conditions. Part of the relevance of this study is its ability to investigate and clarify whether an evidence-based treatment such as MBI may benefit this unique population. This study contributes to the small but growing literature on interventions aimed at improving attentional difficulties in individuals with neurological disorders.

4.5 Study Limitations

This study was an opportunistic research design, with no control group. Having a control group would have helped to show if clinical improvement of attention and psychological wellbeing was based on MBI or other factors. As it stands, this study cannot firmly conclude that the improvement that was observed in attention and reduced psychological distress was down to the intervention. In order to strengthen this study, an RCT design using a control group could be used to determine the true of

effectiveness of the intervention. In addition, this study had a relatively small group size, which limited the statistical power of the analyses, particularly on the self-report measures of mindfulness (MASS) and attention (APT-II AQ). There were some limitations that were associated with the sample recruitment for this study. The small sample size and the demographic characteristics of the majority of participants (female of White British origin) suggest that the ecological validity of the study is limited and its findings may not apply to a wider and more diverse population of clients recovering from a brain injury.

Another limitation in our analysis is the confounding of the treatment such as medication and on-going rehabilitation programme. Without better separation of the variables, it is impossible to determine how much influence the MBI has had on the clinical findings of this study. In regards to medications, details of medication were not collected, given the type of neurological disorders (e.g. NICE, (2006) recommend pharmacological therapy for PD) that were recruited for the study. It is probable that some were taking medication as part of the treatment for their disorders, and these medications could potentially have an effect on individuals' attention and mood levels. Some participants had been receiving concurrent rehabilitation and it was not possible to isolate the effects of MBSR. Therefore, it can be assumed that other interventions offered as part of the rehabilitation programme could potentially have an effect in managing or improving cognitive difficulties.

4.6 Future Research

Most notably the outcome of this study indicates that a brief intervention of mindfulness led to improvement on self-reported measures of attention and psychological wellbeing. The research on brief mindfulness intervention is sparse, and future considerations could be to look further at the effectiveness of brief mindfulness intervention for this population. One possible direction for future research in this area could be to look at the effects of other mindfulness based programmes, such as ACT or MBCT. Future research could also investigate the potential benefits of a full length MBSR programme (i.e. 8 weeks versus 4 weeks). The evidence of this study can only be tentative and so the next study should run the MBI for longer.

Another important area for future consideration is the sample size and the formation of the group. Several factors could be improved, for instance, using a larger sample size, using a control group and matching participants would all strengthen this study and lead to being able to generalise outcomes to a wider and more diverse group with ABI which would make it more ecologically valid. The matching of participants could include grouping the different type of neurological disorders, e.g. putting those with MS in one group and the same for stroke, PD and TBI.

Finally, the current study did not have a control group. This was not possible in this study due to the size of the service being small and resources limited. This makes it difficult to determine how effective MBI was on attention impairment and psychological wellbeing in light of confounding variables. Having a control group would help bridge this gap in knowledge. Furthermore, in order to see how people have managed since attending the group, a follow-up would be beneficial to determine if MBI provides a short-term effect or a long-term effect. Being able to evaluate mindfulness meditation practices over time would provide a richer understanding of meditation as attention training (Semple, 2010), particularly with clients with ABI. This could have an impact on the future funding of services and on service planning. Future consideration may also be given to researching qualitative data on this subject, exploring individuals' processes and better understanding the impact of intervention on attention deficits, neurological condition and the benefits of and limitations of MBI treatment.

4.7 Conclusion

Mindfulness-based interventions have been widely used to help alleviate physical and psychological distress in recent years. The number of studies available stating the benefits of mindfulness is now considerably vast. Given the perceived benefits of MBI, it was noticeable that few studies were available on the effects of MBI for individuals with impaired attention due to a neurological disorder. This led to the current study, which aimed to investigate and gain clarity on whether the benefits of MBI can be applied to sufferers of ABI, specifically in relation to some of the most common complaints that arise as a consequence of ABI, around attention difficulties and psychological distress. The outcome of the study revealed that participants' self-

reported attention and psychological wellbeing improved as a result of having completed a brief MBI treatment.

This study is not without its limitations; 1) It had a small sample size, and 2) It did not have a control group. However, despite its limitations, this study is one of very few to investigate the potential benefits and impact on attention related difficulties after MBI on individuals with neurological disorders. Its outcome, particularly on the self-report measures, is promising. As improved attentional skills can be of great benefit to a person's life functioning and general wellbeing, which are often impeded by neurological conditions, this is an important area of research with great clinical relevance. Given the benefits, even though it was small, the hope is that this study will serve to encourage future research into interventions that will help alleviate the specific problems which are faced by people with neurological disorders and continue to help fine tune which evidence based treatments are available.

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6. Appendices

6.1 Appendix 1: Outline of the Mindfulness-Based Intervention Sessions

Slide 1:

Mindfulness Meditation
Session 1

- Introductions
- Who we are
- This group will focus on teaching you mindfulness meditation
- My personal experience of meditation

Slide 2:

Rules of the group

Confidentiality
Respect what people say
One at a time
You are welcome to record the meditation
Fire drills

Slide 3:

Your introductions

Slide 4:

Dates of the group
Times: approximately an hour

Slide 5:

Handouts

- How to meditate guideline
- Meditation diary
- Articles on mindfulness meditation and Jon Kabat Zinn

Slide 6:

What do you know about meditation?

Slide 7:

Mindfulness meditation

- A meditation that encourages you to be in the moment
- Based in Buddhism, but not necessarily subscribe to Buddhism to meditate
- Now part of CBT, third wave

Slide 8:

Meditation is fundamentally an experiential process and so we will meditate rather than talk about it

Slide 9:

I will guide you through the process
I will also meditate

Slide 10:

Meditation 1

Slide 11:

Feedback

Slide 12:

Meditation 2

And

Feedback 2

Slide 1:

Mindfulness Meditation
Session 2

Quick Introductions

Slide 2:

Feedback from mindfulness diary

Slide 3:

Mindfulness Practice

Slide 4:

Feedback from mindfulness practice

Slide 5:
Applying mindfulness to everyday living

The aim is to apply mindfulness meditation in everyday life in relation to difficult experiences eg Pain, Anxious & Depressed thoughts.
In the same way that you let go of distracting thoughts/pain in meditation when you notice that you are caught up in negative thoughts in day- to- day life you try and let go of them.
They may well come back but once again you let go of them.
The idea is to let go of them and so you don't get caught up in them as much as you presently do.

Slide 6:

Goals over the next week

Week 2-3 continue with your mindfulness meditation practice
Also try and apply mindfulness thinking in your day-to-day life (see meditation diary)
Any questions
See you next week

Slide 1:

Mindfulness Meditation
Session 3

Quick Introductions

Slide 2:

Feedback from mindfulness diary

Slide 3:

Mindfulness Practice

Slide 4:

Feedback from mindfulness practice

Slide 5:

<u>Applying mindfulness to everyday living</u>

The aim is to apply mindfulness meditation in everyday life in relation to difficult experiences. Principle of avoidance or being fearful of an experience. We avoid situations which make us anxious or we get caught up in a negative spiral of thoughts. Apply the mindfulness approach of noticing but letting go of unpleasant thoughts/feelings. You are not avoiding and it can also lessen fear response.

Negative thoughts/feelings may well come back but once again you let go of them. The idea is to let go of them and so you don't get caught up in them as much as you presently do.

Slide 6:

Goals over the next two weeks

Week 4-5 continue with your mindfulness meditation practice
In week 4-5 also try and apply mindfulness thinking in your day-to-day life (see meditation diary)
Any questions

Slide 1:

Mindfulness Meditation
Session 4

Quick Introductions

Slide 2:

Feedback from mindfulness diary

Slide 3:

Mindfulness Practice
Feedback from mindfulness practice

Slide 4:
Learning to take care of yourself
Do you ruminate e.g. feeling anxious/sad/depressed or do you avoid feelings/thoughts/situations.
Through the mindfulness practice you are able to notice but let go of ruminations.
Or you can learn to face thoughts/feelings/sensations which you would normally avoid.

Slide 5:
Learning to take care of yourself cont..

The idea is to meditate but also apply this way of thinking in your day to day life.
By doing this you will be able to take more care of yourself.
You cannot always change events themselves but you can change your response to them.

Slide 6:

Future Goals

- Continue with your mindfulness meditation practice
- Continue to apply mindfulness thinking in your day-to-day life
- Any questions

6.2 Appendix 2: How to meditate guidelines

How to meditate

Sit in a comfortable position

Relax your body and notice if there is any tension in your body

Gently breathe and try and relax that part of your body

Bring your attention to your breath

Focus on following your in- breaths and out- breaths

As soon as you have become aware that you have moved away from your breath note what has distracted you and bring your attention back to your breath

Try and keep your attention on your breath

Do this for 10/15/20 minutes

At the end of the meditation think about whether you have distractible or not

Slowly open your eyes

6.3 Appendix 3: Mindfulness Diary Sample

Meditation Diary

Week 1-2

Name:

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Y/N							
Distraction level out of 10 1=very few distractions 10= lots of distractions							

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Y/N							
Distraction level out of 10 1=very few distractions 10= lots of distractions							

Week 2-3

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Y/N							
Distraction level out							

of 10 1=very few distractions 10= lots of distractions							
Reminder to apply mindfulness thinking in your everyday living	Y N	Y N	Y N	Y N	Y N	Y N	Y N

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Y/N							
Distraction level out of 10 1=very few distractions 10= lots of distractions							
Reminder to apply mindfulness thinking in your everyday living	Y N	Y N	Y N	Y N	Y N	Y N	Y N

Meditation Diary
Name:

Week 3-4

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Y/N							
Distraction level out of 10 1=very few distractions 10= lots of distractions							
Reminder to apply mindfulness thinking in your everyday living	Y N	Y N	Y N	Y N	Y N	Y N	Y N

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Y/N							
Distraction level out of 10 1=very few distractions 10= lots of distractions							
Reminder to apply mindfulness thinking in your everyday	Y N	Y N	Y N	Y N	Y N	Y N	Y N

living							

Meditation Diary

Name:
Week 4-5

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Y/N							
Distraction level out of 10 1=very few distractions 10= lots of distractions							
Reminder to apply mindfulness thinking in your everyday living	Y N	Y N	Y N	Y N	Y N	Y N	Y N

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Y/N							
Distraction level out of 10 1=very few distractions 10= lots of distractions							
Reminder to apply mindfulness thinking in	Y N	Y N	Y N	Y N	Y N	Y N	Y N

your everyday living							

6.4 Appendix 4: The MAAS Questionnaire

Day-to-Day Experiences

Instructions: Below is a collection of statements about your everyday experience. Using the 1-6 scale below, please indicate how frequently or infrequently you currently have each experience. Please answer according to what *really reflects* your experience rather than what you think your experience should be. Please treat each item separately from every other item.

1	2	3	4	5	6
Almost Always	Very Frequently	Somewhat Frequently	Somewhat Infrequently	Very Infrequently	Almost Never

I could be experiencing some emotion and not be conscious of it until some time later.	1	2	3	4	5	6
I break or spill things because of carelessness, not paying attention, or thinking of something else.	1	2	3	4	5	6
I find it difficult to stay focused on what's happening in the present.	1	2	3	4	5	6
I tend to walk quickly to get where I'm going without paying attention to what I experience along the way.	1	2	3	4	5	6
I tend not to notice feelings of physical tension or discomfort until they really grab my attention.	1	2	3	4	5	6
I forget a person's name almost as soon as I've been told it for the first time.	1	2	3	4	5	6
It seems I am "running on automatic," without much awareness of what I'm doing.	1	2	3	4	5	6
I rush through activities without being really attentive to them.	1	2	3	4	5	6
I get so focused on the goal I want to achieve that I lose touch with what I'm doing right now to get there.	1	2	3	4	5	6
I do jobs or tasks automatically, without being aware of what I'm doing.	1	2	3	4	5	6
I find myself listening to someone with one ear, doing something else at the same time.	1	2	3	4	5	6

1

1 Almost Always	2 Very Frequently	3 Somewhat Frequently	4 Somewhat Infrequently	5 Very Infrequently	6 Almost Never

I drive places on 'automatic pilot' and then wonder why I went there.	1	2	3	4	5	6
I find myself preoccupied with the future or the past.	1	2	3	4	5	6
I find myself doing things without paying attention.	1	2	3	4	5	6
I snack without being aware that I'm eating.	1	2	3	4	5	6

6.5 Appendix 5: Attention Process Training-II Attention Questionnaire

APT –II

ATTENTION QUESTIONNAIRE

Client Name_____ Date_____

I. **RATING SCALE*:** Please answer the following questions about your attention as it applies to daily functioning by ticking the box which offers the best description.

DESCRIPTION	Not a problem or no change from before	Only gets in the way on occasion (less than once a week)	Sometimes gets in the way (about 1-3 times per week)	Frequently gets in the way (is a problem most days)	Is a problem all the time (affects most activities)
1. Seem to lack mental energy to do activities					
2. Am slow to respond when asked a question or when participating in conversations					
3. Can't keep mind on activity or thought because mind keeps wandering					
4. Can't keep mind on activity or thought because mind feels "spacey" or "blank"					
5. Can only concentrate for very short periods of time					
6. Miss details or make mistakes because level of concentration decreased					
7. Easily get off track if other people milling about nearby					
8. Easily distracted by surrounding noise					
9. Trouble paying attention to conversation, if more than one other person					
10. Easily lose place if task or thinking interrupted					
11. Easily overwhelmed if task has several components					
12. Difficult to pay attention to more than one thing at a time					

Scoring:

a. Total number of items ticked in second column multiplied by (1)_____

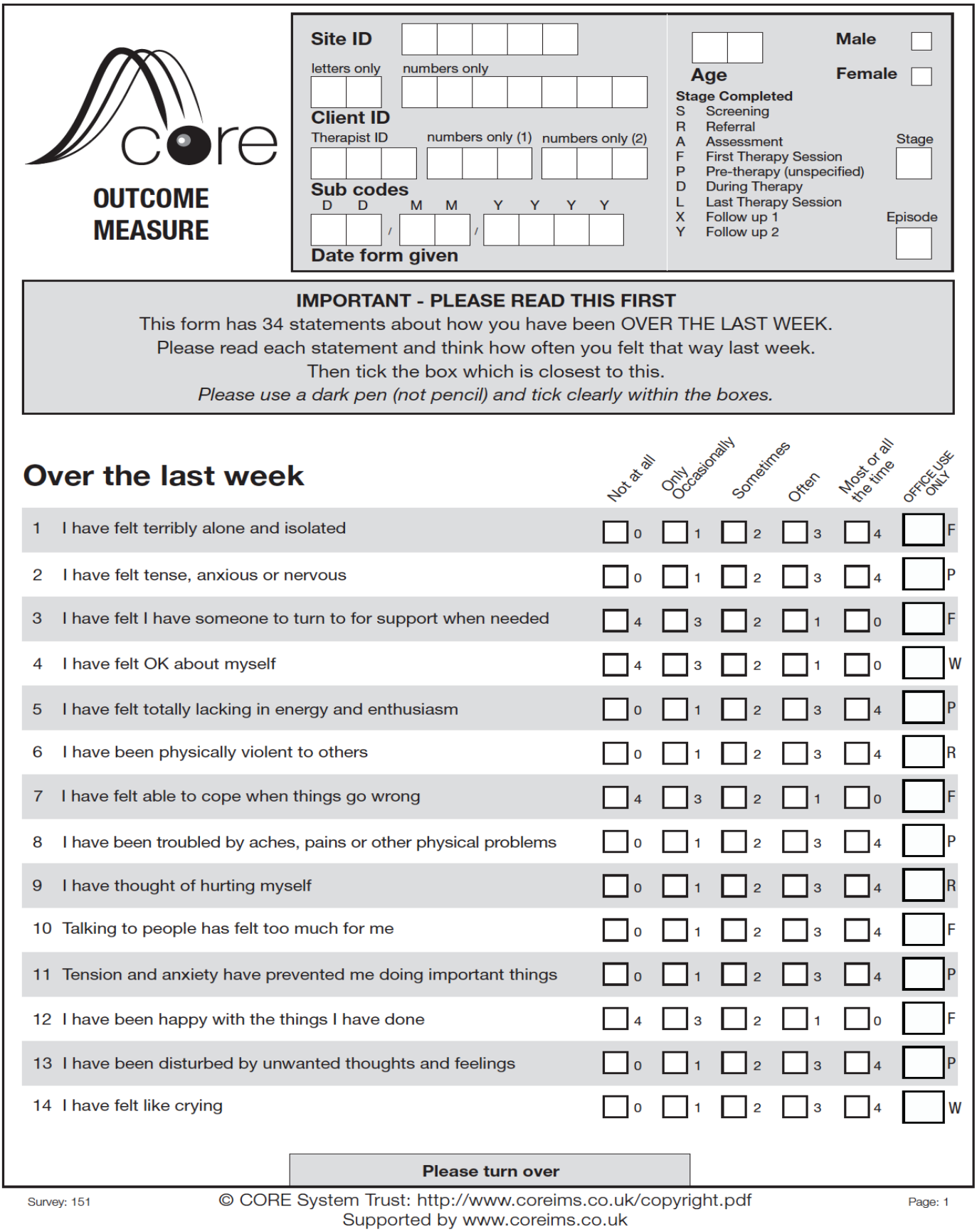
b. Total number of items ticked in third column multiplied by (2)_____

c. Total number of items ticked in fourth column multiplied by (3)_____

d. Total number of items ticked in fifth column multiplied by (4)_____

Total Score: add a. through to d._____

6.6 Appendix 6: The CORE-OM Questionnaire



core

OUTCOME MEASURE

Site ID

letters only

numbers only

Client ID

Therapist ID

numbers only (1)

numbers only (2)

Sub codes

D D / M M / Y Y Y Y

Date form given

Age

Male

Female

Stage Completed

S Screening
R Referral
A Assessment
F First Therapy Session
P Pre-therapy (unspecified)
D During Therapy
L Last Therapy Session
X Follow up 1
Y Follow up 2

Stage

Episode

IMPORTANT - PLEASE READ THIS FIRST

This form has 34 statements about how you have been OVER THE LAST WEEK.
Please read each statement and think how often you felt that way last week.
Then tick the box which is closest to this.
Please use a dark pen (not pencil) and tick clearly within the boxes.

Over the last week

		Not at all	Only Occasionally	Sometimes	Often	Most or all the time	OFFICE USE ONLY
1	I have felt terribly alone and isolated	0	1	2	3	4	F
2	I have felt tense, anxious or nervous	0	1	2	3	4	P
3	I have felt I have someone to turn to for support when needed	4	3	2	1	0	F
4	I have felt OK about myself	4	3	2	1	0	W
5	I have felt totally lacking in energy and enthusiasm	0	1	2	3	4	P
6	I have been physically violent to others	0	1	2	3	4	R
7	I have felt able to cope when things go wrong	4	3	2	1	0	F
8	I have been troubled by aches, pains or other physical problems	0	1	2	3	4	P
9	I have thought of hurting myself	0	1	2	3	4	R
10	Talking to people has felt too much for me	0	1	2	3	4	F
11	Tension and anxiety have prevented me doing important things	0	1	2	3	4	P
12	I have been happy with the things I have done	4	3	2	1	0	F
13	I have been disturbed by unwanted thoughts and feelings	0	1	2	3	4	P
14	I have felt like crying	0	1	2	3	4	W

Please turn over

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Page: 1

Over the last week

	Not at all	Only Occasionally	Sometimes	Often	Most or all the time	OFFICE USE ONLY
15 I have felt panic or terror	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ P
16 I made plans to end my life	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ R
17 I have felt overwhelmed by my problems	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ W
18 I have had difficulty getting to sleep or staying asleep	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ P
19 I have felt warmth or affection for someone	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0	☐ F
20 My problems have been impossible to put to one side	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ P
21 I have been able to do most things I needed to	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0	☐ F
22 I have threatened or intimidated another person	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ R
23 I have felt despairing or hopeless	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ P
24 I have thought it would be better if I were dead	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ R
25 I have felt criticised by other people	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ F
26 I have thought I have no friends	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ F
27 I have felt unhappy	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ P
28 Unwanted images or memories have been distressing me	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ P
29 I have been irritable when with other people	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ F
30 I have thought I am to blame for my problems and difficulties	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ P
31 I have felt optimistic about my future	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0	☐ W
32 I have achieved the things I wanted to	☐ 4	☐ 3	☐ 2	☐ 1	☐ 0	☐ F
33 I have felt humiliated or shamed by other people	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ F
34 I have hurt myself physically or taken dangerous risks with my health	☐ 0	☐ 1	☐ 2	☐ 3	☐ 4	☐ R

THANK YOU FOR YOUR TIME IN COMPLETING THIS QUESTIONNAIRE

	(W)	(P)	(F)	(R)	All items	All minus R
Total Scores	☐	☐	☐	☐	☐	☐
Mean Scores (Total score for each dimension divided by number of items completed in that dimension)	☐	☐	☐	☐	☐	☐

Survey: 151

6.7 Appendix 7: An example of the CPT-3 Progress Report

CONNERS CPT3™

Continuous Performance Test 3rd Edition™

C. Keith Conners, Ph.D.

Progress Report

Name/ID: 01
Gender: Male
Birth Date:
Normative Option: Gender Specific norms

	Admin 1	Admin 2
Name/ID:	01	01
Administration Date:	December 9, 2014	February 24, 2015
Age:	74 years	74 years
Input Device:	Keyboard	Keyboard
Assessor's Name:	Judy Emenalo-Strange	Judy Emenalo-Strange
Medication/Notes:		

This Progress Report is intended for use by qualified assessors only, and is not to be shown or presented to the respondent or any other unqualified individuals or used as the sole basis for clinical diagnosis or intervention. Administrators are cautioned against drawing unsupported interpretations. To obtain a comprehensive view of the individual, information from this report should be combined with information gathered from other psychometric measures, interviews, observations, and available records. This report is based on an algorithm that produces the most common interpretations of the obtained scores. Additional interpretive information is found in the *Conners CPT 3 Manual* (published by MHS).

P.O. Box 950, North Tonawanda, NY 14120-0950
3770 Victoria Park Ave., Toronto, ON M2H 3M6

Introduction

MHS

The Conners Continuous Performance Test 3rd Edition (Conners CPT 3™) assesses attention-related problems in individuals aged 8 years and older. During the 14-minute, 360-trial administration, respondents are required to respond when any letter appears, except the non-target letter "X." By indexing the respondent's performance in areas of inattentiveness, impulsivity, sustained attention, and vigilance, the Conners CPT 3 can be a useful adjunct to the process of diagnosing Attention-Deficit/Hyperactivity Disorder (ADHD), as well as other psychological and neurological conditions related to attention. This report combines the results of up to four administrations to help the user interpret important changes that have occurred over time. Please note that this Progress Report is intended to provide an overview of how scores have changed over time. For detailed information about any given administration, please refer to the Conners CPT 3 Assessment Reports.

Validity of Administration

The Conners CPT 3 performs a validity check based on the number of hits and omission errors committed, as well as a self-diagnostic check of the accuracy of the timing of each administration. If there is an insufficient number of hits to compute scores, and/or if the omission error rate exceeds 25%, these issues will be noted. Also, the program will issue a warning message noting that the administration was invalid if a timing issue is detected.

Admin 1 (09/12/2014)	Admin 2 (24/02/2015)
Valid	Valid

There was no indication of any timing difficulties for Admin 1 and Admin 2.

Response Style Analysis

The variable *C* represents an individual's natural response style in tasks that involve a speed-accuracy trade-off. 01's response style, and its influence on other Conners CPT 3 scores, should be taken into consideration throughout the interpretation process for each administration.

	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)
T-score	41	51
Classification	Balanced	Balanced
Interpretation	Balanced response style between speed and accuracy	Balanced response style between speed and accuracy

T-score Guidelines

The guidelines in the following table apply to all T-scores in this report.

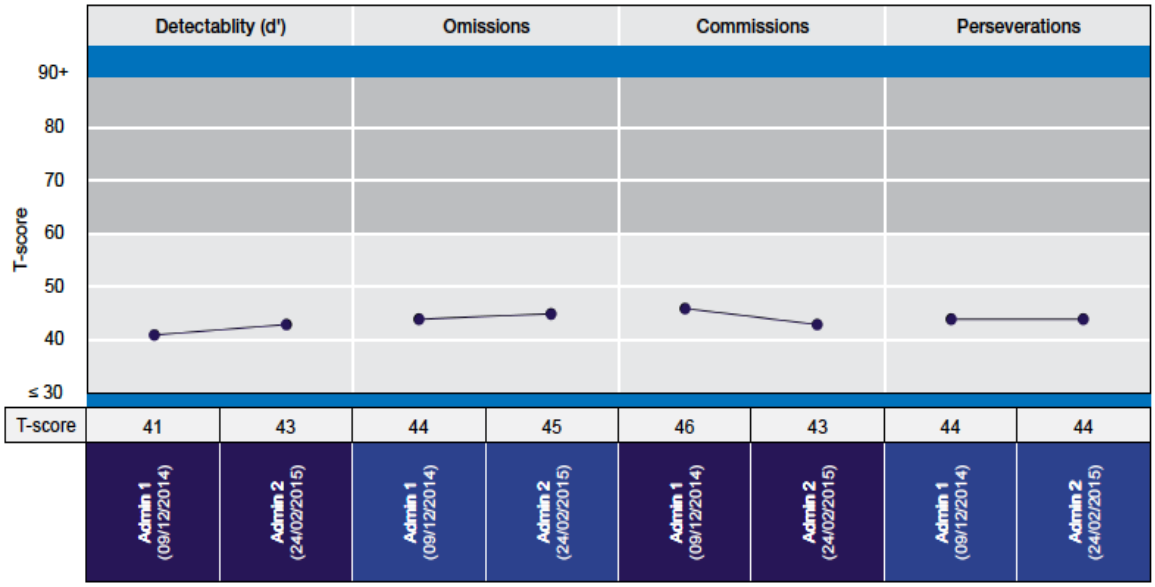
Guidelines			
T-score	For Hit Reaction Time (HRT)	T-score	For all other variables
70+	Atypically Slow	70+	Very Elevated
60-69	Slow	60-69	Elevated
55-59	A Little Slow	55-59	High Average
45-54	Average	45-54	Average
40-44	A Little Fast	< 45	Low
< 40	Atypically Fast		

Overview of Changes in Conners CPT 3 Scores

MHS

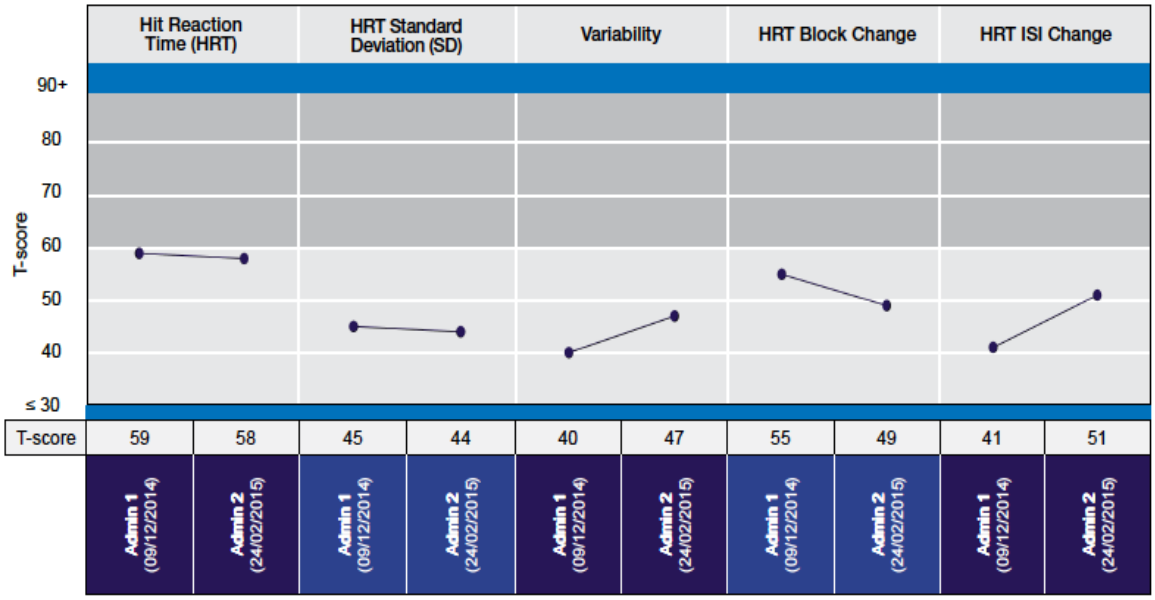
This section provides an overview of 01's Conners CPT 3 scores across administrations.

Measures of Detectability and Errors



	Detectablity (d')		Omissions		Commissions		Perseverations	
T-score	41	43	44	45	46	43	44	44
	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)

Measures Involving Reaction Times



	Hit Reaction Time (HRT)		HRT Standard Deviation (SD)		Variability		HRT Block Change		HRT ISI Change	
T-score	59	58	45	44	40	47	55	49	41	51
	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)

Overview of Changes in Conners CPT 3 Scores

MHS

Overview Summary

The following table summarizes the aspect(s) of attention 01 may have had problems with at each administration.

Area	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)
Inattentiveness Problems	No Indication	No Indication
Impulsivity Problems	No Indication	No Indication
Sustained Attention Problems	No Indication	No Indication
Vigilance Problems	No Indication	No Indication

The following tables summarize 01's Conners CPT 3 scores across administrations. If a statistical difference is noted between a pair of administrations, then the difference reached statistical significance ($p < .10$) and/or was at least 10 T-score points (1 Standard Deviation) apart. Statistical significance is denoted with this symbol (°).
Notes. T = T-score; Guide = Guideline.

Measures of Detectability and Errors

Score	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Statistical Differences in T-scores
			Overall (1 to 2)
Detectability (d'): Ability to differentiate targets from non-targets			
T	41	43	No Change
Guide	Low	Low	
Omissions: Rate of missed targets			
T	44	45	No Change
Guide	Low	Average	
Commissions: Rate of incorrect responses to non-targets			
T	46	43	No Change
Guide	Average	Low	
Perseverations: Rate of random, repetitive,or anticipatory responses			
T	44	44	No Change
Guide	Low	Low	

Overview of Changes in Conners CPT 3 Scores

MHS

The following tables summarize 01's Conners CPT 3 scores across administrations. If a statistical difference is noted between a pair of administrations, then the difference reached statistical significance ($p < .10$) and/or was at least 10 T-score points (1 Standard Deviation) apart. Statistical significance is denoted with this symbol (°).
Notes. T = T-score; Guide = Guideline.

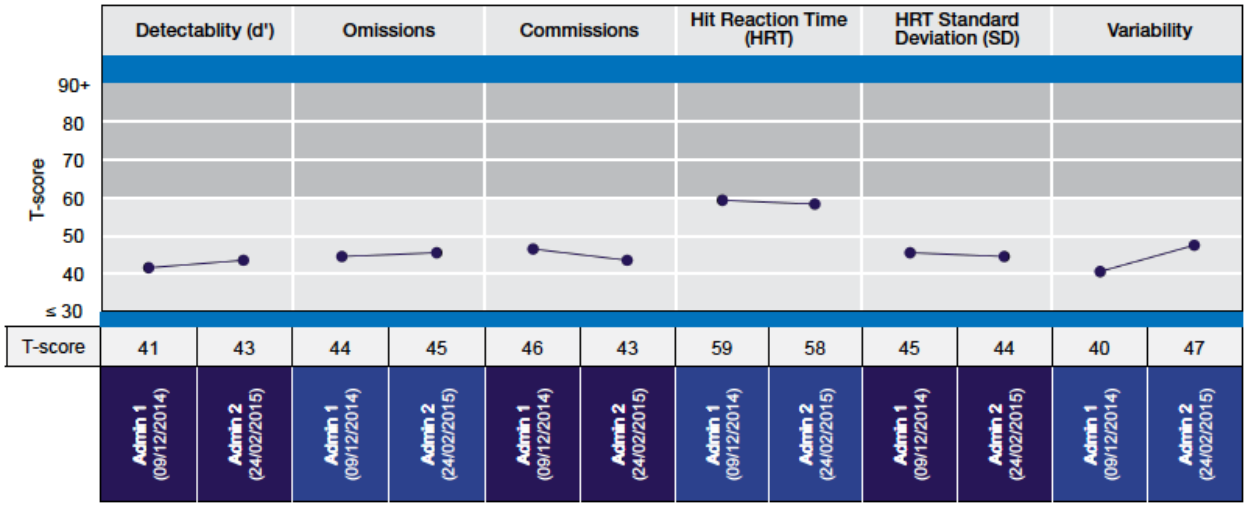
Measures Involving Reaction Times

Score	Admin 1 (09/12/2014)	Admin 2 (24/02/2015)	Statistical Differences in T-scores: Overall (1 to 2)
Hit Reaction Time (HRT): Mean response speed across the administration			
T	59	58	No Change
Guide	A Little Slow	A Little Slow	
HRT Standard Deviation (SD): Reaction times consistency across the administration			
T	45	44	No Change
Guide	Average	Low	
Variability: Variability in reaction times consistency across the administration			
T	40	47	No Change
Guide	Low	Average	
HRT Block Change: Change in average response speed across blocks			
T	55	49	No Change
Guide	High Average	Average	
HRT Inter-Stimulus Interval (ISI) Change: Change in average response speed at various ISIs			
T	41	51	More slowing at longer ISIs
Guide	Low	Average	

Measures of Inattentiveness

MHS

This section summarizes 01's scores on the inattentiveness measures across administrations. If a statistical difference is noted between a pair of administrations, then the difference reached statistical significance ($p < .10$) and/or was at least 10 T-score points (1 Standard Deviation) apart. Statistical significance is denoted with this symbol (°).



Detectability (d') measures the respondent's ability to differentiate non-targets (i.e., the letter X) from targets (i.e., all other letters). Higher T-scores indicate worse performance. The following T-scores were obtained: Admin 1 (T = 41; Low) and Admin 2 (T = 43; Low). Scores did not statistically change across administrations.

Omissions result from a failure to respond to targets. Higher T-scores indicate worse performance. The following T-scores were obtained: Admin 1 (T = 44; Low) and Admin 2 (T = 45; Average). Scores did not statistically change across administrations.

Commissions are made when responses are given to non-targets. Higher T-scores indicate worse performance. The following T-scores were obtained: Admin 1 (T = 46; Average) and Admin 2 (T = 43; Low). Scores did not statistically change across administrations.

HRT is the mean response speed of correct responses for the whole administration. Higher T-scores indicate slower responses. The following T-scores were obtained: Admin 1 (T = 59; A Little Slow) and Admin 2 (T = 58; A Little Slow). Scores did not statistically change across administrations.

HRT SD is a measure of response speed consistency during the entire administration. Higher T-scores indicate less consistency. The following T-scores were obtained: Admin 1 (T = 45; Average) and Admin 2 (T = 44; Low). Scores did not statistically change across administrations.

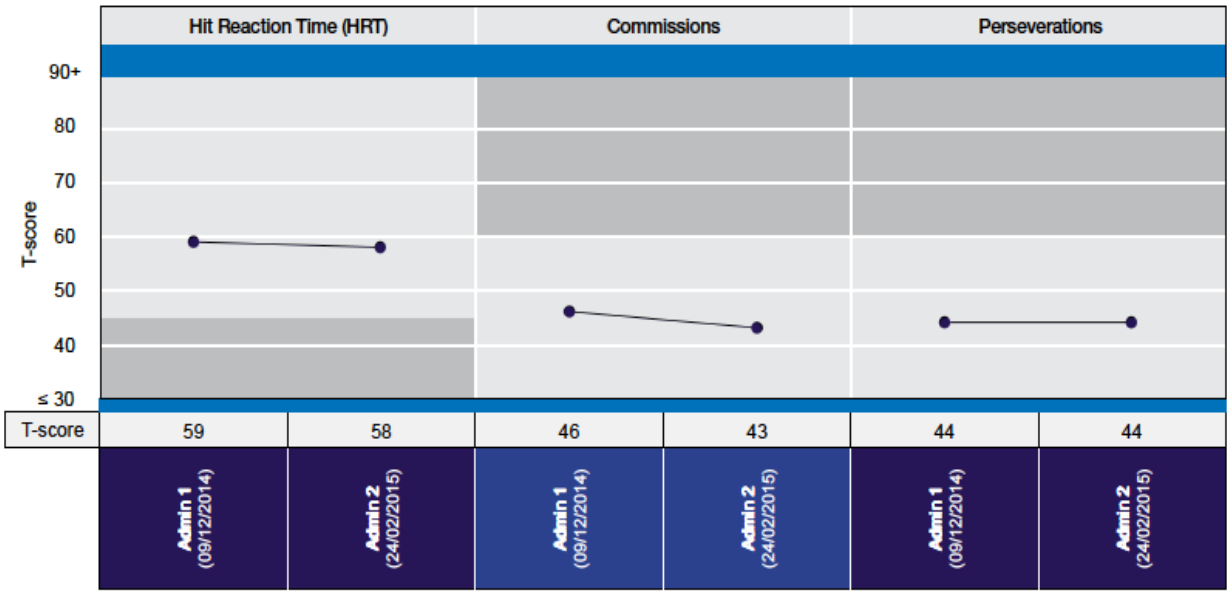
Variability, like HRT SD, is a measure of response speed consistency; however, Variability is a "within respondent" measure; that is, the amount of variability the individual shows in 18 separate segments of the administration in relation to his own overall HRT SD. The following T-scores were obtained: Admin 1 (T = 40; Low) and Admin 2 (T = 47; Average). Scores did not statistically change across administrations.

01's profile of scores did not indicate inattentiveness during Admin 1 and Admin 2.

Measures of Impulsivity

MHS

This section summarizes 01's scores on the impulsivity measures across administrations. If a statistical difference is noted between a pair of administrations, then the difference reached statistical significance ($p < .10$) and/or was at least 10 T-score points (1 Standard Deviation) apart. Statistical significance is denoted with this symbol (°).



HRT is the mean response speed of correct responses for the whole administration. Lower T-scores indicate faster responses. The following T-scores were obtained: Admin 1 (T = 59; A Little Slow) and Admin 2 (T = 58; A Little Slow). Scores did not statistically change across administrations.

Commissions are made when responses are given to non-targets. Higher T-scores indicate worse performance. The following T-scores were obtained: Admin 1 (T = 46; Average) and Admin 2 (T = 43; Low). Scores did not statistically change across administrations.

Perseverations are random or anticipatory responses. Higher T-scores indicate worse performance. The following T-scores were obtained: Admin 1 (T = 44; Low) and Admin 2 (T = 44; Low). Scores did not statistically change across administrations.

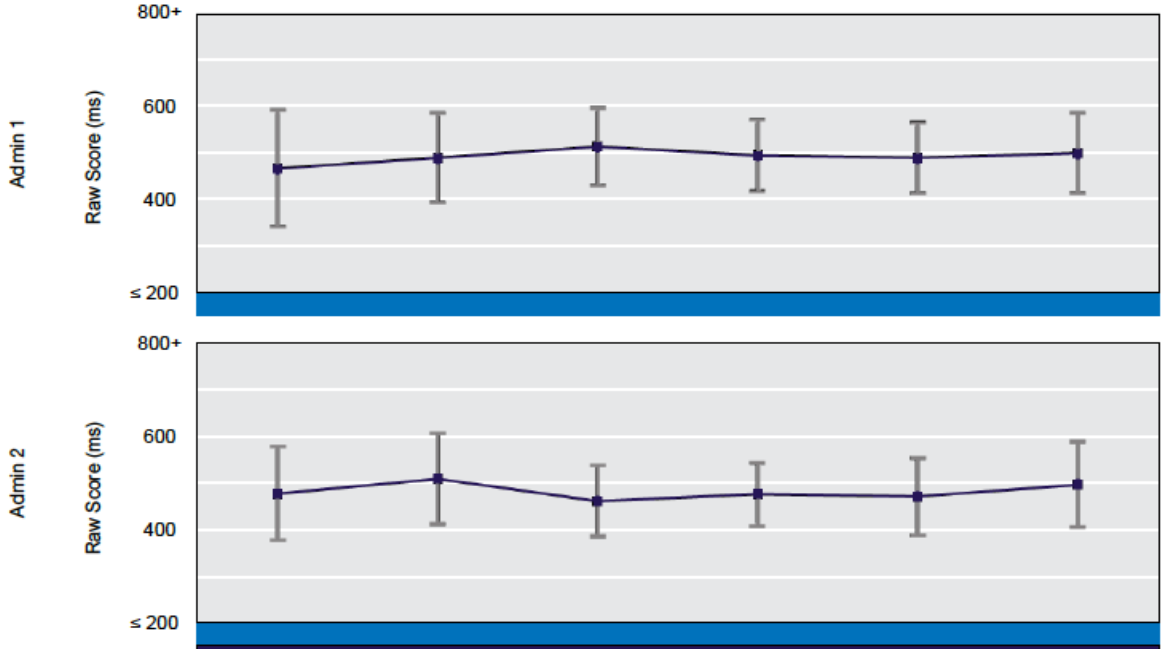
01's profile of scores did not indicate impulsivity during Admin 1 and Admin 2.

Measures of Sustained Attention

MHS

This section summarizes 01's scores on the sustained attention measures across administrations. For Hit Reaction Time (HRT) Block Change, if a statistical difference is noted, then the difference reached statistical significance ($p < .10$) and/or was at least 10 T-score points (1 Standard Deviation) apart. Statistical significance is denoted with this symbol (°).

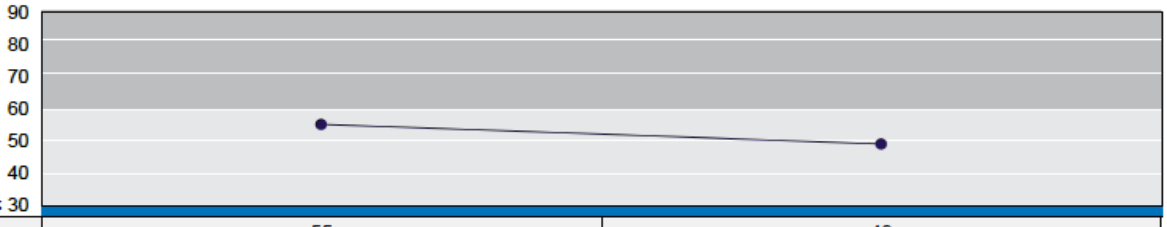
Hit Reaction Time by Block



	HRT (SD)					
	Block 1	Block 2	Block 3	Block 4	Block 5	Block 6
Admin 1 (09/12/2014)	464 (124)	487 (96)	511 (83)	492 (77)	487 (76)	497 (85)
Admin 2 (24/02/2015)	477 (101)	509 (98)	461 (77)	476 (69)	471 (84)	496 (92)

Note. ms = milliseconds; SD = Standard Deviation.

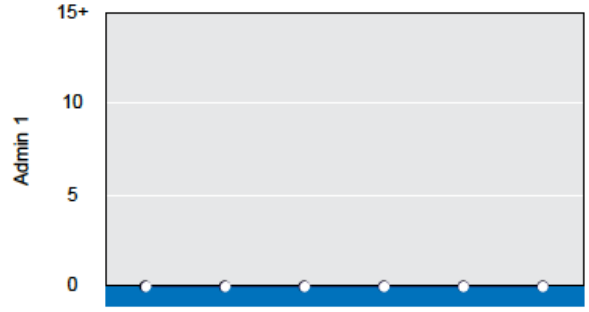
HRT Block Change

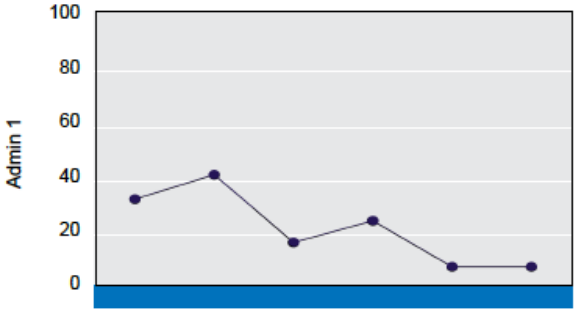


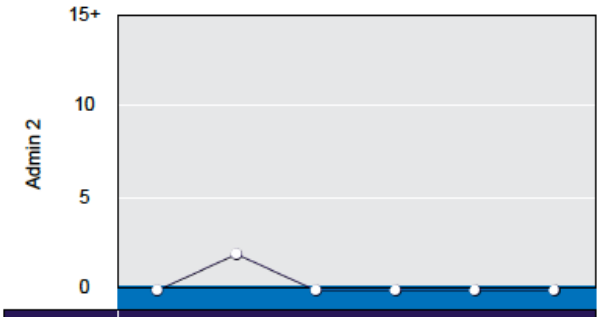
T-score	55	49
	Admin 1 (09/12/2014)	**Admin 2** (24/02/2015)

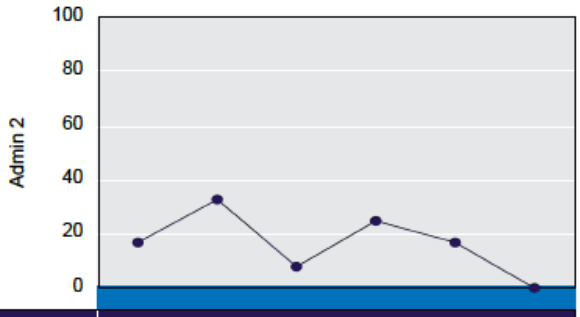
Ver 1.0

Omissions and Commissions by Block









Admin	Omissions (%) By Block					
	1	2	3	4	5	6
1 (09/12/2014)	0	0	0	0	0	0
2 (24/02/2015)	0	2	0	0	0	0

Admin	Commissions (%) By Block					
	1	2	3	4	5	6
1 (09/12/2014)	33	42	17	25	8	8
2 (24/02/2015)	17	33	8	25	17	0

Note. No statistically significant differences were found in error rates between blocks.

HRT Block Change indicates the change in mean response speed across blocks. Higher T-scores indicate more slowing across blocks. The following T-scores were obtained: Admin 1 (T = 55; High Average) and Admin 2 (T = 49; Average). Scores did not statistically change across administrations.

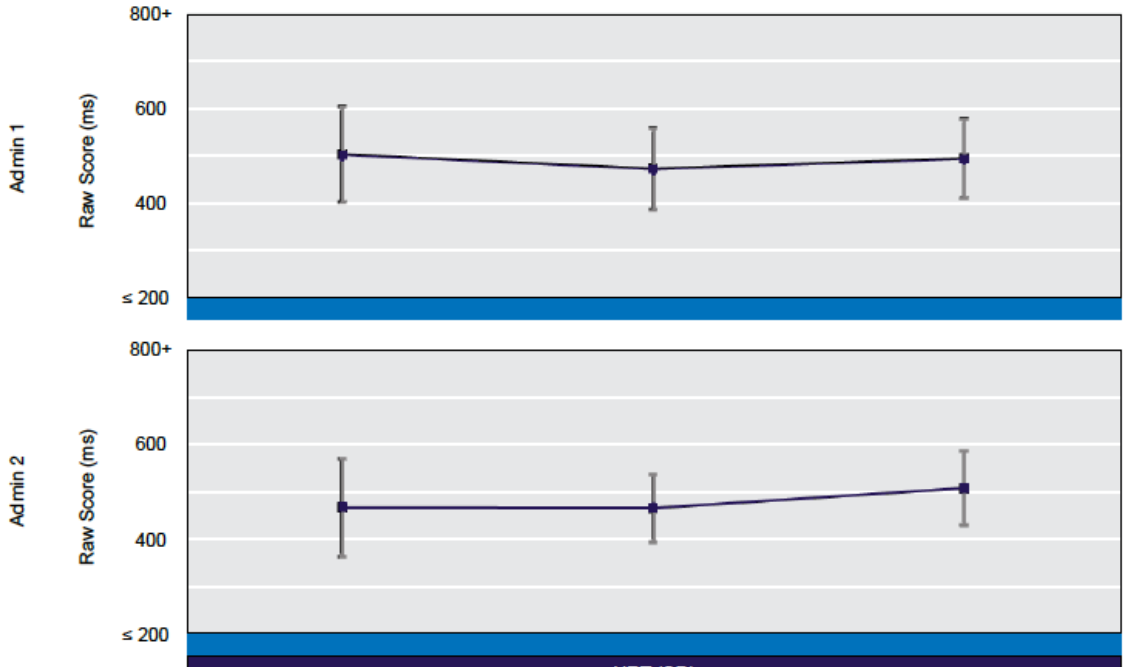
01's profile of scores did not indicate a problem with sustained attention during Admin 1 and Admin 2.

Measures of Vigilance

MHS

This section summarizes 01's scores on the vigilance measures across administrations. For Hit Reaction Time Inter-Stimulus Interval Change (HRT ISI Change), if a statistical difference is noted, then the difference reached statistical significance ($p < .10$) and/or was at least 10 T-score points (1 Standard Deviation) apart. Statistical significance is denoted with this symbol (°).

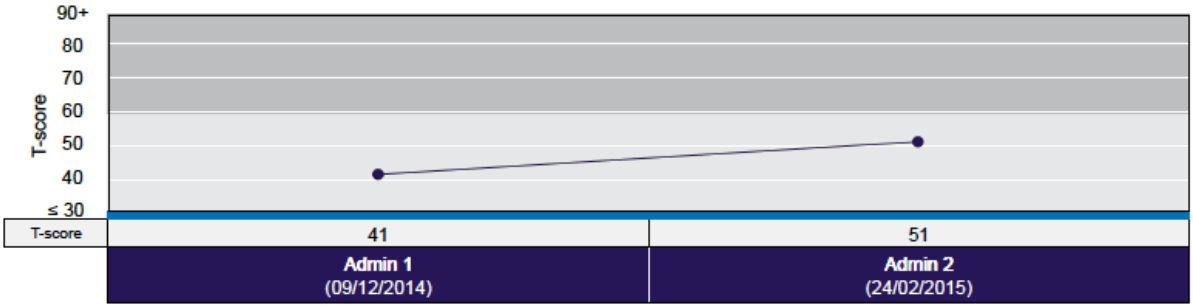
Hit Reaction Time by ISI



	HRT (SD)		
	1-second ISI	2-second ISI	4-second ISI
Admin 1 (09/12/2014)	503 (102)	472 (87)	494 (86)
Admin 2 (24/02/2015)	468 (105)	467 (73)	510 (79)

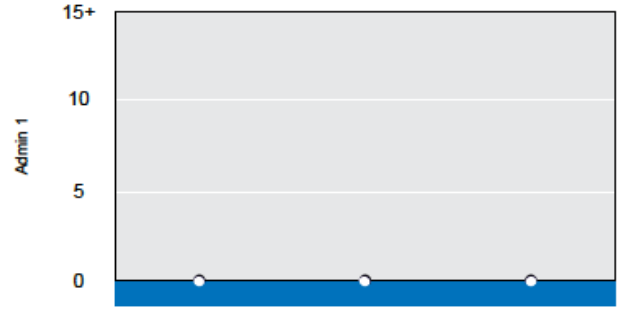
Note. ms = milliseconds; SD = Standard Deviation.

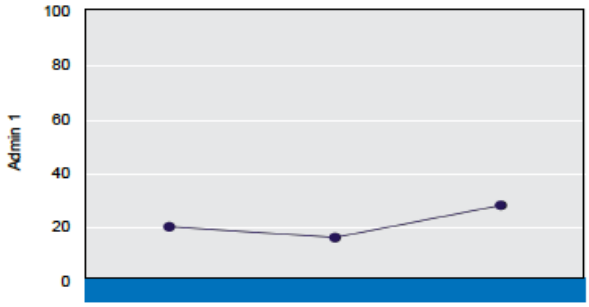
HRT ISI Change

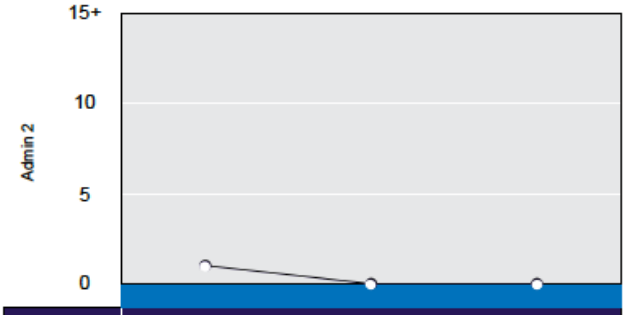


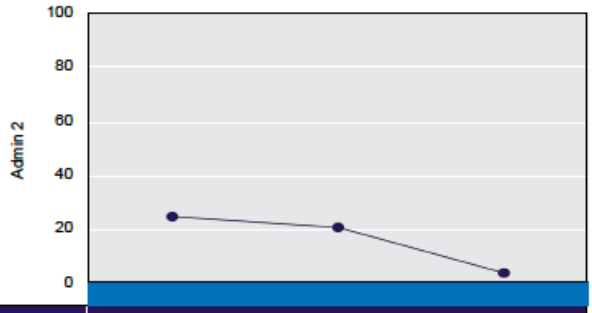
Ver 1.0

Omissions and Commissions by ISI









Admin	Omissions (%) By ISI		
	1-second ISI	2-second ISI	4-second ISI
1 (09/12/2014)	0	0	0
2 (24/02/2015)	1	0	0

Admin	Commissions (%) By ISI		
	1-second ISI	2-second ISI	4-second ISI
1 (09/12/2014)	21	17	29
2 (24/02/2015)	25	21	4

Note. No statistically significant differences were found in error rates between ISIs.

HRT ISI Change reflects change in response speed across ISIs. Higher T-scores indicate more slowing across on trials with longer ISIs. The following T-scores were obtained: Admin 1 (T = 41; Low) and Admin 2 (T = 51; Average). Scores on this variable statistically increased across: Admin 1 to Admin 2.

01's profile of scores did not indicate a problem with maintaining vigilance during Admin 1 and Admin 2.

Response Style

C is a signal detection statistic that measures an individual's natural response style in tasks involving a speed-versus-accuracy trade-off. Based on his or her score on this variable, a respondent can be classified as having one of the following three response styles: a *conservative* style that emphasizes accuracy over speed; a *liberal* style that emphasizes speed over accuracy; or a *balanced* style that is biased neither to speed nor accuracy. Response style can affect scores such as Commissions and Hit Reaction Time (HRT), and should be taken into consideration during interpretation.

Detectability (*d'*)

d-prime (*d'*) is a measure of how well the respondent discriminates non-targets (i.e., the letter X) from targets (i.e., all other letters). This variable is also a signal detection statistic that measures the difference between the signal (targets) and noise (non-targets) distributions. In general, the greater the difference between the signal and noise distributions, the better the ability to distinguish non-targets and targets. On the Conners CPT 3, *d'* is reverse-scored so that higher raw score and *T*-score values indicate worse performance (i.e., poorer discrimination).

Omissions (%)

Omissions are missed targets. High omission error rates indicate that the respondent was not responding to the target stimuli due to a specific reason (e.g., difficulty focusing). Omission errors are generally an indicator of inattentiveness.

Commissions (%)

Commissions are incorrect responses to non-targets. Depending on the respondent's HRT, high commission error rates may indicate either inattentiveness or impulsivity. If high commission error rates are coupled with slow reaction times, then the respondent was likely inattentive to the stimulus type being presented and thus responded to a high rate of non-targets. If high commission error rates are combined with fast reaction times, the respondent was likely rushing to respond and failed to control his or her impulses when responding to the non-targets. In the latter case, high commission error rates would reflect impulsivity rather than inattentiveness.

Perseverations (%)

Perseverations are responses that are made in less than 100 milliseconds following the presentation of a stimulus. Normal expectations of physiological ability to respond make it virtually impossible for a respondent to perceive and react to a stimulus so quickly. Perseverations are usually either slow responses to a preceding stimulus, a random response, an anticipatory response, or a repeated response without consideration of the task requirements. Perseverations may be related to impulsivity or an extremely liberal response style. Perseverations are, therefore, likely the result of anticipatory, repetitive, or impulsive responding.

Hit Reaction Time (HRT)

HRT is the mean response speed, measured in milliseconds, for all non-perseverative responses made during the entire administration. An atypically slow HRT may indicate inattentiveness (especially when error rates are high), but it may also be the results of a very conservative response style. Alternatively, a very fast HRT, when combined with high commission error rates, may indicate impulsivity.

Hit Reaction Time Standard Deviation (HRT SD)

HRT SD measures the consistency of response speed to targets for the entire administration. A high HRT SD indicates greater inconsistency in response speed. Response speed inconsistency is sometimes indicative of inattentiveness, suggesting that the respondent was less engaged and processed stimuli less efficiently during some parts of the administration.

Variability

Variability, like HRT SD, is a measure of response speed consistency; however, Variability is a "within respondent" measure (i.e., the amount of variability the respondent showed in 18 separate sub-blocks of the administration in relation to his or her overall HRT SD score). Although Variability is a different measure than HRT SD, the two measures typically produce comparable results and are both related to inattentiveness. High response speed variability indicates that the respondent's attention and processing efficiency varied throughout the administration.

Hit Reaction Time Block Change (HRT Block Change)

HRT Block Change is the slope of change in HRT across the six blocks of the administration. A positive slope indicates decelerating reaction times as the administration progressed, while a negative slope indicates accelerating reaction times. If reaction times slow down, as indicated by a higher HRT Block Change score, the respondent's information processing efficiency declines, and a loss of sustained attention is indicated.

Omissions by Block

Omissions by Block (raw score only) is the rate of the respondent's missed targets in each of the six blocks. An increase in omission error rate in later blocks indicates a loss of sustained attention.

Commissions by Block

Commissions by Block (raw score only) is the rate of the respondent's incorrect responses to non-targets in each of the six blocks. An increase in commission error rate in later blocks indicates a loss of sustained attention.

Hit Reaction Time Inter-Stimulus Intervals Change (HRT ISI Change)

HRT ISI Change is the slope of change in reaction time across the three ISIs (1, 2, and 4 seconds). A positive slope indicates decelerating HRT at longer intervals; whereas, a negative slope indicates accelerating HRT at longer intervals. A higher HRT ISI Change score means that the respondent's information processing efficiency declined with longer pauses between stimuli, and a loss of vigilance is indicated. A significant change in response speed at the different ISIs may indicate that the respondent was having trouble adjusting to changing task demands. Sometimes, this finding relates to activation/arousal needs; some respondents may be more efficient in a busier/more stimulating environment (e.g., during the 1-second ISI) than in a less active environment where the stimuli are presented less frequently (e.g., during the 4-second ISI), or vice-versa.

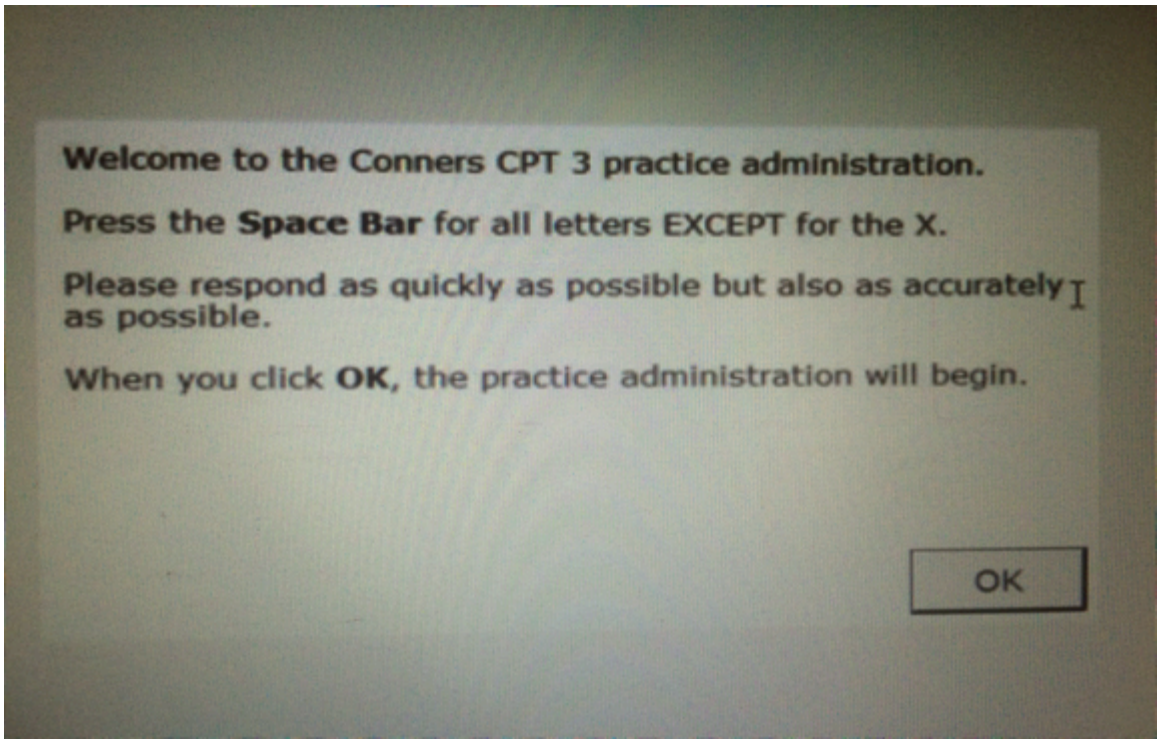
Omissions by ISI

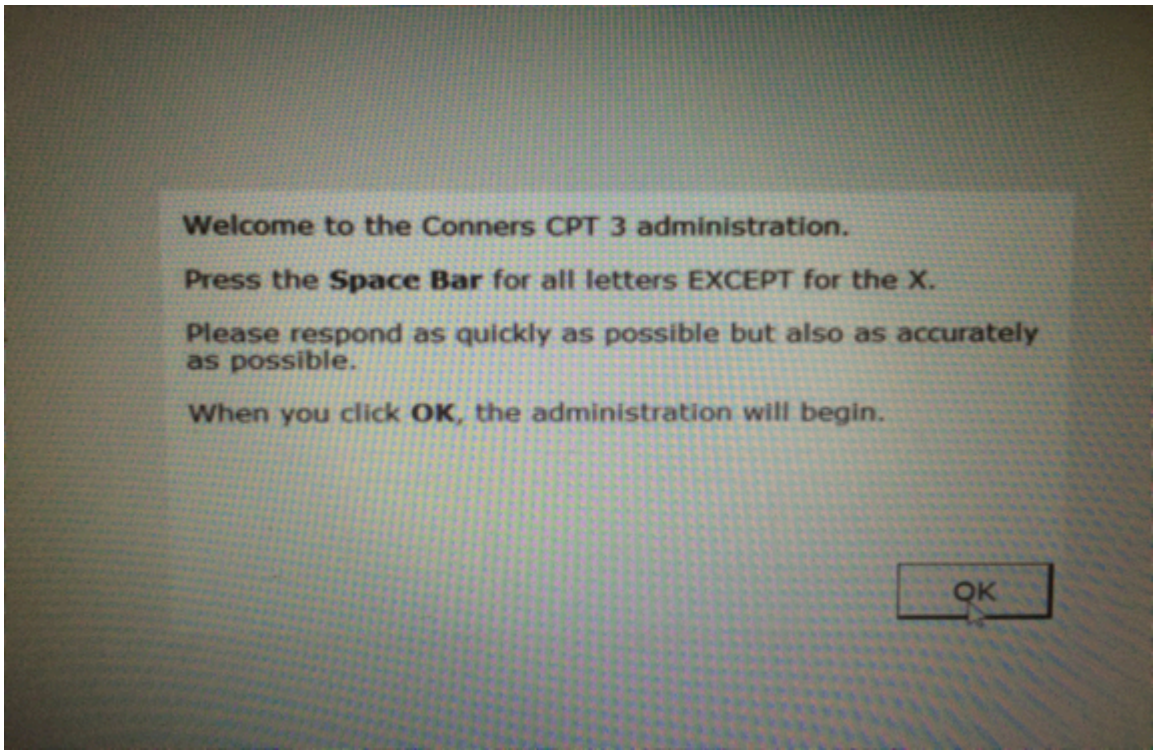
Omissions by ISI (raw score only) is the rate of missed targets in each of the three ISI trial types. An increase in omission error rate on trials with longer ISIs indicates a loss of vigilance.

Commissions by ISI

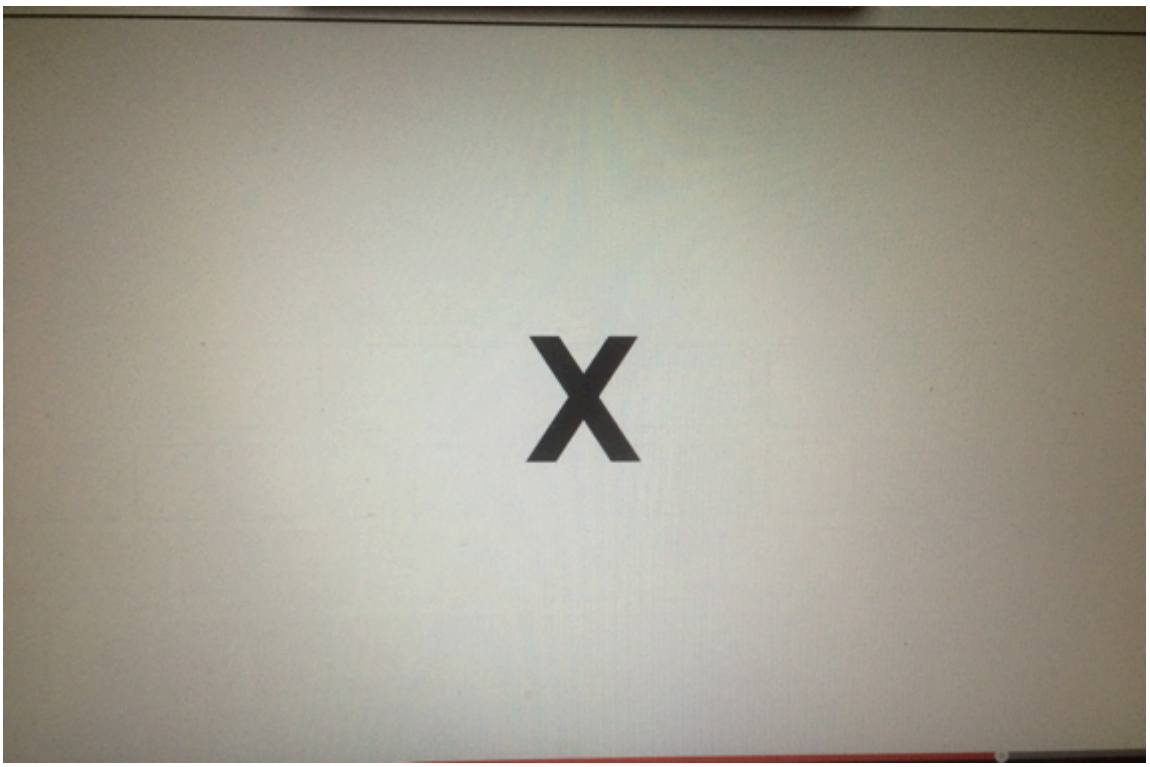
Commissions by ISI (raw score only) is the rate of incorrect responses to non-targets in each of the three ISI trial types. An increase in commission error rates on trials with longer ISI indicates a loss of vigilance.

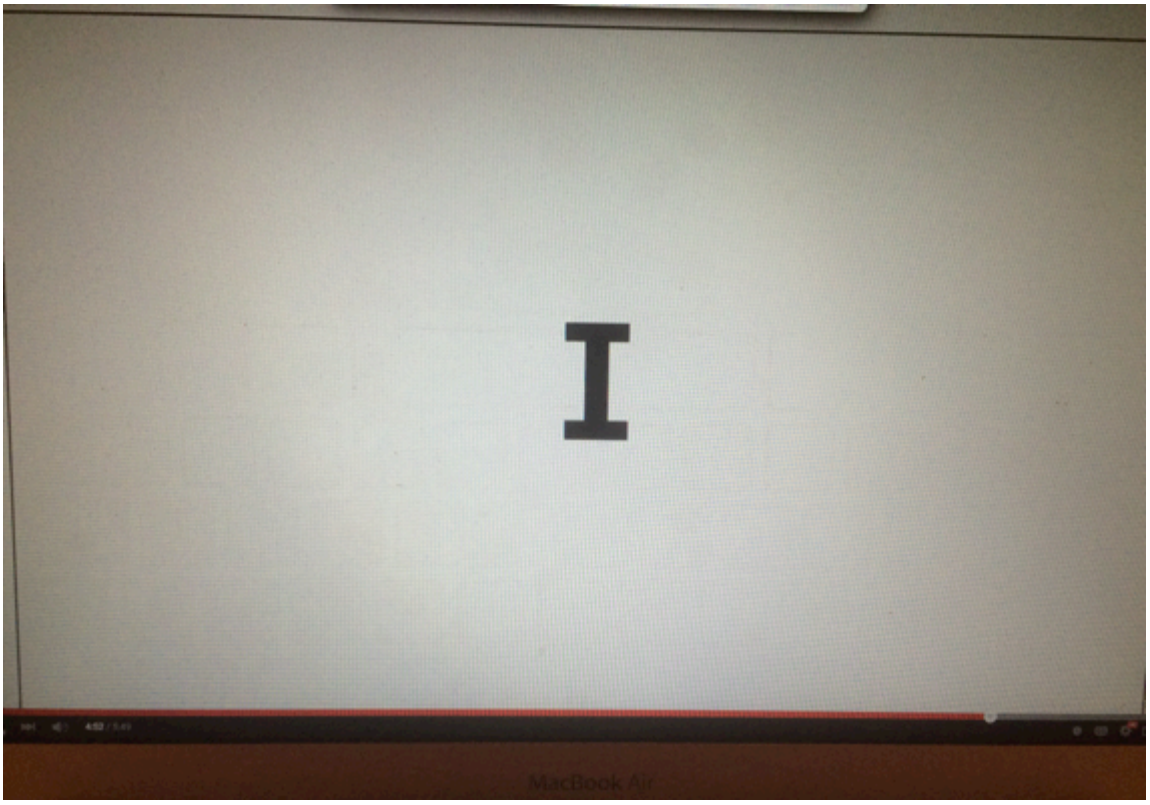
6.8 Appendix 8: A screen shot of CPT-3 instruction for participants before starting the test.





6.9 Appendix 9: A screen shot of the letters appearing on the screen





6.10 Appendix 10: A description of the variables in the CPT-3

Table 4.3. Understanding *T*-scores on the Conners CPT 3: All Other Variables

T-score	Classification	Interpretation Guideline
70+	Very Elevated	Poor Performance
60–69	Elevated	Below Average Performance
55–59	High Average	Slightly Below Average Performance
45–54	Average	Average Performance
< 45	Low	Good Performance

Note that even though the classification labels are useful for summarizing results in a general sense, the score cut-offs that define the various categories are only conventional guidelines and should not be used as absolute rules. For example, there is no reason to believe that a *T*-score of 69 is perceptibly different from a *T*-score of 70. In fact, scores that border two categories warrant special consideration. It may be more informative to report a *T*-score of 69 as falling between Elevated and Very Elevated ranges, rather than unequivocally placing it in the Elevated range.

Percentile Ranks

Most Conners CPT 3 scores can also be expressed as percentile ranks. A percentile rank reflects the percentage of individuals in the normative group who scored the same as, or lower than, the respondent. For example, a score in the "90th percentile" indicates that 90% of individuals in the normative sample had either the same raw score, or lower. A higher percentile rank generally means that the respondent performed less well relative to his or her peer group. Percentiles are computed using the actual frequency counts in the normative sample (i.e., empirical percentiles). Similar to *T*-scores, percentiles compare a respondent's scores to those obtained by others in the same age and gender groups. Use of either metric is acceptable. Empirical percentiles are available as one of the scoring options for the reports.

Confidence Intervals

All measurements contain some error. Chapter 6, *Standardization and Psychometric Properties of the Conners CPT 3* (see *Standard Error of Measurement*), provides information on the measurement errors associated with the Conners CPT 3 scores. The effects of measurement error are taken into account by using confidence intervals during score interpretation. Confidence intervals take measurement error into account by providing, at a specific level of probability (e.g., 90%), a range of scores within which the true score is expected to fall. The 90% confidence intervals were computed for all standardized scores (see appendix B *Computing Confidence Intervals for the Conners CPT 3*).

For example, if an 8-year-old boy has a *T*-score of 60 on the HRT Block Change score, it is appropriate to state that there is a high degree of confidence (as reflected by the 90% confidence interval) that the true HRT Block Change score falls within the range of 55 and 65. The confidence interval for every *T*-score is available as a scoring option for both the Assessment and Progress Reports.

Conners CPT 3 Scores

The following scores help assess response style and four different dimensions of attention: Inattentiveness, Impulsivity, Sustained Attention, and Vigilance.

- ***C*** is a signal detection statistic that measures an individual's natural response style[1] in tasks involving a speed-versus-accuracy trade-off (Ingham, 1970). Based on his or her score on this variable, a respondent can be classified as having one of the following three response styles: a *conservative* style that emphasizes accuracy over speed; a *liberal* style that emphasizes speed over accuracy; or a *balanced* style that is biased neither to speed nor accuracy. Response style can affect scores such as Commissions and HRT, and should be taken into consideration during interpretation. The Assessment Report includes automatic prompts to consider the respondent's response style in relevant parts of the interpretation process.

- **d-prime *(d')*** is a measure of detectability; that is, it measures how well the respondent discriminates non-targets (i.e., the letter *X*) from targets (i.e., all other letters). This variable is also a signal detection statistic that measures the difference between the signal (targets) and noise (non-targets) distributions (Swets, 1964). In general, the greater the difference between the signal and noise distributions, the better the ability to distinguish non-targets and targets. On the Conners CPT 3, this variable is reverse-scored so that higher raw score and *T*-score values indicate worse performance (i.e., poorer discrimination/detectability).

- **Omissions** are missed targets. High omission error rates indicate that the respondent was not responding to the target stimuli due to a specific reason (e.g., difficulty focusing). Omission errors are generally an indicator of inattentiveness.

1 On previous editions of the Conners' CPT, a different statistic, cut-off β (Beta), was used to measure response style. For more details regarding this scoring change, see *chapter 5, Development of the Conners CPT 3*.

- **Commissions** are incorrect responses to non-targets. Depending on the respondent's HRT, high commission error rates may indicate either inattentiveness or impulsivity. If high commission error rates are coupled with slow reaction times, then the respondent was likely inattentive to the stimulus type being presented and thus responded to a high rate of non-targets. If high commission error rates are combined with fast reaction times, the respondent was likely rushing to respond, and failed to control his or her impulses to respond to the non-targets. In this case, high commission error rates would reflect impulsivity rather than inattentiveness.

- **Perseverations** are responses that are made in less than 100 milliseconds following the presentation of a stimulus. Normal expectations of physiological ability to respond make it virtually impossible for a respondent to perceive and react to a stimulus so quickly. Perseverations are usually either slow responses to a preceding stimulus, a random response, an anticipatory response, or a repeated response without consideration of the task requirements. In other words, a perseverative response is unlikely to be a valid response in which the respondent saw, processed, and meaningfully responded to the stimulus. Perseverations may be related to impulsivity or an extremely liberal response style.

- **Hit Reaction Time (HRT)** is the mean response speed, measured in milliseconds, for all non-perseverative responses made during the entire administration. An atypically slow HRT may indicate inattentiveness (especially when error rates are high), but it may also be the results of a very conservative response style. Alternatively, a very fast HRT, when combined with high commission error rates, may indicate impulsivity. HRT is also affected by response style; a liberal response style tends to produce a faster HRT, whereas a conservative response style is often associated with a slower HRT.

- **Hit Reaction Time Standard Deviation (HRT SD)** measures the consistency of response speed to targets for the entire administration. A high HRT SD indicates greater inconsistency in response speed. Response speed inconsistency is sometimes indicative of inattentiveness, suggesting that the respondent was less engaged and processed stimuli less efficiently during some parts of the administration.

- **Variability**, like HRT SD, is a measure of response speed consistency; however, Variability is a "within respondent" measure (i.e., the amount of variability the respondent showed in 18 separate sub-blocks of the administration in relation to his or her overall HRT SD score). High response speed variability indicates that the respondent's attention and information processing efficiency varied throughout the administration. Although Variability is a different measure than HRT SD, the two measures typically produce comparable results and are both related to inattentiveness. However, if HRT SD is poor and Variability is average or better, this means that consistency was poor but response variability did not change substantially during the administration (i.e., although speed consistency was poor, it remained about the same level throughout the test). If HRT SD is average or better but Variability is poor, then the respondent may have been unable to sustain optimal performance level throughout the test even though overall consistency may have been satisfactory.

- **HRT Block Change** is the slope of change in HRT across the six blocks of the administration. A positive slope indicates decelerating HRT as the administration progressed; a negative slope indicates accelerating HRT; a flat slope indicates no change in HRT. If reaction times slow down, as indicated by a higher HRT Block Change score, the respondent's information processing efficiency declines over time, and a loss of sustained attention is indicated.

- **Omissions by Block** (raw score only) is the rate of missed targets in each of the six blocks. The graphical and tabular displays of raw omission error rates by block augment the analysis of the HRT Block Change *T*-score in assessing Sustained Attention. An increase in omission error rate in later blocks indicates a loss of sustained attention. Significant increases in omission error rates across blocks are automatically flagged in the Assessment Report, and are used in combination with HRT Block Change and Commissions by Block (see next) to assess Sustained Attention.

- **Commissions by Block** (raw score only) is the rate of incorrect responses to non-targets in each of the six blocks. The graphical and tabular displays of raw commission error rates by block augment the analysis of the HRT Block Change *T*-score in assessing Sustained Attention. An increase in commission error rates in later blocks indicates a loss of sustained attention. Significant increases in commission error rates across blocks are automatically flagged in the Assessment Report, and are used in combination with HRT Block Change and Omissions by Block to assess Sustained Attention.

- **HRT Inter-Stimulus Interval (ISI) Change** is the slope of change in reaction time across the three ISIs (1, 2, and 4 seconds). A positive slope indicates decelerating HRT at longer intervals; whereas, a negative slope indicates accelerating HRT at longer intervals. A higher HRT ISI Change score means that the respondent's information processing efficiency declined with longer pauses between stimuli, and a loss of vigilance is indicated. A change in HRT across ISIs may indicate that the respondent was having trouble adjusting to changing task demands. Sometimes, this finding relates to activation/arousal needs; some respondents may be more efficient in a busier/more stimulating environment (e.g., during the 1-second ISI) than in a less active environment where the stimuli are presented at a less frequent rate (e.g., during the 4-second ISI), or vice-versa.

- **Omissions by ISI** (raw score only) is the rate of missed targets in each of the three ISI trial types. The graphical and tabular displays of raw omission error rates by ISI augment the analysis of the HRT ISI Change *T*-score in assessing Vigilance. An increase in omission error rate on trials with longer ISIs indicates a loss of vigilance. The Assessment Report will automatically flag any statistically significant increases in omission error rates at longer ISIs and use them in combination with HRT ISI Change and Commissions by ISI (see next) to assess Vigilance.

- **Commissions by ISI** (raw score only) is the rate of incorrect responses to non-targets in each of the three ISI trial types. The graphical and tabular displays of raw commission error rates by ISI augment the analysis of the HRT ISI Change *T*-score in assessing Vigilance. An increase in commission error rates on trials with longer ISI indicates a loss of vigilance. The Assessment Report will automatically flag any statistically significant increases in commission error rates at longer ISIs and use them in combination with HRT ISI Change and Omissions by ISI to assess Vigilance.

Demographic Considerations

The presentation of attention deficits in individuals tends to vary by age and gender (e.g., Newcorn et al., 2001; Ramtekkar, Reiersen, Todorov, & Todd, 2010; Seidman et al., 2005). With respect to continuous performance test (CPT) performance in particular, a number of studies have found significant age and gender effects (e.g., Burton et al., 2010; Conners, Epstein, Angold, & Klaric, 2003; Miranda, Sinnes, Pompéia, & Bueno, 2008). In the Conners Continuous Performance Test 2nd Edition (Conners CPT II™) normative samples (Conners, 2000), there were also age and gender effects on a number of scores. In general, males tended to make more errors than females, and younger respondents tended to perform worse than older respondents reflecting expected developmental trends.

Age and gender effects were also found in the current normative sample (see chapter 6, *Standardization and Psychometric Properties of the Conners CPT 3*, for detailed information about age and gender differences in Conners CPT 3 scores). To account for these effects in the interpretation process, the default *T*-score calculations are done based on comparisons to individuals in the norm group who are in the same age and gender group (i.e., Gender Specific norms). For assessors who prefer to examine *T*-scores for a given sample, regardless of the respondent's gender, Combined Gender norms are available as a report option (see chapter 3, *Administration and Scoring of the Conners CPT 3*, for more information on scoring and reporting options).

Step-by-Step Interpretation Guidelines

This section provides a seven-step strategy for interpreting the Conners CPT 3. Before beginning the interpretation procedure, the assessor should check for any notes that may have been made during the administration and see if any irregularities (i.e., deviation from the standard protocol) were recorded. This will help the assessor contextualize the results and facilitate interpretation.

Step 1: Determine the Validity of the Administration.

Review the *Validity of the Administration* section of the Assessment Report (see Figure 4.1). The Conners CPT 3 automatically checks the validity of each administration and flags any validity issues related to timing, missing scores, or score patterns that may indicate invalid responding or administration. If a validity concern is flagged, the report offers cautionary statements and interpretative advice to guide the assessor. Table 4.4. lists the possible validity issues that may be flagged in the computerized reports and their interpretive information. Recommended actions that should be taken are also listed. Note that if a respondent cannot complete the entire administration, his or her scores are likely invalid; however, the respondent's inability to complete the task may be important qualitative information. If the administration is considered valid, proceed to Step 2.

6.11 Appendix 11: A paired sample t-test for measures of MAAS, APT-II-AQ, CORE-OM

Paired Samples Test- APT-II AQ, MAAS, CORE-OM

		Paired Differences					t	df	Sig. (1-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	MAAS Total (Pre) - MAAS Total (Post)	-.304	.810	.191	-.707	.099	-1.590	17	0.06
Pair 2	APT Total (Pre) - APT Total (Post)	3.833	7.462	1.759	.123	7.544	2.180	17	.044
Pair 3	CORE-OM Total Score (Pre) - CORE-OM Total Score (Post)	14.889	14.158	3.337	7.848	21.930	4.462	17	.000

6.12 Appendix 13: Participant information sheet

University of Hertfordshire

PARTICIPANT INFORMATION SHEET

Can Brief Mindfulness-Based Intervention Improve Attention In Individuals With Mixed Neurological Disorders?

University of Hertfordshire/Hertfordshire Neurological Service (Hertfordshire Community NHS Trust)

What is this study about?

Research has shown that coping with the lifestyle changes and symptoms particularly attention and concentration associated with acquired brain injury (or ABI) can be challenging for a lot of people. Many patients with ABI experience periods of feeling down, distressed and/or anxious and find it difficult to manage these feelings and adjust to life after an ABI. Mindfulness is a set of simple techniques, which helps with improving attention. It's a way of paying attention to the present, using simple meditation and relaxation techniques such as focused breathing that help people become more aware. Research shows that when people practice mindfulness their attention and concentration capacity might improve which then enables them to manage their difficulties better. In this study we would like to find out whether a short, specially adapted mindfulness group programme currently being offered to ABI patients in Hertfordshire can be helpful for people who report difficulties with attention, and also help improve their quality of life after injury. We would like to invite you to take part in this study.

Who is conducting the research?

This study is part of a Clinical Psychology Doctorate led by Judy Emenalo-Strange (Trainee Clinical Psychologist). It is being supervised by Mr Joerg Schulz (Senior Lecturer in Research Methods & Statistics) at the University of Hertfordshire, and Mr Daniel Friedland (Consultant Clinical Neuropsychologist) at Jacketts Field Neurological Centre (Hertfordshire Neurological Service).

How will this help people affected by ABI?

We cannot promise the study will help you, but the evidence so far is showing more and more that mindfulness-based programmes are very helpful for people with chronic conditions (including those who have suffered a brain injury) in coping with some common difficulties and adjusting to their life. We hope that the information we get as a result of this study will help us make the programme more relevant to the needs of people with ABI. Because it is a shorter programme than usual, if our results show it does help people, we hope it will be able to be offered to more patients than is currently the case.

What will happen during the study?

If you agree to take part, we will then allocate you to either the mindfulness group or a waiting list group. This means that some of you will start the course very soon after you've agreed to take part. Some of you may have to wait for a few weeks before you start. However, all of you will have the opportunity to be in the group at some point. The mindfulness course will consist of 4 one-hour sessions (i.e. one mindfulness session per week). Each session lasts only one hour. The course will be delivered in a group format. We expect that there will be around 6-8 people to each group. The group is facilitated by a clinical psychologist who has a lot of experience in teaching and practising mindfulness techniques, and who has worked for a number of years with ABI patients.

As part of the programme, we will ask you to practice mindfulness meditation and the techniques regularly between sessions. In order to find out whether the programme is helping, we will also ask you to fill in 3 Questionnaires and 1 computer task at three points:

- before you start the group;
- when the group finishes;
- 3 months after the group has finished.

These questionnaires and the computer task should take about 50-60 minutes to complete. Somebody will be with you to help complete these. At the end of the programme, we will ask you to feed back about your experiences and views about the mindfulness sessions.

Why are you being invited to take part in this study?

You have been invited to take part in this study because:

- you have an acquired brain injury (ABI);
- you have been identified as someone who may benefit from a mindfulness-based group and are already on a waiting list for the group;
- you have NOT received any formal training in mindfulness methods before;
- you are NOT currently receiving any other psychological treatment;
- you do NOT suffer from severe pain problems;
- you are NOT highly distressed.

When can I take part in this study?

We expect that you will be able to take part in the study from October 2014 - May 2015.

Time Commitment

The group typically takes an hour per session over 4 sessions. The group takes place once a week, so you will finish the group after 4 weeks. The questionnaires we will ask you to complete are relatively straightforward and take around 50-60 minutes of your time. We hope that we can arrange for you to complete these at a convenient time for you.

Participants' Rights

You may decide to stop being a part of the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn or destroyed. You have the right to omit or refuse to answer or respond to any question that is asked of you without penalty.

You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome). If you have any questions as a result of reading this information sheet, you should ask the researcher before the study begins.

We think it is important to let your GP know that you are taking part in the study, so we will be writing to your GP to inform them of this.

Confidentiality

If you agree to take part, your name will not be recorded on any of the questionnaires and the information will not be disclosed to other parties. Your responses to the questionnaires will be used for the purpose of this study only. We will not have access to any of your medical records. You can be assured that if you take part in the study you will remain anonymous. When the data we have collected is analysed, it will remain anonymous.

Benefits and Risks

There are no known benefits or risks for you in this study. However, people who have been involved in previous mindfulness groups have said that they have found some of the techniques very helpful in managing with life after ABI. They have also said that they enjoy being in a group.

Where is this research taking place?

This research is taking place at the University of Hertfordshire, Hatfield and the Hertfordshire Neurological Service.

Will you inform me of the results of the study?

Yes. When we have completed the study we will produce a summary of the findings which we will be more than happy to send to you if you are interested.

Interested?

If you are interested in taking part, or would like to find out more about this study or discuss anything in more detail, please contact Judy at j.emenalo-strange@herts.ac.uk or call 01923 299124. Please note that enquiring about participation does not commit you in any way. If you decide you would rather not participate in this study simply ignore this letter and no further contact will be made. If you would like to take part, please complete the enclosed consent form and return in the pre-addressed envelope provided.

6.13 Appendix 14: Consent form

Judy Emenalo-Strange Consent Sheet Version 2: 22/10/14

University of Hertfordshire

Centre Number:

Study Number:

Patient Identification Number for this trial:

INFORMED CONSENT FORM

Title of Project: Can Brief Mindfulness-Based Intervention Improve Attention In Individuals With Mixed Neurological Disorders?

Name of Researcher: Judy Emenalo-Strange

Please initial all boxes

1. I confirm that I have read and understand the information sheet dated 04/09/2014, version 1 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected. ☐

3. I understand that relevant sections of my medical notes and data collected during the study, may be looked at by individuals who work at Hertfordshire Neurological Service, from regulatory authorities or from the NHS Trust, where it is relevant to my taking part in this research. I give permission for these individuals to have access to my records. ☐

4. I agree to take part in the above study. ☐

Name of Participant	Date	Signature

Name of Person taking consent	Date	Signature

Informed Consent form date of issue: 22/10/2014
Informed Consent form version number: 2

Page 1 of 1

6.14 Appendix 16: Ethics approval

NHS
Health Research Authority
NRES Committee East of England - Essex
The Old Chapel
Royal Standard Place
Nottingham
NG1 6FS

Telephone: 0115 8839697

19 November 2014

Ms Judy Emenalo-Strange
128B
Whittington Road
Wood Green
London

Dear Ms Emenalo-Strange,

Study title:	**Can brief mindfulness treatment improve attention in individuals with mixed acquired brain injury?**
REC reference:	**14/EE/1173**
Protocol number:	**LMS/PG/NHS/00270**
IRAS project ID:	**154897**

Thank you for your letter of 17th November 2014, responding to the Committee's request for further information on the above research and submitting revised documentation.

The further information has been considered on behalf of the Committee by the Chair.

We plan to publish your research summary wording for the above study on the HRA website, together with your contact details. Publication will be no earlier than three months from the date of this opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to make a request to postpone publication, please contact the REC Manager, Mrs Helen Poole, nrescommittee.eastofengland-essex@nhs.net.

Confirmation of ethical opinion

On behalf of the Committee, I am pleased to confirm a favourable ethical opinion for the above research on the basis described in the application form, protocol and supporting documentation as revised, subject to the conditions specified below.

Conditions of the favourable opinion

The favourable opinion is subject to the following conditions being met prior to the start of the study.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission ("R&D approval") should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk.

Where a NHS organisation's role in the study is limited to identifying and referring potential participants to research sites ("participant identification centre"), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the current registration and publication trees).

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non clinical trials this is not currently mandatory.

If a sponsor wishes to contest the need for registration they should contact Catherine Blewett (catherineblewett@nhs.net), the HRA does not, however, expect exceptions to be made. Guidance on where to register is provided within IRAS.

It is the responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Ethical review of research sites

NHS sites

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see "Conditions of the favourable opinion" below).

Non-NHS sites

Approved documents

The final list of documents reviewed and approved by the Committee is as follows:

Document	*Version*	*Date*
Covering letter on headed paper [Response to the REC Provisional opinion letter]	Version 1	29 October 2014
Covering letter on headed paper [Response to the REC Provisional opinion letter]	3	16 November 2014
Evidence of Sponsor insurance or indemnity (non NHS Sponsors only) [Indemnity letter]	1	04 September 2014
Letter from sponsor [In Principle Letter from Sponsor]	1	05 September 2014
Other [Email providing clarification]		10 September 2014
Other [Validated Questionnaire - APT-II Attention Questionnaire]		
Other [Validated Questionnaire - CORE Outcome Measure]		
Other [Validated Questionnaire - Day to Day Experiences]		
Other [Mindfulness Meditation Group Session 1]	Version 1	22 October 2014
Other [Mindfulness Meditation Group Session 2]	Version 1	22 October 2014
Other [Mindfulness Meditation Group Session 3]	Version 1	22 October 2014
Other [Mindfulness Meditation Group Session 4 Last session]	Version 1	22 October 2014
Other [Conners CPT 3 Screen Shot]	Version 1	22 October 2014
Other [Scientific review by Dr Nick Wood]	Version 1	17 March 2014
Participant consent form [Participant consent form]	Version 2	22 October 2014
Participant information sheet (PIS) [Participants Information Sheet]	4	16 November 2014
REC Application Form [REC_Form_09092014]		09 September 2014
Research protocol or project proposal [JES Project Proposal]	1	22 August 2014
Summary CV for Chief Investigator (CI) [Judy Emenalo-Strange CV 2014]	1	22 August 2014
Summary CV for supervisor (student research) [Supervisor's CV]	1	04 September 2014

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document *"After ethical review – guidance for researchers"* gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
- Notifying the end of the study

The HRA website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

User Feedback

The Health Research Authority is continually striving to provide a high quality service to all applicants and sponsors. You are invited to give your view of the service you have received and the application procedure. If you wish to make your views known please use the feedback form available on the HRA website:
http://www.hra.nhs.uk/about-the-hra/governance/quality-assurance/

HRA Training

We are pleased to welcome researchers and R&D staff at our training days – see details at http://www.hra.nhs.uk/hra-training/

14/EE/1173	Please quote this number on all correspondence

With the Committee's best wishes for the success of this project.

Yours sincerely,

Dr Alan Lamont
Chair

Email:nrescommittee.eastofengland-essex@nhs.net

Enclosures: "After ethical review – guidance for researchers"

Copy to: *Professor John Senior*

Sally Anne Doyle-Caddick

Hertfordshire Community NHS
NHS Trust

Date 8th January 2015

Unit 1A, Howard Court
14 Tewin Road
Welwyn Garden City
Hertfordshire
AL7 1BW

Research Office 01438 347 788
sallyanne.doyle-caddick@hchs.nhs.uk

Ms Judy Emenalo-Strange,
Psychology trainee – HCT,
c/- 128B Whittington Road,
Wood Green, London

cc.
Judy Emenalo-Strange - CI j.emenalo-strange@herts.ac.uk
Dr Caroline Allum – HCT Executive Lead for Research
Jason Taylor – HCT Research Delivery Coordinator
Dr D. Friedland – HCT Consultant Neuropsychologist
Dr J. Schulz – University Herts supervisor / on behalf of Sponsor UH : j.schulz@herts.ac.uk

Dear Ms Emenalo-Strange,

Re: Can brief mindfulness treatment improve attention in individuals with mixed acquired brain injury?
IRAS ref: 154897
Trust ref: hct 014 (Please quote in all communications with Trust Research Office)

I am pleased to confirm that this non-NIHR Portfolio study has been reviewed under the Research Governance Framework 2005 and NHS Permission has been issued for the project to proceed at Hertfordshire Community NHS Trust (HCT) on the basis of the following approved documents:

Description	Version and date
Study protocol	LMS/PG/NHS/00270
UH Ethics approval	Not required
NRES Committee East of England – Essex approval REC reference: 14/EE/1173	19 November 2014
UH indemnity certificate - Arthur J. Gallagher, signed	30th July 2014

As part of this approval to proceed, you will be required to:

- Provide information to HCT, on request, as part of the Trust annual research monitoring process;
- Provide HCT with a summary of the research once it is completed;
- Inform HCT about all publications relating to the research; and
- Acknowledge HCT in all publications relating to the research.

Hertfordshire Community NHS Trust thanks you for your governance submission and looks forward to working with you on this project.

Yours sincerely,

Sally Anne Doyle-Caddick
Research Delivery Lead,
Hertfordshire Community NHS Trust.

1 of 1 pages - hct 014 Mindfulness and ABI non-Pf TPL

University of Hertfordshire UH

UNIVERSITY OF HERTFORDSHIRE
HEALTH & HUMAN SCIENCES

ETHICS VALIDATION

TO	Judy Emenalo-Strange
CC	Joerg Schulz
FROM	Health and Human Sciences
DATE	12/01/15

Protocol number: LMS/PG/NHS/00270

The UH protocol number above has now been validated for the study detailed below. Please quote this number should you need to contact us .

Study title:	Can brief mindfulness treatment improve attention in individuals with mixed acquired brain injury?
REC reference	14/EE/1173
IRAS project ID:	154897

6.15 Appendix 17: Literature Search Strategy

psychINFO

1. PsycINFO; "what is attention".ti,ab; 84 results. 1.

2. PsycINFO; *ATTENTION/; 22465 results.

3. PsycINFO; *COGNITIVE PROCESSES/; 51934 results.

4. PsycINFO; 2 AND 3; 1607 results.

5. PsycINFO;

4 [Limit to: Publication Year 2007-2014]; 442 results.

6. PsycINFO; COGNITIVE PSYCHOLOGY/ [Limit to: Publication Year 2007-2014]; 1357 results.

7. PsycINFO; 2 AND 6 [Limit to: Publication Year 2007-2014]; 25 results.

8. PsycINFO; CRANIOCEREBRAL TRAUMA/; 0 results.

9. PsycINFO; ATTENTION/; 29189 results.

10. PsycINFO; 8 AND 9; 0 results.

11. PsycINFO; NEUROPSYCHOLOGY/; 16727 results.

12. PsycINFO; 9 AND 11; 558 results.

13. PsycINFO; MINDFULNESS/; 3700 results.

14. PsycINFO; 8 AND 13; 0 results.

15. PsycINFO; TRAUMATIC BRAIN INJURY/; 11289 results.

16. PsycINFO; 13 AND 15; 10 results.

17. PsycINFO; 9 AND 11; 558 results.

18. PsycINFO; 9 AND 13; 200 results.

19. PsycINFO; 9 AND 15; 195 results.

20. PsycINFO; 17 [Limit to: Human and English Language and Publication Year 2004-2014]; 220 results.

Medline

Attention, Neuropsychology and Mindfulness

1. MEDLINE; CRANIOCEREBRAL TRAUMA/; 19517 results.

2. MEDLINE; ATTENTION/; 63578 results.

3. MEDLINE; 1 AND 2; 55 results.

4. MEDLINE; NEUROPSYCHOLOGY/; 2063 results.

5. MEDLINE; 2 AND 4; 93 results.

6. MEDLINE; MINDFULNESS/; 282 results.

7. MEDLINE; 1 AND 6; 0 results.