

**An evaluation of a brief sensory modulation intervention
for people presenting with anxiety in a community mental
health service**

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Certificate of Authorship

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material that has been previously published or written by another person nor material which to a substantial extent has been accepted to the award of any other diploma or degree of a university or other institution of higher learning, except where due acknowledgement has been made in the acknowledgements.

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ABSTRACT

Anxiety affects one in four New Zealanders at some time in their life and current treatments are unaffordable. Heightened neural arousal influences the extent of anxiety. There is growing research to support sensory modulation as an intervention to regulate emotional and physiological arousal, however further evidence is needed to support this approach with people experiencing severe mental illness. This one group prospective quasi-experimental design study evaluated the effectiveness of a brief sensory modulation intervention in reducing anxiety for people accessing mental health services. It consisted of three phases; baseline, intervention and follow-up with data collected throughout. The stability of the data collected during the baseline phase enabled the intervention group to act as their own controls. The data were analysed to determine whether the participants experienced changes in self-reported anxiety and quality of life. Participants showed a significant reduction in anxiety, measured using the Beck Anxiety Index, and this reduction continued at three months follow up. There was significant support for effectiveness of the intervention in increasing participation, as measured by the The World Health Organization Disability Assessment Schedule. However, the results of The World Health Organization Quality of Life measures did not support the hypothesis that the intervention would improve overall quality of life. Overall, the results indicate that a three-session sensory modulation intervention could provide a limited cost approach for reducing anxiety and increasing participation in people accessing community mental health services.

CHAPTER 1: INTRODUCTION

The study described in this thesis set out to explore whether a brief sensory modulation intervention would reduce anxiety and improve quality of life and participation for people experiencing mental health issues. This introductory chapter provides a summary of the difficulties faced by health services in treating anxiety and the need to look for cost effective solutions. Sensory modulation is introduced as one potential solution. Then the study question, objectives and hypotheses are outlined before the significance of the research is discussed and an overview of the thesis is provided.

Statement of the Problem

Anxiety can be debilitating, reducing quality of life and preventing people from participating in activities and roles within their communities (Engel-Yeger & Dunn, 2011). It may be experienced alongside many other physical, mental and cognitive impairments or on its own (Wells, 2006). Anxiety disorders are the most prevalent form of mental illness seen across health services, with the condition affecting almost 25% of New Zealanders at some time in their life (Wells, 2006). Much higher rates are seen for Maori with one third experiencing anxiety (Wells, 2006). Research has found that the ongoing treatment of anxiety disorders, in particular generalised anxiety disorder and post traumatic stress disorder, are extremely costly (Issakidis, Sanderson, Corry, Andrews & Lapsley, 2004). Furthermore, the same research suggests that providing the gold standard treatment of combined cognitive behavioural therapy (CBT) and medication is unaffordable (Issakidis, Sanderson, Corry, Andrews & Lapsley, 2004). Cost effective interventions that reduce anxiety and improve participation, as well as quality of life, need to be explored.

Sensory modulation is an evolving approach in mental health services, used in response to the challenge of providing trauma-informed mental health services which support people to manage their own distress and regulate their day-to-day arousal levels and emotional responses (Le Bel, Champagne, Stromberg & Coyle, 2010). Sensory modulation involves the regulation of sensory input to allow for a functional response. This is both an internal neurological process where incoming sensations are monitored and filtered within the brain, and an intervention where sensory input can

be purposefully modified to enable optimal functioning and provide signals of safety to reduce distress (Champagne & Koomar, 2012; Dunn, 1997; Miller, Anzalone, Lane, Cermak, & Osten, 2007). Within sensory modulation intervention the regulation of sensory input is achieved through changing aspects of the environment and using the specific sensory characteristics of activities and objects to support a calm and alert state (Abernethy, 2010). The intervention, along with related theory and principles, are discussed in greater detail in Chapter 2.

Recent research has established a link between a low neurological threshold for sensory input and heightened anxiety, with a resulting decrease in quality of life and participation (Engel-Yeger & Dunn, 2011). While this relationship between sensory processing and anxiety has been highlighted, there is only limited evidence to support the use of sensory modulation intervention for anxiety. A few studies have been conducted which show promise for the approach, but there is a need to explore the impact of sensory-based intervention with people accessing specialist mental health services for anxiety related issues.

Research Question

The research question underpinning the study was; does completing a three week sensory modulation intervention reduce anxiety and improve the quality of life and participation of people presenting with anxiety in a community mental health service over a three month period? In addition to the primary research question the following was also investigated; is there a relationship between anxiety and sensory processing patterns? In order to answer these questions a one group prospective design was utilised, with the following objectives and hypotheses.

Objectives

To investigate the efficacy of a three week sensory modulation intervention for the reduction of anxiety, and whether any effect is sustained after three months

To investigate the impact of a three week sensory modulation intervention on quality of life and participation, and whether any effect is sustained after three months

Hypotheses

1. A brief sensory modulation intervention will reduce the anxiety levels experienced by people who are diagnosed with a mental illness
2. A brief sensory modulation intervention will improve the quality of life of people who are diagnosed with a mental illness
3. A brief sensory modulation intervention will increase the participation in activities of people who are diagnosed with a mental illness
4. The secondary hypothesis is that people experiencing heightened anxiety will have a low neurological threshold for sensory input

Significance of the Study

Case study and anecdotal evidence suggest that the use of sensory intervention with adults experiencing mental health problems is a promising approach, however there is currently limited generalisable research to support its use (Abernethy 2010; Moore & Henry, 2012, Pfeiffer & Kinnealey, 2003). It was anticipated that the study could contribute to the emerging evidence that sensory modulation can provide an effective intervention for people who experience anxiety. The potential benefits of a brief, limited-cost treatment for anxiety include faster access to treatment, reducing the progression of anxiety symptoms and the associated reduction in functioning. Sensory modulation is a person-centred and trauma-informed intervention that can be used alongside both pharmaceutical treatment and talking therapies (Champagne, 2008), increasing its applicability for people already receiving these interventions.

This study set out to provide New Zealand based evidence to support a brief sensory modulation intervention, which might help lessen the growing societal and financial burden of increasing rates of anxiety in the national population. Although the study is relatively small it will provide the basis for larger studies in the future.

Overview of the Thesis

This thesis is organised into five chapters. Chapter 1 provides evidence of the problem under investigation; presents the research question; aims of the study and the hypotheses; and ends with the significance of the study. Chapter 2 provides a review of the recent literature related to anxiety, sensory processing, current treatments for anxiety and sensory modulation intervention. Chapter 3 describes the

methodology and measures used in this study, while Chapter 4 provides analysis of the participant data. Finally, Chapter 5 discusses the study findings in relation to the hypotheses, the strengths and limitations of the study and provides recommendations for research and clinical practice, along with a conclusion.

CHAPTER 2: LITERATURE REVIEW

The purpose of this review is to draw together relevant literature from a number of fields to describe why sensory modulation may support the management of anxiety. Over the past decade research into sensory processing disorders (SPD) has expanded from being focused on childhood learning and developmental disorders to understanding sensory processing issues in adult psychiatric populations, including those who have experienced trauma (Abernethy, 2010). In the following review literature from the fields of psychology, psychiatry, neuroscience and occupational therapy will be integrated to form an argument that there is a significant relationship between sensitivity to sensory input and anxiety.

Current understandings of anxiety will be discussed and literature on the etiology and prevalence of sensory processing disorders will be reviewed. Then the relationship between sensory processing issues and trauma will be further explored and the implications will be outlined, including the resultant impact on functioning. Current interventions used to address the symptoms of anxiety will be reviewed. Finally, the existing literature evaluating the use of sensory modulation interventions will be discussed. Gaps in the literature will be highlighted and the need for further research determined.

Literature Search Strategy

A literature search of electronic databases was conducted in February 2015, and repeated in September 2015 using Pubmed, Psychology and Behavioural Sciences Collection, PsycINFO, CINAHL and the Australia/New Zealand Reference Centre. A total of 304 articles were found in the initial search and an additional three in the second search. Titles and abstracts were reviewed to determine relevance, with 134 being discarded. Then 170 were reviewed in full and a total of 76 were retained, with most coming from the fields of occupational therapy and psychology. A further six articles were found in a manual search of the reference lists. The 82 articles selected were recent, reflecting the rapid development of knowledge in the fields of sensory processing and anxiety. The search process is summarised in Figure 1.

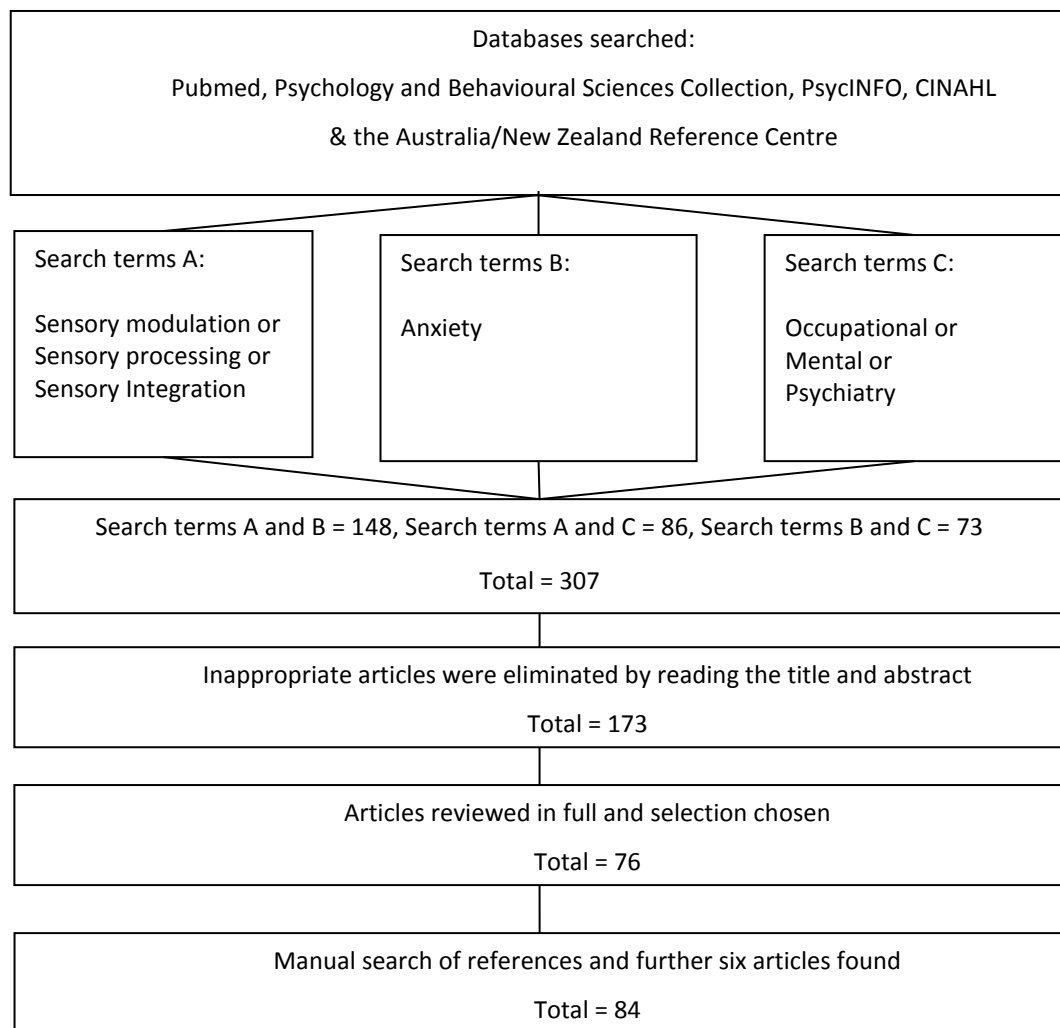


Figure 1. *Search Strategy*

Anxiety and Anxiety Disorders

Anxiety can be described as a biological warning system preparing the body both mentally and physically for danger (American Psychiatric Association, 2013; Hoehn-Saric & McLeod, 2000). In the latest edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, American Psychiatric Association, 2013) anxiety is described as being the “anticipation of a future threat” (p.189) and is associated with muscle tension, hypervigilance and avoidance. When a person believes they are in danger, the neural pathways of the sympathetic nervous system are activated causing physiological changes to occur in preparation for fighting or fleeing. Physical symptoms of anxiety include fast shallow breathing, increased heart rate, pupil dilation, and increased sweating. The body’s resources are redirected from the digestive organs and

used to deliver nutrients and oxygen to the muscles (American Psychiatric Association, 2013; Hoehn-Saric & McLeod, 2000).

Whilst anxiety can be a useful and protective response to environmental stressors in the short term (state anxiety), over time anxiety can become a stable trait of a person's personality and may develop into an anxiety disorder (Lau, Eley, & Stevenson, 2006; Metzger, 1976). Anxiety disorders listed in the DSM-5 include phobias, social anxiety disorder, panic disorder, generalised anxiety disorder, substance/medication induced anxiety, separation anxiety, and agoraphobia. Anxiety is also a feature of the trauma and stressor-related disorders including attachment, adjustment and posttraumatic stress disorder (American Psychiatric Association, 2013).

Alongside the physiological changes in the body, anxiety causes reduction in executive and social functions, including problem solving, concentration, judgement and memory (Shearer, 2007; Sherbourne et al., 2010). Anxiety also has an impact on occupational functioning with decreased sleep, poor performance at work or school, difficulty socialising, leaving the home and using public transport (American Psychiatric Association, 2013). People with anxiety are less likely to be employed, and may require support and training to succeed in the workforce (Wagner, Chant, White & Whitford, 2005). Anxiety disorders are the most prevalent group of all mental illnesses and alongside the high personal cost, anxiety causes the greatest burden on government and community resources (McLean, Asnaani, Litz & Hofmann, 2011; Wells, 2006)

Current Treatments for Anxiety Disorders

Health providers are challenged to source or develop a range of innovative intervention approaches, particularly for addressing high prevalence disorders such as anxiety with a focus on early identification and treatment (Mental Health Commission, 2012). While mild anxiety is a common human experience, if left untreated anxiety symptoms may develop into a more severe disorder with associated maladaptive coping strategies such as alcohol misuse (Starcevic, 2011). Ongoing anxiety causes a number of biological, psychological and functional issues and commonly co-exists with depression, compounding the psychological effects (Kessler et al., 2008). Many other disorders including post-traumatic stress disorder, borderline personality disorder,

psychosis and obsessive compulsive disorder are also characterised by heightened levels of anxiety (American Psychiatric Association, 2013).

Current clinical treatments for anxiety disorders include cognitive behavioural therapy, psychotherapy, dialectical behavioural therapy and medication. The aims of treatment are centred on reducing symptoms and increasing the person's ability to regulate their level of arousal (Shearer, 2007). Whilst these existing interventions are supported by evidence and have proven to be effective, there are limitations in their application (Shearer, 2007; Zhao et al., 2012). In the following section current treatments for anxiety are briefly reviewed along with some of the issues identified in the use of these interventions. Limitations in the current treatment options will be highlighted to support the argument for the development of further treatment options.

Medication

The most commonly prescribed medication for anxiety symptoms are Selective Serotonin Reuptake Inhibitors (SSRI's) with large studies showing good effect size. However, many people choose to discontinue use of medication due to unpleasant side-effects (Shearer, 2007). People seeking reduction in the symptoms of anxiety are often prescribed benzodiazepines to reduce arousal and alleviate distress. While this group of medications are shown to be effective over a period of up to three weeks, neural plasticity is impaired when use continues for more than one month and its efficacy sharply diminishes (Zhao et al, 2012). Benzodiazepines are more likely to be prescribed for people experiencing severe anxiety as an adjunctive treatment, however they have been shown to impair psychological treatment (Shearer, 2007). Medications continue to be useful for treating anxiety however it is recommended they are used alongside psychological and behavioural treatments (Shearer, 2007).

Psychological therapies

Cognitive behavioural therapy (CBT) has been described as the gold standard psychological treatment for anxiety, based on studies where it was compared to treatment as usual, and found to be as effective as medication. However, studies found the level of CBT's efficacy was less clear when compared to general counselling (Shearer, 2007). Cognitive behavioural therapy focuses on the relationship between

thought processes and the experiences associated with the person's anxiety. Therapists enable the person to understand and modify the thoughts, behaviours, emotions, feelings and body sensations that influence their experiences (Shearer, 2007). However, ongoing heightened neural arousal, such as seen in generalised anxiety disorder and post-traumatic stress disorder can cause a 'pervasive apprehension', emotional dysregulation and negative affect, which may impair the ability of psychological intervention to address the source of the anxiety (McTeague & Lang, 2012).

Dialectical Behavioural Therapy (DBT) is a form of cognitive-behavioural therapy specifically developed for people experiencing heightened arousal levels resulting in dysfunctional emotional regulation patterns and suicidality (Linehan, 2015). The DBT programme consists of individual therapy and group sessions where a range of skills are taught to change cognitive and behavioural patterns. However, research has found that the self-soothe module, which contains sensory and body-focused strategies, was one of the least effectively taught, despite it being one of the most commonly used techniques alongside distraction. It has been proposed that changes are made to the delivery of the program so that these crisis survival strategies are taught prior to more complex interpersonal skills (Dewe & Krawitz, 2007).

Whilst psychological therapies have been found to be an effective treatment for anxiety, they are time consuming and rely on the availability and accessibility of highly trained clinicians. For example, CBT is found to be most effective in treating anxiety within specialist mental health services when delivered by a clinical psychologist with at least twelve sessions, however the effects of treatment were found to have diminished at one year follow-up (Seekles et al., 2013). Over the last decade there has been a focus on developing body-centred therapies as a strategy to support engagement in psychological therapy, as well as stand-alone interventions to reduce anxiety (Van der Kolk, 2006).

Body centred therapies

Kabat-Zinn, Chapman, and Salmon (1997) suggest that those who experience anxiety cognitively (worry, overwhelming thoughts) prefer relaxation with attention to bodily sensations, while those who experience somatization prefer cognitive

techniques. Outside of the western world healing traditions frequently use body centred approaches to regulate emotional and physical states, however these approaches are not easily accepted by the dominant medical paradigm (Van der Kolk, 2006).

Yoga has been increasingly recognized within western literature as a valid therapeutic tool for people experiencing anxiety disorders, with studies showing improvements in heart rate variability and significant decreases in symptomology (Mollo, Schaaf, & Benevides, 2008; Van der Kolk, 2006). Sensory enhanced yoga incorporates deep touch pressure, slow rhythmical and proprioceptive movement and often meditation music is played to reduce unwanted auditory distractions. One study found that sensory-enhanced yoga significantly reduced both state and trait anxiety regardless of gender, with improvements in functioning, sleep, mood, and reduced anger (Stoller et al., 2012). Van der Kolk (2006) advocated for an integrated approach to treatment of anxiety disorders where a person gains control of their arousal level and develops awareness, so that having distressing thoughts does not inevitably result in becoming overwhelmed.

To increase recognition of bodily sensations and the ability to self-soothe, Langmuir, Kirsh, and Classen (2012) developed a group intervention where participants were first able to experience soothing bodily sensations and learn to observe the individual senses non-judgmentally before gaining an understanding of the neurological processes of arousal and threat appraisal. Once able to anticipate and manage the potential responses, the participants were able to discuss arousal in the context of trauma and examine existing coping styles. This pilot study provided an indication that the use of a sensory approach prior to addressing trauma cognitively, is effective in reducing trauma symptoms, reduces anxiety and increases reconnection with one's body (Langmuir, Kirsh, & Classen, 2012). Sensorimotor psychotherapy such as this focuses on sensations associated with trauma and can be distinguished from a sensory modulation approach to reducing arousal levels, which aims to enable the person to develop a tolerance to a number of environments with the intent of increasing function and participation rather than psychological integration.

While a range of treatments for anxiety exist, research suggests there are issues with the acceptability and cost and that the focus of these treatments does not necessarily address sensory processing and hyperarousal issues in relation to everyday coping and functioning. Sutton, Hocking and Smythe (2012) suggested that in recovery from mental illness, opportunities to re-awaken the senses should be provided to enable people to “inhabit” their bodies again. When a person is disengaged from their valued roles and occupations they may feel numb in their body, yet over-sensitive to the external environment. The same authors also described the process of re-engaging with the world, where a person may experience their physical sensations as unpleasant to begin with, however as a person becomes fully engaged in life roles they may experience more pleasurable sensations. In order to overcome the state of disengagement or passivity, individuals must first gain a sense of safety and control and be supported to experience pleasure and regain a physical sense of being (Van der Kolk, 2006). Ogden and Minton (2000) suggest that prior to learning to do this for themselves, the person must first experience regulation of affective and arousal states. Sensory modulation intervention aims to support this experience of regulation and the following discussion outlines the principles and strategies used in this approach. First underpinning concepts related to sensory processing and issues in the regulation of sensory input will be outlined.

Sensory Processing

Sensory processing involves the sensory receptors, spinal cord, brain stem, thalamus and the higher cortical areas, which together form the peripheral and central nervous system (CNS). Koziol (2010) proposed that the sensory system forms a continuous source of feedback which is integrated with the cognitive areas of reward and decision making to influence behaviour and function in real time. The following provides an explanation of the structures of the peripheral and central nervous system, including the internal and external senses, and how these are organised to provide a person with the ability to maintain an optimal state of arousal.

The peripheral nervous system

The human sensory systems can be categorised by receptors that receive input from the surrounding environment (exteroceptive or ‘external’ senses) and those that

receive input from the body and its internal organs (interoceptive or the ‘internal’ senses) (Ayres, 1972). The ‘external’ senses include gustatory (taste), olfactory (smell), auditory (hearing), tactile (touch, pain, temperature) and visual (sight) systems. The ‘internal’ senses include vestibular (body orientation, balance, acceleration) and proprioceptive (joint position and movement) systems, as well as sensations from internal organs (eg, heart-beat, stomach ‘butterflies’ and pain, breathing rate). Table 1 provides descriptions of how stimulation is obtained through each of the sensory systems (Champagne & Koomar, 2011).

Table 1

The Sensory Systems and Means of Obtaining Stimulation

Proprioception	Engaging in activities which provide movement against resistance or sustained muscle tension.
Vestibular	Engaging in activities requiring head movement(s) through space. Three categories: vestibulospinal, vestibulo-ocular, and vestibulo- perceptual
Tactile	Engaging in activities that stimulate the skin receptors. Includes light and deep pressure touch, pain, vibration, and temperature.
Auditory	Engaging in activities that stimulate the auditory receptors of the inner ear (cochlea).
Visual	Stimulation of the visual system through the optic nerve, optic chiasm, and optic tract.
Olfactory	Stimulation of the olfactory receptors: epithelium in the lining of the nose; olfactory bulb.
Gustatory	Stimulation of the oral receptors of the tongue and mouth (e.g., taste buds)

Adapted from: Champagne, T., & Koomar, J. (2011). Expanding the focus: Addressing sensory discrimination concerns in mental health. *Mental Health Special Interest Section Quarterly*, 34(1), 1.

The development of sensory systems has been described as a hierarchal process where the proximal senses (tactile, proprioceptive and vestibular) form the foundation on which the distal senses (visual, taste, olfactory, auditory) are developed

(Ayres, 1979). The occupational therapist and neuroscientist, Jean Ayres (1979) developed a theory related to how sensory input is integrated within the brain. She determined that dysfunction in the integration of sensory input influences the development of sensory-motor, behavioural and cognitive functioning.

While the sensory systems have typically been described and researched individually, it is now understood that almost all experiences are multi-modal involving more than one sense and part of a dynamic feedback system involving both sensory and motor pathways (Thelen & Smith, 2000). Miller, Anzalone, Lane, Cermak, and Osten (2007) described sensory integration theory as encompassing the “constructs that discuss how the brain processes sensation and the resulting motor, behaviour, emotion, and attention responses” (p. 135). While research into sensory processing continues to draw from sensory integration theory, recent literature also describes the importance of non-linear dynamic sensory feedback as the basis of functional behaviour including motor, social and communication skills (Champagne, 2008). For example, tactile, proprioceptive and early visual processing are now known to be critical for bonding and attachment in early childhood (Cascio, 2010). In adulthood these same senses form the basis of non-verbal gesturing and communication within larger groups, which provides some indication as to why sensory processing disorders appear to be associated with social anxiety (Cascio, 2010).

[The central nervous system](#)

A key function of the CNS is to regulate and process the sensory information received from the external and internal senses, integrating the input to enable the person to react in an adaptive manner. It has been proposed that sensory perceptual abnormalities occur as a result of changes within the CNS including the basal ganglia (attention, gating) and cerebellum (modification of emotional and behavioural responses), rather than at the peripheral receptors (Koziol, Budding, & Chidekel, 2011). Research findings supports this theory, where people with sensory processing issues noticed sensations similarly to others, however they perceived the same sensations as be more painful, suggesting the disorder lies in the CNS and not the peripheral receptors (Bar-shalita, Vatine, Parush, Deutsch & Seltzer, 2012).

Dunn (1997) describes the point where sufficient sensory stimuli is provided for the CNS to register and respond as the *neurological threshold*. An important developmental aspect related to the neurological threshold is the ability to habituate to familiar and safe stimuli, therefore requiring less attention or behavioural response. On the other hand, sensitisation occurs when the body more frequently recognises sensory stimuli as being harmful and develops heightened reactivity (Dunn, 1997). When the CNS perceives sensory stimuli to be dangerous it causes the sympathetic neural pathways to be activated, whereby attaining safety is prioritised and the person experiences increased anxiety and a 'fight or flight' response. Neurological thresholds for sensory input vary across populations, and people with very low or very high thresholds may become sensitised and overresponsive to neutral stimuli or habituated to potentially dangerous stimuli (Dunn, 1997). When these neurological responses cause difficulties in everyday functioning the issue can be described as a sensory processing disorder.

Taxonomy of Sensory Processing Disorders

Disruptions to sensory integration and processing were first described in occupational therapy literature by Ayres (1979) in her work with children. Over the past decade research into sensory processing has expanded from being largely focused on issues related to learning and developmental disorders to a new focus on adult psychiatric populations. Possibly due to the rapid expansion of knowledge in this area, there have been a number of terms coined to describe sensory processing patterns. Bundy, Lane and Murray (2002) described sensory processing disorder as the result of disruption in the neurological processing of sensation (sensory integration) impacting on a person's ability to respond to changes from the body and environment. Sensory defensiveness is described by the same authors as a sensory processing disorder characterised by a tendency to display a fight /flight reaction to sensation that others do not perceive to be harmful (Bundy et al., 2002). A taxonomy of sensory processing disorders has recently been developed, which describes three subtypes of Sensory Processing Disorders (SPD) (Miller, Anzalone, Lane, Cermak, & Osten, 2007). These include 1) Sensory Discrimination Disorder (SDD), which involves difficulty distinguishing different types of sensory input; 2) Sensory-Based Motor Disorder (SBMD), which involves challenges with translating sensory input into coordinated

movements and 3) Sensory Modulation Disorder (SMD), which involves issues with regulation of sensory input (Miller et al, 2007). Miller et al (2007) describe sensory modulation issues as a difficulty “responding to sensory input with behaviour that is graded relative to the degree, nature, or intensity of the sensory information” (p.136). They describe three types of SMD; 1) over-responsivity, 2) under-responsivity and 3) craving/seeking, and suggest that a diagnosis of Sensory Processing Disorder can only be given where a person’s occupational functioning is impaired.

To enable accurate identification of individual’s sensory processing issues and preferences, Brown and Dunn (2001) developed the Adult and Adolescent Sensory Profile. This assessment tool is based on Dunn’s (1994) Model of Sensory Processing which is designed to capture the range of neurological and behavioural responses to everyday sensory experiences. The Sensory Profile is used to recognize when a person may be experiencing their sensory environment as more or less intense as those around them. This can then enable people to articulate their needs and make changes in their sensory environment, routine and occupations to support optimal performance and neural arousal.

Table 2

Dunn’s (1997) Model of Sensory Processing Patterns

	Passive Behavioural Response	Active Behavioural Response
High Neurological Threshold (requires more sensory input to register)	<i>Low Registration</i>	<i>Sensation Seeking</i>
Low Neurological Threshold (requires less sensory input to register)	<i>Sensory Sensitivity</i>	<i>Sensation Avoiding</i>

Dunn (1994) proposed that in addition to individuals being on a continuum of neurological sensitivity from a low threshold (more sensitive) to a high threshold (less sensitive), people may also utilize either active or passive strategies to cope with

incoming stimuli. These neurological and behavioural continuums are depicted as a matrix of sensory processing patterns, which include sensory sensitivity and avoidance responses for those with a low neurological threshold, and low registration (slow to attend to input) and sensation seeking for those with a high neurological threshold (see table 2). While a person may be generally over-responsive or under-responsive to sensory stimulation, it is recognized that sensitivities and behavioural responses will vary across the individual's sensory systems. For example, an individual may be hyper-sensitive to visual and auditory input, but have a preference for increased proprioceptive and deep touch input (Dunn, 1994).

Developmental and Functional Impact of Sensory Processing Issues

Although the etiology of sensory processing disorders remains unclear, recent studies suggest that neurological changes may occur in-utero where the unborn child may be exposed to toxins, or during a traumatic delivery and in very early infancy. Porges and Furman (2011) argue that very early disruption to the development and functioning of the vagal nerve, which is involved in the modulation of arousal states, can affect the self-regulation in young children. They suggest that a crucial time in development is in the last trimester when the baby begins to develop the mechanisms for sucking, swallowing and breathing, which are all innervated by the vagal nerve. This allows the infant to feed and metabolize food, and maintain a calm state where food may be digested. Where this process is interrupted by prematurity, illness or neglect, difficulties in arousal regulation and affective stability decrease the child's capacity to learn through experience and develop social bonds (Porges & Furman, 2011).

This early period of development appears to determine whether the child becomes hyper-sensitive, meaning they may become easily overwhelmed by too much sensory stimulation. Although being sensitive to sensory stimuli is correlated with introversion, it does not on its own predict psychological dysfunction or decreased participation. Further research investigating the association between SPD and interpersonal relationships found those with a low threshold for sensory stimuli reported social introversion, low self-esteem, increased pain perception, problems in the family, and decreased function at work and in social situations as well as increased sexual risk behaviours (Bar-Shalita, Vatine, Parush, Deutsch, & Seltzer, 2012; Ben-Avi,

Almagor, & Engel-Yeger, 2012; Kinnealey & Fuiiek, 1999; Kinnealey, Koenig & Smith, 2011; Wagner, 2001). The proposed etiology of sensory processing disorder shares some commonalities with the etiology of Borderline Personality Disorder (BPD) where the developing child is described as having poor attachment and a low threshold to emotional stimuli with difficulty retuning to baseline once triggered (Chapman, Turner & Dixon-Gordon, 2011). This sensitive predisposition does not alone predict BPD, but when coupled with an invalidating environment, the child learns to fear heightened arousal.

Sensory Processing and Trauma

People who seek support from mental health services are more likely to have experienced trauma than the general population and high anxiety is commonly reported in this group (Mueser et al., 2004). This link appears particularly evident in people who have experienced physical or emotional trauma where their central nervous system has become over-responsive to their environment (Engel-Yeger, Palgy-Levin, & Lev-Wiesel, 2013). The symptoms of Post-Traumatic Stress Disorder (PTSD) are defined by the American Psychiatric Association (2013) as including re-experiencing of the trauma, avoidance, negative cognitive and mood changes, and hyperarousal. According to Cantor (2009) experience of severe trauma over time causes the body to prioritize survival despite great cognitive and emotional cost. In attempts to avoid exposure to triggering stimuli, people with trauma related anxiety prefer to exist in familiar and predictable environments and become exhausted in their efforts cope in the outside world, finding social and occupational roles very difficult and preferring to withdraw into predictable familiar routines away from possible danger (Cantor, 2009; Champagne, 2011).

Neurological research indicates sensory processing differences may influence why some people develop PTSD and some do not (Stewart & White, 2008). Despite the varying contexts of their trauma, study participants with PTSD experienced increased disturbances in their ability to filter out unwanted sensory stimuli compared to those who had also experienced trauma, but had not developed PTSD. Disturbances in sensory filtering and processing are associated with even one or two symptoms of PTSD (Stewart & White, 2008). Findings indicate that PTSD symptoms are strongly

correlated with increased visual and olfactory recognition and a rapid response to non-trauma related noxious stimuli (Croy, Schellong, Joraschky & Hummel, 2010; Hendler et al., 2003). Engel-Yeger et al., (2013) compared the sensory profiles of 30 participants who had a diagnosis of PTSD with healthy controls and were able to confirm the existence of sensory processing disorder. This study demonstrated that this group of people were most affected in the sensory domains of visual, auditory and tactile processing and that over-responsivity was linked to strong emotional responses including fear and anxiety (Engel-Yeger et al., 2013). The higher prevalence of substance abuse in people diagnosed with PTSD appears to be an attempt to cope with the increased sensory challenges of social environments. It is proposed that the anxiolytic effect of alcohol and marijuana may reduce neural arousal levels, acting as a coping strategy. Substance abuse may be seen as a form of symptom relief for this group of people as level of use is associated with the severity of PTSD symptoms experienced, rather than the intensity or type of trauma exposure (Cornelius et al., 2010; Hovdestad, Tonmyr, Wekerle, & Thornton, 2011).

It appears that those who develop PTSD in response to trauma are likely to have a predisposed hyper-responsiveness, leading to more intense experiences and increased levels of anxiety, which in turn affects memory formation. People with PTSD maintain a hyper-vigilant state at a pre-attentive level and will prioritize processing of noxious sensory stimuli over all other (Croy et al., 2010; Hendler et al, 2003). In short, research suggests that people who are more sensitive to stimuli in the environment are more at risk of developing PTSD if subjected to trauma (Hendler et al, 2003). Future research may provide greater clarity, but it appears that where a person has an underlying sensitivity to stimuli, they may be more likely to develop PTSD when faced with trauma due to decreased social supports, heightened anxiety, increased pain perception and difficulty regulating their arousal level suggesting a lowering of resilience.

Sensory Processing and Anxiety

Whilst the relationship between sensory processing disorders and heightened anxiety has been established, it remains unclear which is the primary condition (Pfeiffer, 2012). Anxiety is the term given to the physiological and psychological

response to anticipated threat, while sensory processing disorder refers to dysfunction in the central nervous system effecting a person's ability to detect, integrate and modulate incoming sensory stimuli (American Psychiatric Association, 2013; Koziol, Budding, & Chidekel, 2011). It appears possible that over-responsivity of the central nervous system to incoming stimuli may contribute to a state of hypervigilance to threat and heightened anxiety.

A significant correlation has been demonstrated between sensory over-responsivity and increased symptoms of anxiety and depression in general populations with no clinical diagnosis (Ben-Avi et al., 2012; Kinnealey et al., 2011; Pfeiffer & Kinnealey, 2003). For example, Ben-Avi et al (2012) compared the sensory profiles of healthy participants with their personality traits and found people who have a low neurological threshold (sensitive or avoidant) are more likely to experience high anxiety, somatisation, interpersonal difficulties and distress. It is likely that how a person experiences the world, contributes to the development of their personality, affecting both performance and participation in a variety of social and occupational contexts (Ben Avi et al., 2012; Engel-Yeger and Dunn, 2011).

The genetic influences on anxiety may provide some insight into possible the role of sensory processing and the ability to attend to sensory stimuli. Around twenty percent of the population have been found to be more attuned to changes in their environment and able to detect possible threats before others (Acevedo et al., 2014). Whilst this provides a survival advantage in the face of danger, it may cause increased anxiety where the person is unable to modulate the intensity or shift their attention away from the triggering stimuli (Cisler & Koster, 2010).

People who are sensitive appear to carry a gene which may provide an evolutionary advantage. Those with the gene were found to pause to assess and reflect on previous experience, were more perceptive, and were willing to take risks only when there was a high probability of being successful (Acevedo et al., 2014). The ability to detect threat appears to occur at a sub-conscious level and direct attention where it is needed for survival, while the processes involved in emotional regulation and active avoidance of unpleasant stimuli involve some awareness. The person is able to detect potential threat and then consciously shift their attention to where it is needed (Acevedo et al., 2014). Where a person has difficulty redirecting their attention

at a cognitive level, they may be exposed to overwhelming sensory stimuli resulting in increased anxiety (Cisler & Koster, 2010).

People who are more sensitive than others find it difficult to focus on the moment and filter out unwanted stimuli (Bakker & Moulding, 2012). Where a person is more sensitive to the threat related sensory stimuli, the top down cognitive processes of problem solving, emotional regulation and judgement are in competition with the bottom-up sensory receptors, even at a pre-conscious level (Acevedo, et al., 2014; Krusemark & Li, 2012). People who are anxious were found to have an increased ability to sense unpleasant odours, even where there was no obvious smell. When an odour is detected, even without conscious awareness, the level of physiological arousal increases and subsequently an associated emotional response occurs (Krusemark & Li, 2012).

Further to the understanding that stimuli from sensory receptors can compete with cognitive processes for attention, is the suggestion that difficulties with sensory processing would affect a person's internal representation of their environment and peri-personal space (Stein, Perrault, Stanford & Rowland, 2009). The superior colliculus is a mid-brain structure which plays a role in integrating sensorimotor information and initiating and controlling motor responses. Research suggests that the superior colliculus requires compatible multi-sensory feedback to establish functional sensory integration. Interestingly, it was found that neuro-plasticity allows for sensory integration to occur in adulthood, suggesting that sensory approaches could be used to support long lasting changes in the neurological processing of sensory information (Stein et al., 2009). Where a person has a difficulty accurately modulating and integrating multi-sensory stimuli, they would likely feel disorientated and their attention remain drawn towards sub-conscious threat-related stimuli (Stein et al., 2009). Jerome and Liss (2005) found that individuals experiencing prolonged and overwhelming stimuli due to difficulty modulating input, may 'shut down' as a means of managing their experiences.

Similarly, Engel-Yeger and Dunn (2011) reported that some people with high sensory threshold and a passive behavioral response (low registration) appeared to have difficulty appraising the relevance of sensory stimuli resulting in a delayed response, with an apparent over-reaction when they did respond, while others were more likely to deny they were experiencing stress and shut off both mentally and

behaviorally. Individuals with low registration are more likely to experience high levels of distress, increased fear and guilt, somatization, and higher levels of trait anxiety particularly in males (Ben Avi et al., 2012; Engel-Yeger & Dunn, 2011).

Anxiety frequently co-occurs with other mental health and addiction disorders and the changes in sensory processing that occurs related to each of the disorders can build a complex dynamic. For example, a delayed response to sensory stimuli has been observed in people diagnosed with schizophrenia who were found to be more likely to miss sensory information in the first instance, and were more likely to move away or avoid increased sensory stimulation (Olson, 2010). However, people diagnosed with schizophrenia along with co-existing anxiety were found to experience more severe hallucinations, impaired social and cognitive functioning, a reduced quality of life and were less hopeful (Lysaker & Salyers, 2007). Lysaker and Salyers (2007) also established that people with a diagnosis of schizophrenia who had experienced trauma were found to report higher levels of anxiety and had a greater awareness of the physical symptoms of hyper-arousal.

The studies conducted to date demonstrate a complex relationship between anxiety-related psychiatric conditions and patterns of sensory processing with resultant impact on functioning and participation. People who have experienced trauma, and report symptoms of anxiety would most likely have changes in their ability to process sensory information. However, the direction of the relationship between anxiety and sensory processing issues is still not clear. Abernethy's (2010) review of the literature related to sensory processing issues and mental health problems highlighted the lack of research with adult populations diagnosed with mental health disorders and recommended further studies into the relationship between sensory over-responsivity and anxiety.

Sensory Modulation Interventions

Sensory modulation intervention is used to organise and regulate the intensity of sensory input from the environment to support optimal functioning (James et al., 2011). The intervention can be described as preparatory, where the person is supported to choose and use sensory tools and strategies to provide a sense of safety, grounding and increase body awareness, while building therapeutic alliance (Champagne, 2011). Once the person has built a secure foundation they are able to

engage in both psychological and occupational therapy where they may begin to participate fully in their chosen roles and meaningful occupations. Research suggests that a sensory intervention should begin with psycho-education to gain insight into both individual sensory processing styles and an understanding of the effect on anxiety (Engel-Yeger & Dunn, 2011). Sensory modulation appears to be most effective when education of the bodily process involved in regulating arousal is provided and this awareness is used to develop a range of individualized strategies to increase functioning and participation (Pfeiffer & Kinnealey, 2003). Commonly used sensory modalities include weighted blankets, massage chairs, squeeze balls, rocking chairs, essential oils, music and specifically designed sensory rooms (Champagne, 2011). The following discussion briefly reviews these sensory modalities.

Sensory modalities

Stimulation of deep pressure receptors using modalities such as weighted blankets and vests, massage and squeeze balls is believed to help 'ground' people in their bodies and induce a calmer state (Sutton & Nicholson, 2011). For a number of years weighted blankets and vests have been used to provide deep pressure and proprioceptive input to reduce distress in children and adults with Autism (Mullen, Champagne, Krishnamurty, Dickson, & Gao, 2008). More recently they have been used with good effect in psychiatric settings. In one study 33% of participants were found to have a significant reduction in anxiety after using the weighted blanket as measured by changes in skin conductance (Mullen et al., 2008). Additionally, 78% of the participants subjectively rated their anxiety as having reduced. This study provides evidence that for people with no existing physical health concerns, using a weighted blanket may provide fast and effective relief from anxiety without adverse effects (Mullen et al., 2008). Reynolds, Lane and Mullen (2015) used skin conductance to measure the effects of a deep pressure vest on the autonomic nervous system and found that in adults without mental illness, the intervention both increased parasympathetic arousal, and reduced sympathetic arousal causing a decrease in the stress response. The authors therefore suggest using deep pressure for people who experience anxiety and difficulty with arousal regulation during or in preparation for engagement in occupation.

Many psychiatric community and inpatient settings are now providing mechanical massage chairs for people to use when distressed. Heard et al (2012) found a relatively short session in a mechanical massage chair significantly reduces anxiety symptoms in people with severe mental illness. The study showed a large effect size, with 96% reporting that fifteen minutes in the massage chair significantly reduced self-reported stress. The authors conclude that the use of a massage chair in an inpatient unit is convenient, cost effective and available 24 hours a day. Additionally, stimulation of the vestibular system through chairs with linear rocking or gliding movements is believed to have a calming influence on the CNS (Sutton & Nicholson, 2011). In older adults the regular use of a rocking chair has been found to decrease anxiety, depression and agitated behaviour associated with dementia (Watson, Wells, & Cox, 1998).

Sensory modalities that stimulate the external senses may also prove useful for arousal regulation and to help mental health service users' adapt to potentially stressful settings such as waiting rooms and psychiatric inpatient units (Sutton & Nicholson, 2011). For example, in their review of neurological processes related to the therapeutic use of music, Berger and Schneck (2003) reported that the body synchronizes and organizes itself to the rhythm when listening to familiar and predictable music, allowing adaptation of the sensory and arousal systems. The use of essential oils has also been found to decrease stress and anxiety, enhance relaxation and improve mood in mental health contexts (Maddocks-Jennings & Wilkinson, 2004). Furthermore, service users within inpatient settings have reported having visual input with calming characteristics such as images from nature can be helpful in providing distraction from worrying thoughts (Sutton & Nicholson, 2011).

Alongside the use of sensory modalities, a structured routine with familiar and predictable sensory focused activities has been found to support reduction of the cognitive and emotional load required to participate in daily tasks and provide reduction in anxiety (Engel-Yeger & Dunn, 2011). A local example of a sensory focused activity was provided in a study which explored the use of kapa haka (Maori traditional dance and song) within a forensic psychiatric inpatient setting. Study participants found the rhythm and collective movement characteristic of the activity supported people to self-regulate (Hollands, Sutton, Wright-St Clair & Hall, 2015).

Sensory rooms and environmental modification

Sensory modulation has been recommended as a tool to reduce seclusion and restraint in mental health services (Huckshorn, 2006; O'Hagan, Divis and Long, 2008). This has driven a focus on implementing the approach within inpatient settings, and has revolved around the use of multiple sensory modalities within a dedicated sensory room and environmental modifications within wider ward environment. Several studies indicated that sensory modulation can help reduce distress and arousal, with the most commonly used items being the massage chair, music and soft lighting (Chalmers, Harrison, Mollison, Molloy, & Gray, 2012; Scanlan & Novak, 2015). In their review of Trauma-Informed Care practices in inpatient units, Azeem et al. (2011) found that refurbishing the ward environments to provide a welcoming environment which supported people to modulate arousal levels was perceived by staff as equally important as all other strategies used. Of interest was that education and support to use sensory tools and strategies resulted in a positive culture change that empowered people using psychiatric services to be active partners in their recovery (Azeem, Aujla, Rammerth, Binfield, & Jones, 2011). In their scoping review of literature examining the efficacy of sensory modulation in mental health services, Scanlan and Novak (2015) found that sensory modulation is most effective where staff receive adequate training and are supported in developing experience and confidence in order to change their practice. Additionally, local qualitative research into sensory modulation found that resources needed to be allocated to maintain the room and tools, and the use of sensory modulation should not be limited only to sensory rooms (Sutton & Nicholson, 2011). Overall, the evidence available suggests that sensory modulation appears to be effective in reducing distress and aggressive behaviours for adults within inpatient settings, however the research is largely limited to studies exploring the implementation of the approach or describing impact on individuals, with few studies using experimental designs or control groups (Le Bel & Champagne, 2010; Lee, Cox, Whitecross, Williams, & Hollander, 2010; Scanlan & Novak, 2015; Sutton & Nicholson, 2012).

Multiple session sensory modulation interventions

The study described in this thesis focused on the efficacy of a multi-session individualised sensory modulation intervention in a community setting, rather than the

management of distress in an inpatient service. It has been argued that the purpose of intervention should extend beyond the immediate resolution of distress, and provide a sense of safety and security from which to re-engage with the world (Moro, 2012). Sensory modulation is an approach that is unique to each person's sensory experience and preferences. People choose from a range of modalities and strategies to either alert or calm their neural arousal level to be able to function and participate. Sensory interventions are believed to provide a sense of control of arousal level to enable active involvement in a range of activities (Champagne, 2011). In gaining an understanding of what is occurring at a physiological level and developing the ability to cope with an increased sensitivity, a state of stability can be reached from which social and occupational participation are possible (Champagne, 2011).

A handful of small case studies have explored the impact of a multiple-session sensory intervention for reducing anxiety and increasing participation with participants who had a psychiatric diagnosis (Champagne, 2011; Champagne et al., 2010; Moore & Henry, 2002; Pfeiffer, 2012; Wallis, 2013). Three of these case studies used the AASP to identify unique sensory processing patterns which provided the basis for intervention (Champagne, 2011; Champagne et al., 2010; Wallis 2013). The interventions provided within the studies all consisted of education around the central nervous system, senses and anxiety, and the development of a routine and range of strategies to modulate incoming sensory stimuli. The sensory modalities used in the intervention provided in these studies included weighted blankets, joint compression, exercise, tactile objects, music and essential oils (Champagne, 2011; Champagne et al., 2010; Wallis 2013). The duration of the intervention lasted between three weeks and three months with participants experiencing a decrease in anxiety symptoms, improvements in social participation and quality of life, readiness to work, and in one study there was a decrease in self-harm behaviours (Champagne, 2011; Champagne et al., 2010; Moore & Henry, 2002; Pfeiffer, 2012; Wallis, 2013). Other outcomes reported in sensory modulation research include a reduction in number and length of inpatient admissions, increased engagement in therapy, a decrease in substance abuse, and reduced use of crisis services (Brown, Shankar & Smith, 2009).

Measures used in sensory modulation and anxiety research

Research in the area of sensory processing and anxiety has either focused on one modality such as the efficacy of a weighted blanket, or measured a change in an independent variable such as anxiety (Ben-Avi et al., 2012; Mullen, et al., 2008). Several studies determining the effect of individual sensory modalities have used biomarkers to measure the immediate physiological effects (Mollo, Schaaf, & Benevides, 2008; Mullen et al., 2008; Reynolds, Lane & Mullen, 2015), however, this can be challenging and expensive to implement in the context of community based mental health practice. The Beck Anxiety Inventory (BAI) is a widely used self-report measure of both the physiological aspects (sweating, heart racing, dizziness) and the psychological symptoms (catastrophizing, fear) related to anxiety (Beck, Epstein, Brown, & Steer, 1988; Pfeiffer and Kinnealey, 2003). May-Benson and Kinnealey (2012) recommend that research into sensory processing and anxiety use both the BAI, and also the World Health Organisation Quality of Life-Bref (WHOQOL-Bref) (World Health Organization, 2004) to capture changes in anxiety and quality of life. While no measures have been recommended to evaluate the outcome of anxiety on participation, the World Health Organisation Disability Assessment scale (WHODAS 2.0) has been used in a small local study into the effects of sensory modulation intervention, and is used more widely in mental health research (Fuller, 2011; Krägeloh et al., 2013; Ustün et al., 2010; Wallis, 2013). The AASP has been used in a number of studies to both measure the sensory processing patterns and the preferences as part of developing self-awareness, and to make recommendations for strategies and sensory modalities to regulate arousal (Ben-Avi et al., 2012; Brown & Dunn, 2001; Kinnealey, Koenig & Smith, 2011; Pfeiffer & Kinnealey, 2003).

Summary of Evidence and Research Implications

Sensory modulation has been largely developed and implemented by the occupational therapy profession, which is relatively small in size and immature in the development its evidence base (Abernethy, 2010). This has potentially limited the number of sufficiently prepared researchers to provide research in this complex field of knowledge (Byrne, 2006). Therefore, while research supports the use of sensory modulation in helping people to reduce distress, the depth of the evidence remains limited. Studies supporting the use of individual sensory tools and sensory rooms have

mostly been conducted within inpatient settings with convenience samples and self-report scales. To build on the current knowledge, it has been suggested that further studies should include both qualitative and quantitative evidence, include people with experience of mental illness in designing the study, and expand the focus to application with a range of populations and in different settings (Scanlan & Novak, 2015). Larger studies that determine whether any relationship exists between specific sensory tools and sensory processing styles would provide a useful indication of which tools may be most effective for different arousal states.

The use of sensory based approaches with mental health service users in home and community settings, rather than inpatient settings is one area needing further exploration. Several studies into the efficacy of sensory modulation has been undertaken with people in the community who do not experience severe mental illness (eg. Engel-Yeger & Dunn, 2011; Kinnealey et al., 1999; Kinnealey et al., 2011). However, people receiving treatment from mental health services experience more stressors and disruptions than the wider population (Wells, 2006). They are also more likely to have changes in their financial status, accommodation, relationships and occupations (Wells, 2006). Community dwelling people with mental illness often experience fluctuations in their wellbeing requiring a change in treatment, therefore a study design that allows for ongoing ability to identify any safety concerns and measure clinical practice in situ is necessary (Bloom, Fischer & Orme, 2009).

Community mental health services are increasingly stretched in their ability to deliver early intervention for people experiencing anxiety, and sensory modulation interventions may provide a cost effective alternative to other lengthy treatments (Issakidis, Sanderson, Corry, Andrews & Lapsley, 2004). Case studies suggest that a sensory approach can be used to reduce distress and anxiety as well as improve quality of life (Champagne, 2011; Champagne et al., 2010; Moore & Henry, 2002; Pfeiffer, 2012; Wallis, 2013). However, the small size of the studies, and absence of experimental design and control groups is an issue in generalising the findings of the existing research.

While the individualized nature of the sensory approach is central to its design, it provides challenges in the development of robust evidence, particularly in defining

the treatment and identifying the outcomes (Shaaf & Miller, 2005). Possibly due to the personalised nature of sensory processing and strategies used, existing research reports have not always clearly described the interventions used. However, some core components have been identified from the literature and these include education regarding sensory processing patterns and preferences, trial of sensory modalities, and the development of individualised sensory strategies based on individual sensory profile and preferences (Engel-Yeger & Dunn, 2011; Pfeiffer & Kinnealey, 2003). Case studies suggest the intervention may be effective within a few weeks, and as little as three (Champagne, 2011; Champagne et al., 2010; Moore & Henry, 2002; Pfeiffer, 2012; Wallis, 2013). Therefore, evaluating a brief three-session sensory modulation intervention with the above core components in a community mental health setting appears to be a worthwhile endeavour.

Conclusion

Anxiety is a significant and growing problem in New Zealand. Therapy and medication have been shown to be effective treatments for most, however it is clear that people need earlier and more accessible approaches to managing anxiety. The evidence suggests a relationship between anxiety and disruptions to sensory processing, with studies indicating that addressing sensory concerns may reduce neural arousal. The literature links sensory processing disorders with disruptions to normal development and experience of trauma, and subsequently a reduction in quality of life and participation.

While research indicates that using sensory based interventions to reduce anxiety may be effective, few studies have been conducted with participants experiencing mental illness and whom receive support from a community mental health service. Those that have explored the use of sensory interventions with people experiencing severe anxiety have used a small sample which limits their generalizability. This study whilst small, is situated within a clinical practise context and is intended to provide evidence supporting an existing treatment. It can be hypothesized from this review that people experiencing anxiety will benefit from education into the physiological and neurological aspects of sensory processing and its relationship to anxiety, exploring sensory modalities and developing individualised

strategies to cope in a range of environments. Therefore this small study will investigate the effectiveness of a brief sensory intervention in reducing anxiety, and improving quality of life and participation for people accessing support from community mental health services.

CHAPTER 3: METHODS

As described in the preceding chapters, this study set out to explore the effectiveness of a three-week sensory modulation intervention in reducing anxiety, and improving quality of life and participation for people presenting with anxiety in a community mental health service. In the following chapter the design of the study will be outlined and justified. The study participants, measures and intervention will be described, and ethical and cultural considerations outlined, followed by an overview of the study phases. Finally, the methods of data preparation and analysis will be discussed.

Study Design

This study was a one group prospective quasi-experimental design in which participants were followed through the three study phases: (1) three weeks baseline, (2) three weeks intervention, and (3) three month follow-up. The research design was chosen because of its suitability to evaluate in a scientific manner the treatment processes that are in current use (Graham, Karmakar & Ottenbacher, 2012). The key characteristic of a single system design in a health setting is the comparison of an intervention period with a non-intervention or baseline period (Bloom, et al., 2009). This design is recommended for evaluating and guiding practice in the field or measuring the efficacy of a specific intervention while enabling the practitioner to monitor the individual participants and make changes if required (Bloom, et al., 2009). In classical designs the researcher cannot observe the effects of the intervention until completion of the study and the effect is generally measured across the cohort rather than for individuals (Bloom, et al., 2009).

Participants were recruited and followed through the three phases of the study with data collected three times in each phase. During the three phases repeated measurements were taken of anxiety, participation and quality of life. The intervention consisted of three sessions, each of one hour's duration, and included information regarding sensory processing, exploring sensory modalities and developing a range of sensory strategies (see Figure 2.). The baseline period of three weeks is similar to the time a service user would wait before receiving therapy for anxiety in the clinical

setting. The intervention and measures are further described in the following sections. The dependent variables were anxiety, quality of life and participation. Outcome measures for anxiety were taken at three points during a baseline period, three points during the intervention phase and then three points during the follow-up phase. The mean anxiety scores for each of the three time periods were then calculated. At the end of the study participants were invited to answer two questions about the usability and impact of the intervention.

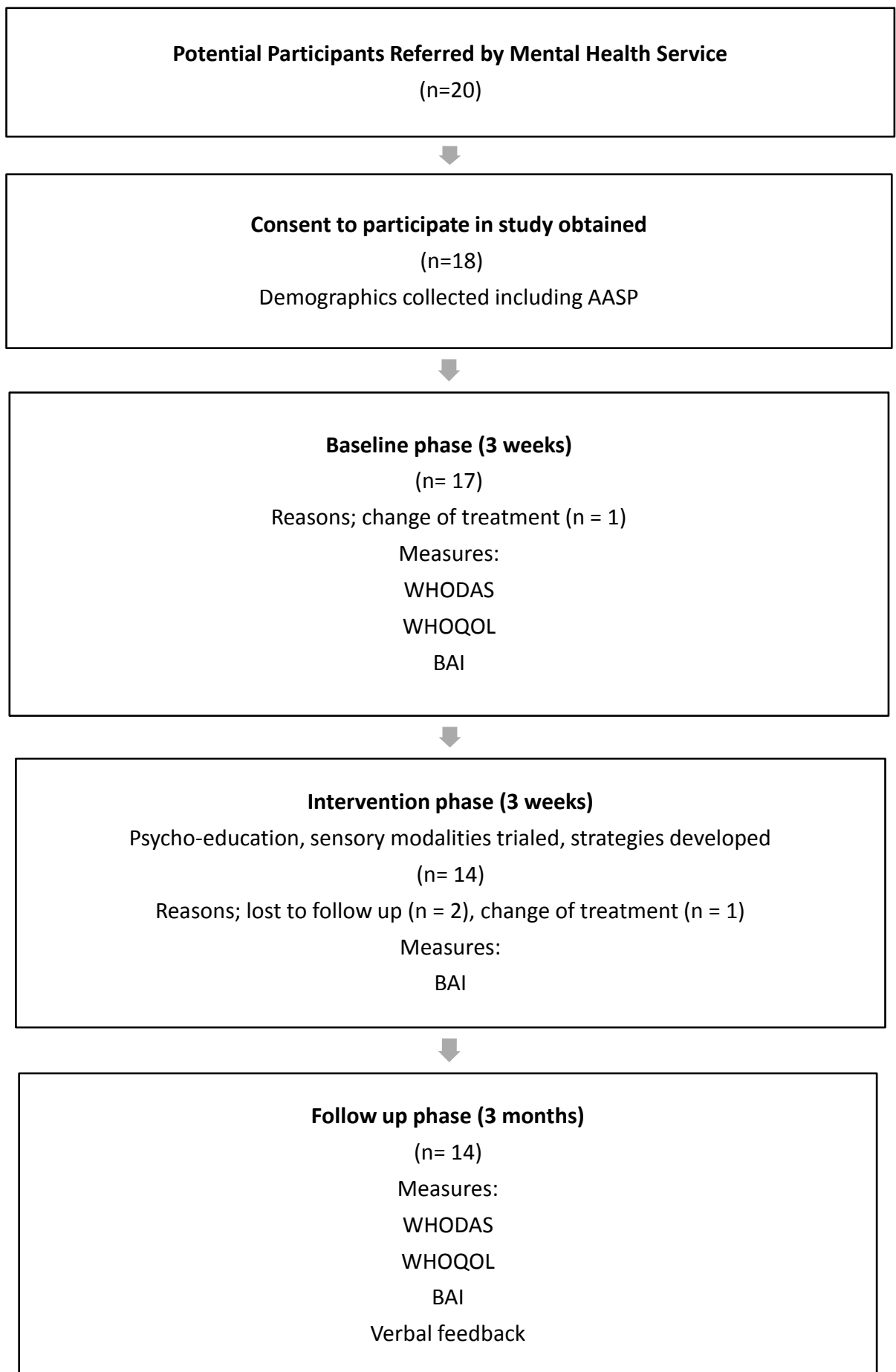


Figure 2: Flow chart showing the participants' progression through the study

Participants

Participants were recruited from two community based mental health services and reflected the diverse socioeconomic and ethnic groups of people accessing these services. Referrals were accessed either through members of the clinical teams who discussed the study with potential participants or via flyers in the service waiting rooms. Inclusion criteria for the study were: people aged between 18 to 65 years who had a primary presentation of anxiety with symptoms present for a minimum of three months. People were excluded if they had started or changed their medications within the two weeks prior to the study commencing; were already undertaking psycho-education interventions; had a cognitive impairment or recent head injury that could affect their ability to give informed consent or participate in the study; or were unable to comprehend English well enough to complete the questionnaires. People with one or more co-existing mental health or addiction issue in addition to anxiety were not excluded, as this form of co-morbidity is a common occurrence in mental health services and the allowance therefore increased the face validity of the study findings (Wang et al, 2007).

Measures

The following outlines the methods used to collect the participant demographic and sensory characteristics, as well as the measures for the dependent variables of anxiety, quality of life and participation.

Demographic and sensory characteristics.

Demographic information including age, gender, ethnicity, duration of anxiety symptoms, contact with mental health services, employment status, and co-existing issues such as experience of trauma, substance use and pain were collected verbally from the participants using a demographics questionnaire (see Appendix A).

Self-reported diagnoses were also collected as these have been shown to be valid compared to professionals' ratings of psychiatric symptoms (Eklund & Sandlund, 2012).

The Adolescent/Adult Sensory Profile: The Adolescent/Adult Sensory Profile (AASP) is a self-administered questionnaire designed to measure how a person generally responds to everyday sensory experiences and was developed from Dunn's

four quadrant model of sensory processing (Brown & Dunn, 2002). Sixty questions are clustered into types of sensations and rated by the respondent between 1 (almost never) and 5 (almost always). Sensory processing patterns are shown as the person's behavioural response to sensory stimuli (active-passive) and the neurological threshold for recognising sensory stimuli (high-low). Standard mean scores are provided for each of the four quadrants of sensory seeking (49.91 ± 6.83), sensory sensitivity (33.71 ± 7.63), sensory avoiding (34.57 ± 7.34), and low registration (30.29 ± 6.25) to determine whether the person scores more or less than most people in their age group (Brown & Dunn, 2002). Brown and colleagues (2001) found the AASP has internal consistency, with coefficient alpha values ranging from 0.63 for Sensation Seeking and 0.69 for Sensation Avoiding.

Anxiety

Beck Anxiety Inventory: The Beck Anxiety Inventory (BAI) is a 21 item self-report questionnaire designed to measure the severity of a person's anxiety (Beck, et al., 1988). Fourteen of the twenty-one questions are specific to somatic symptoms. Each item is rated from 0 to 3 (minimal to severe) and total scores are used to categorize a person's anxiety as minimal, mild, moderate, or severe. Steer and Ranieri (1993) reported that the BAI has concurrent validity with the Hamilton Rating Scale for Anxiety ($r=0.51$) and a high level of internal consistency ($r=0.92$) and a test-retest reliability of $r=0.75$.

Quality of life and participation

World Health Organization Quality of Life - Brief: The World Health Organization Quality of Life - Brief (WHOQOL-BREF) is a 26 item quality of life questionnaire which determines the person's perceived quality of life in four domains; physical health, psychological health, social relationships and environment (World Health Organization, 2004). Higher scores reflect a better quality of life. It has been shown to have excellent psychometric properties (Skevington, Lotfy, O'Connell, & Group, 2004). WHOQOL-BREF is validated in both mental health (Trompenaars et al., 2005) and NZ populations with a Cronbach's alpha over-all value score of 0.91 (Krageloh et al., 2012). The WHOQOL-BREF is a brief version of the original WHOQOL-100, therefore scores in the short form are transformed to enable results to be compared between the two versions. A second transformation allows the scores to be

converted to a 0-100 scale. Transformation tables are included in the manual (World Health Organisation, 1996).

World Health Organization Disability Assessment Schedule: The World Health Organization Disability Assessment Schedule (WHODAS 2.0) is a 36 item measure which captures the impact of health conditions on participation in six life domains; understanding and communicating, getting around, self-care, getting along with people, life activities and participation in society (Ustün et al., 2010). Participants respond on a 1-5 scale (1= *no difficulties due to health condition*, 5= *extreme difficulty or cannot do it*). Lower scores therefore reflect that the persons' disability has less effect on their participation. The WHODAS 2.0 has been validated with people diagnosed with anxiety disorders (Perini et al., 2006) and in New Zealand primary care (MaGPIe Research Group, 2004). It has proven cross-cultural applicability, reliability (ICC 0.98), validity (Cronbach alpha 0.86) and utility in health research (Ustün et al., 2010).

Qualitative data

Participant Feedback: At the end of the study participants were invited to answer two open questions about the usability and impact of the intervention. The first question asked: How did you find the intervention? This aimed to clarify the participants understanding of sensory modulation and the acceptability of the intervention to them. The second question asked: In what ways have you found the intervention useful? This question aimed to find out if the participants identified any particular benefits in relation to anxiety reduction, quality of life or participation. This data was collected to complement the quantitative data rather than as a major aspect of the study. Therefore to contain the amount of qualitative data collected participant responses were limited to a maximum of 10 minutes and taped using an audio recorder, then transcribed for analysis.

Intervention

The intervention consisted of three, one hour long sessions with each individual participant over a period of three weeks. Participants were asked to complete the anxiety measures in the waiting area, prior to attending the intervention

sessions. The sessions were delivered by the researcher, who is a senior occupational therapist with several years of experience in using sensory modulation in mental health practice. The content of the sessions was based on both Champagnes' resources, and Moores' group programme which were then adapted through experience in applying the approach in practice (Champagne, 2008; Moore, 2005). The intervention was simplified to cater for people using mental health services who need practical strategies, and clinicians who have limited time to spend with service users. The first session provided education about the autonomic nervous system including the sympathetic and parasympathetic responses and the ability to influence the neural arousal state through both the somatic and external senses. Written information about the autonomic responses was provided to aid retention of the information and for the participants to share with the people who support them (see Appendix B, C, D, E & F).

The AASP was completed by the participants prior to the session, so that the results could be discussed within the session and the participants' unique sensory preferences identified. Some initial recommendations to support the participants in modifying the sensory environment and modulating their arousal levels were also provided by the practitioner.

The second session focused on exploring a limited range of sensory modalities supplied by the District Health Board to establish which of these are most effective for the person and how they could be used in daily life. The modalities used to induce calming sensations included visual, olfactory, taste, auditory, tactile, proprioceptive, vestibular and oral motor (see Table 3). Where it was established that a particular modality was useful for the participant, funding was available to purchase the larger items and the participant was provided with an information sheet about different ways to obtain the sensation experienced while using the modality.

The third session focused on creating specific sensory strategies to enable successful participation in meaningful occupation. The activities that were identified as being challenging on the sensory profile for each participant were discussed along with sensory strategies to support a reduction in anxiety or distress. A plan was made to integrate sensory strategies into the participants' daily routine and across their work,

leisure and home environments. Participants were invited to bring along family/whanau to the sessions to increase their ability to provide support.

Table 3

The Sensory Properties of Equipment Used to Modulate Participants' Neural Arousal

Equipment	Sensory properties
Yuk e ball or squeeze ball	Proprioception
Lycra wrap	Proprioception
Weighted blanket (7.5kg)	Deep pressure and proprioception
Weighted blanket (10kg)	Deep pressure and proprioception
Weighted blanket (12kg)	Deep pressure and proprioception
Weighted shoulder (5kg)	Deep pressure and proprioception
Weighted Dog (5kg)	Deep pressure and proprioception
Weighted cat (2.5kg)	Deep pressure and proprioception
Scented oils	Olfactory
Rocking chair	Vestibular
Massage chair	Deep pressure and proprioception
Tapping bag	Deep pressure and proprioception
Relaxation CD	Auditory
Frozen orange/flannel	Tactile
Hot face cloths	Tactile
Stretchy Bands	Proprioception
Powders, soaps	Olfactory
Sunglasses	Visual
Mink blankets/pillows	Tactile
Bubbles	Visual and oral motor
Mints, lollies, chewing gum	Gustatory and oral motor
Lava lamp	Visual

Ethical and Cultural Considerations

The research proposal for this study was approved by the Auckland University of Technology Ethics Committee (AUTEC) on the 20th September, 2013 - reference

number 13/200 (see Appendix G). A locality agreement with the District Health Board was sought and approved once ethics approval was gained - registration number RM 0980712531 (see Appendix H). Cultural approval for the study was provided by the Maori Research Committee at the Auckland and Waitemata District Health Board's (see Appendix I). Additionally, consultation was sought with the District Health Board's Maori Cultural Advisor to determine the needs of Maori in relation to the study design, implementation and dissemination of the results. Based on this consultation, adaptations were made to the participant information sheet to provide contact details should there be concerns specific to Maori participants.

Several key ethical considerations were addressed in the study design to ensure that participants were fully informed and were not negatively affected by their participation in any way. Potential participants accessing the community mental health services were assessed and offered a range of treatment options (cognitive therapies, sensory modulation, occupational therapy, medication), as is usual in clinical practice. Where service users decided to undertake sensory modulation they were informed of the study by an intermediary, either their key worker or psychiatrist and preliminary information given. These service users were offered the option of the sensory modulation intervention regardless of whether they wished to take part in the study or not. In usual practice there is typically a delay of three to four weeks between patient referral and the commencement of treatment. Therefore, people participating in this study were not disadvantaged by waiting for the intervention to start during the baseline phase. Those service users who chose to proceed as participants were informed of the study process and expectations through both written and verbal information, which was provided in easily understood language (see Appendix K). They were also asked to sign a consent form (see Appendix L)

The intervention was provided in a collaborative manner with sensory preferences identified based on the participant's individual sensory profile and their choice of sensory tools and strategies. Where the participant identified a particular sensory tool to be beneficial from the specified list available, they were able to keep the tool if they chose to do so. The outcomes of the intervention were fed back to the participants and their supports, their primary clinician as well as their treating

psychiatrist. Participants received a copy of their sensory profile report, transcribed interview, and their measurement scores to check for accuracy.

Confidentiality was maintained throughout the study, and the collected data is stored securely at AUT for a period of six years before being destroyed. Consent forms are being stored separately so no link can be made between participants and data. Participants were informed that they could withdraw from the study at any time without affecting their health care or on-going service in any way. To avoid potential conflict of interest the researcher has not acted as keyworker for any service user in the study. As outlined in the research protocol for clinician sheet (see Appendix J) and the participant information sheet (see Appendix K), if any of the participants had disclosed suicidal ideation or high levels of distress during the study, the treating team would have been informed and with consultation the person would have been withdrawn from the study.

Procedure

The study was structured around three phases and the procedures for each of these are outlined in the following discussion and summarised in Figure 1.

Recruitment and Baseline Phase

After ethical approval had been obtained, the service managers were approached for approval to proceed and a short presentation was provided to inform clinicians of the study methods and procedure, and their role in the study. Clinicians were asked to give verbal information about the study to service users who experience anxiety, and to provide the researcher's contact details to those interested. Then those people who were interested contacted the researcher for further information about the study. As discussed under ethical considerations, the participant information sheet (see Appendix K) was discussed with potential participants prior to the consent process taking place (see Appendix L) and the participants were made aware that they had the right to withdraw at any stage.

Twenty adults with a presenting problem of anxiety were invited to take part in the study (see Figure 2). Of the twenty people who initially agreed to participate, two withdrew before the initial appointment. Eighteen potential participants gave signed

consent to participate, provided demographical information and completed the Adolescent/Adult Sensory Profile (AASP). Measurements of participation and quality of life were collected using the WHODAS and WHOQOL at the start of the baseline phase and the anxiety measure (BAI) was completed weekly by participants through the baseline phase. These measures were administered by the participants' keyworkers or another clinician to avoid the influence of the researcher in collecting the data.

Intervention Phase

The three session sensory modulation intervention was delivered as described previously. The weekly sessions were conducted in the community mental health service clinic rooms and each lasted one hour. All interventions took place between March and December of 2014. Some sessions were delayed by no more than a week due to difficulty with transport or illness. Two participants were lost to follow up during the intervention phase, and one withdrawn due to a change of diagnosis and treatment. The collection of weekly measures of anxiety using the BAI continued through the intervention phase.

Follow-up Phase

During the three month follow-up phase the BAI was completed monthly to identify if changes to anxiety were present and sustained over this period. At the end of the follow up phase fourteen participants completed the WHODAS 2.0 and WHOQOL-BREF measures, and were then invited to give feedback to the researcher using a semi-structured interview. This verbal feedback was audio-taped.

Data Preparation

The data was checked for errors and then entered into the data file in Statistical Package for Social Sciences (SPSS, version 20, IBM Corporation, 2011). The WHOQOL-BREF had 3 negatively phrased items that were reversed before being included into the domain scores. The raw domain scores were transformed using a manual calculation included in the WHOQOL-BREF manual (World Health Organisation, 1996). The mean and standard deviation of the three baseline BAI scores were calculated to determine stability and enable the participants to act as a baseline control (Bloom, et al., 2009).

Data Analysis

Data were analysed using SPSS (version 20), with the alpha level set at $p < .05$ (95% confidence interval). The data were then checked to determine whether it were normal distribution. Where data were not distributed normally, non-parametric testing was used. Where data were found to be distributed normally, parametric testing was employed.

The sample's demographic and illness characteristics were analysed descriptively using frequencies, medians, means and ranges of scores. AASP scores were analysed using frequencies and percentages of the samples scores. Correlations between BAI baseline and AASP scores were examined. The methods of analysis used in relation to each of the hypotheses are as follows.

Hypothesis 1:

Participating in a brief sensory modulation intervention will reduce the anxiety levels experienced by people who are diagnosed with a mental illness

Means, standard deviations and medians were calculated for the BAI scores at each of the three study phases (Zhan & Ottenbacher, 2001). Friedman's non parametric test was used to compare the anxiety scores across the three phases of the study. Where significant differences were identified, a post hoc analysis (Wilcoxon Signed Rank Test) was conducted to determine where these differences occurred (Johnston & Smith, 2010; Pallant, 2011; Portney & Watkins, 2000).

Hypothesis 2:

Participating in a brief sensory modulation intervention will improve the quality of life of people who are diagnosed with a mental illness

The mean and total scores of each domain in the baseline and follow-up from WHOQOL-BREF were compared using paired sample *t*-tests to determine the overall significance, compare mean values and calculate the effect size.

Hypothesis 3:

Participating in a brief sensory modulation intervention will increase the participation in activities of people who are diagnosed with a mental illness

The mean and total scores of each domain in the baseline and follow-up from WHODAS 2.0 were compared using paired sample *t*-tests to determine the overall significance, compare mean values and calculate the effect size.

Hypothesis 4:

Secondary Hypothesis: High scores on the BAI at baseline will be moderately to strongly correlated with sensory sensitivity on the AASP

The relationship between the variables was calculated using Spearman's non parametric correlations.

Participant feedback

The participants' interviews were transcribed and analysed for themes using content analysis (Graneheim, Lundman, Omvårdnad, Medicinsk, & Umeå, 2004). The data were read carefully and experiences or responses relevant to the research question and objectives were identified. Common experiences and responses were grouped into basic themes and the frequency of times that an experience or response was mentioned was noted. Noting the frequency of a particular response is one way of identifying its importance across participants (Holloway, 1997)

CHAPTER 4: RESULTS

The descriptive statistics of the participants' demographic and mental health status will be described in this chapter. This chapter then presents the tests of the hypotheses including the results of the measure for the dependent variables of anxiety, quality of life and participation.

Demographics and Mental Health Status

The sample consisted of 11 women and 7 men, most of whom identified as New Zealand European (see Table 4). Approximately half of the group were employed at least part-time. The age range of the participants spanned from 19 to 65 (mean 35.06, SD 12.55).

Table 4

Descriptive Statistics of Participants' Demographic Characteristics

Characteristics	Descriptive Statistics (N=18)
Gender	
Male	7
Female	11
Ethnicity	
Maori	2
New Zealand European	11
Korean	2
Vietnamese	1
Iraqi	1
South African	1
Employment status	
Employed	10
Unemployed	8
Age range (years)	19-65 (35.06±12.55)

All participants had recent contact with mental health services with the average length of time being nine years, however the participants had experienced mental illness for some years prior to this. As can be seen in Table 5, most participants had a diagnosis of an anxiety disorder and five also experienced depression. All but one of the participants experienced ongoing pain and approximately half the group had difficulties with problematic substance abuse. While only two had a diagnosis of post-traumatic stress disorder, sixteen of the eighteen participants described having experienced a substantial trauma at some time in their lives.

Table 5

Descriptive Statistics of Participants' Mental Health Status and History

Mental health status and history	Descriptive Statistics (N=18)
Mental health service contact (years)	1-34 (09.29±11.06)
Illness duration (years)	1-40 (16.68±14.67)
Diagnosis	
Schizophrenia and anxiety	3
GAD	5
MDE and anxiety	1
GAD, MDE, OCD	1
GAD, MDE	2
GAD, MDE, ASD	1
Post-traumatic stress disorder	2
Borderline personality disorder	2
Psychosis NOS and anxiety	1
Experience of trauma	16
Problem substance use	8
Problem alcohol use	9
Experience of ongoing pain	17
Problem benzodiazepine use	7

Abbreviations: GAD=Generalised Anxiety Disorder, MDE=Major Depressive Episode, OCD=Obsessive Compulsive Disorder, ASD=Autistic Spectrum Disorder

Table 6 shows that seven of the eighteen participants chose to use weighted modalities (deep pressure) as part of the intervention. Five participants chose to use the lycra wrap (proprioception). Two participant's used the essential oils and four participants chose to learn sensory strategies not requiring a particular tool such as walking or taking breaks from noisy environments.

Table 6

Sensory modalities used by Participants

Sensory Modality	Descriptive Statistics (N=18)
7.5kg weighted blanket	1
12kg weighted blanket	4
5kg weighted shoulder blanket	1
5kg weighted cat	1
Lycra wrap	5
Essential oils	2
Strategies only	4

Sensory Profile

The mean sensory profile scores for each of the sensory processing categories are presented in Table 7. The scores for sensory sensitivity (SS) and sensory avoidance (SA) were higher in the visual category, touch, and auditory categories. The participants' mean scores for sensory seeking were highest in taste and activity.

Table 7

Descriptive Statistics of Adult/Adolescent Sensory Profile Scores

Modality		mean	SD
Taste	Low registration	4.64	2.59
	Seeking	8.76	1.55
	Sensitivity	2.82	2.53
	Avoidance	5.94	1.19
Movement	Low registration	5.52	2.69
	Seeking	6.52	2.40
	Sensitivity	8.76	2.33
	Avoidance	1.35	0.60
Visual	Low registration	4.70	1.68
	Seeking	5.41	2.15
	Sensitivity	9.82	3.16
	Avoidance	8.76	2.99
Touch	Low registration	5.94	2.35
	Seeking	7.76	1.43
	Sensitivity	10.76	2.82
	Avoidance	10.76	3.26
Activity	Low registration	9.23	2.68
	Seeking	8.70	1.99
	Sensitivity	4.23	0.97
	Avoidance	10.29	2.68
Auditory	Low registration	9.23	2.58
	Seeking	5.88	2.39
	Sensitivity	11.70	2.46
	Avoidance	9.41	3.35

The range of participants' individual scores in the AASP are provided as percentages in each of the four quadrants in Table 8. In the low registration quadrant almost half of participants' scores were similar to most people and the remaining scores were higher than most people, with no participants scoring less than most people. More than half of the participants scored similar to most people in sensory seeking, with no participants scoring more than most people in this quadrant. In the sensory sensitivity

quadrant the majority of participants scored more, or much more than most people, with no participants within the less sensitive range. In the sensory avoidant quadrant, most of the participants' scores were more, or much more than most people, with the remaining scores in the range of being similar to most people.

Table 8

Participant Adolescent/Adult Sensory Profile Quadrant Frequencies

Quadrant	Percentage of Participants (N=17)
Low registration	
Much less than most people	0%
Less than most people	0%
Similar to most people	47%
More than most people	35%
Much more than most people	18%
Sensation Seeking	
Much less than most people	23%
Less than most people	18%
Similar to most people	59%
More than most people	0%
Much more than most people	0%
Sensory Sensitivity	
Much less than most people	0%
Less than most people	0%
Similar to most people	12%
More than most people	53%
Much more than most people	35%
Sensory Avoidance	
Much less than most people	0%
Less than most people	0%
Similar to most people	30%
More than most people	35%
Much more than most people	35%

Hypothesis One (Anxiety)

BAI scores. The following scores were analysed using non-parametric statistical testing and hence medians are presented in preference to means and standard deviations. A Friedman test compared all the participants' three baseline BAI total scores and showed that there were no statistically significant differences across the three time points $\chi^2(2, n = 13) = 2.72, p = .256$. The median values for each measurement time points at baseline were time 1 ($Md = 26$), time 2 ($Md = 27$), and time 3 ($Md = 21$).

An examination of the data revealed that one participant was an extreme outlier on the three BAI measurements taken in the follow-up phase. The participant had severe anxiety in the baseline phase ($Md=43.67$), then a reduction in the intervention phase ($Md = 37.33$), and an increase at follow-up ($Md=53.67$) which was attributed to a physical illness. Including this participants' data in the final analysis of the data would have increased the cohorts' mean follow-up score from 13.5 to 16.1.

Table 9

Participant BAI scores from baseline, intervention, and follow up

Baseline		Intervention		Follow-up	
Md	Range	Md	Range	Md	Range
23.3	3-37	18.3	3-34	13.5	5-35
(23.62±10.53)		(16.66±8.92)		(16.61±8.97)	

For the data from the remaining twelve participants, a Friedman test showed a statistically significant difference in BAI scores across the three time points (baseline, intervention and three month follow up, $\chi^2(2) = 6.50, p = .039$). Inspection of the median value of the total BAI scores showed a decrease in anxiety from baseline ($Md = 23.3$) to intervention ($Md = 18.3$) and a further decrease at follow-up ($Md = 13.5$). A Wilcoxon Signed Rank test revealed a trend towards a statistically significant reduction in anxiety scores from baseline to intervention, $Z = -1.92, p = .054$ with a medium effect size ($r = .39$), from baseline to follow-up $Z = -2.16, p = .03$ with a medium effect

size ($r = .44$), from intervention to follow-up $Z = -1.06$, $p = .28$ with a small effect size ($r = .28$).

Participants' mean BAI scores were counted and criterion percentages calculated for each of the three study phases (see Table 10). At baseline most of the participants' mean BAI scores were moderate to severe. During the intervention phase the participants' mean BAI scores reduced to within the low range and remained the same during the follow-up phase.

Table 10

Participants' Beck Anxiety Inventory Criterion Frequencies

Severity of anxiety	Baseline	Intervention	Follow-up
Low anxiety (mean scores = 0-21)	29%	71%	71%
Moderate anxiety (mean scores = 22-35)	53%	22%	22%
Severe anxiety (mean scores = 36-63)	18%	7%	7%

Hypothesis Two (Quality of Life)

As can be seen in Table 11, there was no significant difference between the pre-treatment and post-treatment scores in any of the four domains of the WHOQOL. On further investigation, there was no significant change in any of the 26 individual questions.

Table 11

Descriptive Data and Analysis of the Participants' Scores on the Four Domains of WHOQOL between Time 1 and Time 2

	Pre-treatment mean (SD)	Post-treatment mean (SD)	$t(df=1,13)$	p value
Domain 1 (physical health)	19.00 (2.96)	18.42 (3.83)	0.77	0.45
Domain 2 (psychological)	16.64 (3.54)	16.07 (3.70)	0.73	0.47
Domain 3 (social relationships)	7.85 (2.14)	8.00 (2.74)	-0.35	0.72
Domain 4 (environment)	25.92 (4.74)	24.21 (5.82)	1.16	0.26

The transformed scores across the three domains of physical, psychological and social relationships were fairly similar, however all were lower than the WHOQOL norms 13-15 ($SD\pm 3.2$). In domain four the participants' transformed scores were within the range most people would score 12-13 ($SD\pm 2.3$).

Table 12

The Raw and Transformed Scores for the WHOQOL

		Raw score	Transformed scores	
			4-20	0-100
Domain 1 (physical health)	pre	19	11	44
	post	18	10	38
Domain 2 (psychological)	pre	16	11	44
	post	16	11	44
Domain 3 (social relationships)	pre	7	9	31
	post	8	11	44
Domain 4 (environment)	pre	25	13	56
	post	24	12	50

Hypothesis Three (Participation)

There was some variability in the mean scores of the six domains of the WHODAS over the duration of the study as can be seen in Table 13. The decreased scores in four of the six domains scores from pre-treatment to follow-up indicate a reduction of the impact of anxiety on functioning and participation. In the follow up phase, the scores for getting along with people, life activities and participation in society decreased significantly. While both understanding and communicating and self-care scores decreased they did not reach a level of significance. Overall there was decrease in all domain mean scores from pre- intervention to end of the follow up phase, indicating that the participants' anxiety had less impact on their functioning and participation across the domains.

Table 13

Descriptive Data and Statistical Analysis of the Pre-Treatment and Follow Up Phases on the Six Subscales of WHODAS

	Pre-treatment mean (SD)	Follow-up mean (SD)	$t(df=1,13)$	p value
Understanding & Communicating	15.85 (3.57)	13.92 (4.06)	1.62	.129
Getting around	11.35 (4.14)	8.71 (2.39)	2.55	.024
Self-care	7.28 (1.85)	6.28 (1.85)	1.45	.169
Getting along with people	14.42 (4.21)	12.14 (4.07)	3.77	.002
Life activities	19.57 (9.24)	15.92 (6.42)	2.56	.024
Participation in society	23.57 (4.78)	21.07 (5.03)	2.40	.032
Number of days difficulties were present	20.21 (6.91)	16.29 (8.84)	2.03	.063

Participants were also asked to quantify of the past 30 days, how many days were the difficulties they experience present. A paired sample-t test was conducted to evaluate the impact of the intervention on the number of days that difficulties were present for the participants. There was no statically significant decrease found between the pre-treatment mean score (20.21) and the post-treatment mean score (16.29) ($t(13) = 2.03, p=.06$). The mean decrease in this subscale was 3.92 with a 95% confidence interval ranging from -2.50 to 8.10.

Hypothesis Four (Anxiety and Sensory Threshold)

The AASP percentages in each quadrant were then correlated with participants' mean BAI scores taken at baseline. There was a strong significant correlation between high BAI scores and the Sensory Sensitivity quadrant of the AASP ($\rho = .53, p < .05$),

and a moderate correlation between high BAI scores and Low Registration ($\rho = .37$). Both Sensory Seeking ($\rho = .25$) and Sensory Avoidance ($\rho = .28$) were found to have a weak correlation with high BAI scores.

Participants' Qualitative Feedback

Thirteen of the participants provided verbal feedback and analysis of the transcribed data revealed three main themes: 1) perceived efficacy of specific sensory tools, 2) challenges with the intervention, and 3) overall benefits of the intervention.

Perceived efficacy of specific sensory tools

Deep touch was the modality most commonly named by the participants as being useful. This included the use of a weighted blanket (x5), dog (x2), tapping body with bean bag (x1), massage (x1) and body wrap (x2). The feedback indicated that the weight or pressure of these modalities helped them to feel safe when they were anxious or distressed. For example, Participant 6 stated: *"I tried the wrap a few times when I felt very unstable, insecure. It was very nice, it made me feel covered with protection."* Similarly, Participant 9 stated: *"Without a doubt it has reduced my symptoms of anxiety...it's worked, especially the blanket. I don't use it all the time, I save it for when I need it, for when it's really tough and I really, really need it."*

Other modalities mentioned as being particularly helpful were music (x3), candles (x1), scents (x2), peppermint sweets (x1) and sucking from a water bottle (1). Participant 18 described being able to use a range of modalities at once to create the sensory environment needed to reduce her anxiety *"I use a candle at home to calm myself and I listen to music. I think about the volume of music constantly when I do play it, it just sort of effects my mood that I want. It has definitely helped my moods and anxieties"*. Using alerting sensations also helped induce a calmer state by providing a means to distract from distressing thoughts, for example Participant 4 found *"the things like the water, the peppermints and music, all those things were able to really snap me out of it"*.

Challenges with the intervention

The participants noted some challenges in relation to using the sensory strategies. These included finding it difficult to try new sensory experiences: *"I didn't*

like the third session, especially the rocking chair. I didn't like trying all the new things." (Participant 2), and being able to determine if the effect of the sensory tools had reduced, or whether life stressors had caused an increase in their anxiety symptoms: *"Lately I've been struggling but that's possibly just because maybe it's not working so well anymore or maybe it's just because I've got something going on."* (Participant 14).

Benefits of the intervention

Overall the participants found the intervention to be relevant to them and the education provided was easily understood; *"It suited the way I was thinking and how I analyse things, and maybe understand why I was feeling those things I was feeling, and the actions that I take, so it was very helpful"* (Participant 3). Participants also described that having an understanding of both the nervous system and their unique sensory preferences reduced their level of anxiety and increased their confidence: *"It's more there is something going wrong with your body and there is a reason why all this is happening and you're not just another freak that just can't deal with your problems"* (Participant 18).

Some participants found that knowing they had sensory strategies enabled them to feel less anxious and provided them with a sense of agency. Participant 12 described the experience of anxiety as fluctuating in terms of duration and intensity:

I use it when I come home from work. And I usually am feeling kind of stressed and works been a bit hard, and I live in a really small place, and I sometimes I can get cabin fever and everything just makes me a bit uneasy, and I use the blanket and everything just gets a bit better.

Similarly, Participant 3 described the fluctuation in anxiety symptoms and the importance of continuing to use and develop new strategies, while being aware of the changes in their levels of anxiety *"I basically think about the situation I'm in at the time and my response to it and instead of putting up a barrier and thinking automatically that I can't do that or it's too stressful, I can work through it"*. Most participants indicated their intention to continue to use and develop further sensory strategies to enable participation in their life roles and chosen occupations.

CHAPTER 5: DISCUSSION

The purpose of this study was to examine the efficacy of a brief sensory modulation intervention in reducing anxiety, increasing quality of life and participation. There was support for hypothesis one with significant differences found between the baseline and treatment anxiety scores, which were maintained at the three month follow-up. Hypothesis two was not supported, as no significant differences were found in the participants' quality of life scores between baseline and follow-up. Partial support could be given for hypothesis three with significant differences in the level of participation found in four of the six subscales of the WHODAS. A significant correlation was found between high levels of anxiety and increased sensory sensitivity. Moderate correlations were found between high levels of anxiety and both sensory avoidance and low registration. The results will be discussed and interpreted in relation to existing research and other relevant literature. The chapter will conclude with strengths and limitations of the study, recommendations for future research and practice followed by a summary of the key findings.

Demographic and Sensory Characteristics

Overall the demographic characteristics of the sample are similar to those previously reported for people who experience anxiety (Wells, 2006). The larger number of women within the study is in keeping with the higher prevalence of anxiety in women than men (McLean, Asnaani, Litz, & Hofmann, 2011). The mean age of the participants was 35 years (± 12.55), which is consistent with local studies which indicate the prevalence of anxiety disorders being highest in the 25-44 year age group (Bushnell et al., 2003; Wells, 2006). New Zealand prevalence studies show Maori experience higher rates of anxiety than non-Maori, however only two participants identified as Maori with the majority of participants identifying as European ($n=11$) (Wells, 2006).

More than half of the people who took part in the study were employed which is in line with literature showing anxiety appears to have a mild-moderate level of interference with work or studying (Wells, 2006). The number of years that the participants had contact with mental health services varied greatly (0.29 ± 11.06)

which may be a reflection of the large range in age of the participants. This wide range was also seen in the number of years that the participants had experienced anxiety (16.68 ± 14.67).

Of the initial 18 participants, half of them had a diagnosis including generalised anxiety disorder (GAD), four had a diagnosis that related to trauma and attachment issues (borderline personality disorder, post-traumatic stress disorder), and four experienced psychotic symptoms. Almost all of the participants reported having experienced substantial trauma (89%) as compared to population norms (75%) (Mills et al., 2011). Experience of trauma has been found to be correlated with both increased anxiety and increased sensory sensitivity, with literature recommending self-regulation and stabilising strategies such as sensory modulation taught prior to engaging in therapy (Cantor, 2009; Engel-Yeger et al., 2013).

Participants described illicit substance use (44%), alcohol use (50%) and benzodiazepine use (39%) as being a problem for them, illustrating the interwoven issues and their attempts to manage the symptoms of heightened neural arousal (Cornelius et al, 2010; Hefner, Moberg, Hachiya & Curtin, 2013). Benzodiazepines are often prescribed to reduce arousal levels for people experiencing anxiety, however their addictive properties can be problematic over time (Zhao et al, 2012). Problem alcohol use is commonly seen in people with GAD and PTSD, where it has been found to provide an anxiolytic effect and reduce the exaggerated startle response (Cornelius et al, 2010; Hefner et al., 2013). With the exception of one, the participants described experiencing ongoing pain which may be related to the high levels of sensory sensitivity in the sample. People with high sensory sensitivity were found to be more sensitive to pain and have a greater expressed pain response (Engel-Yeger & Dunn, 2011). Pain, trauma and substance misuse are all commonly seen alongside both anxiety and sensory sensitivity which will be discussed in the following section.

Sensory Characteristics

The participants in this study completed a Sensory Profile to enable the intervention to be shaped to their individual needs, and to add to the understanding of how people experiencing anxiety perceive and process sensory stimuli. The sensory profiles of the participants in this study were similar to those reported for other people

experiencing anxiety with higher scores in the low registration (39.29 ± 10.23), sensory sensitivity (48.05 ± 6.82), and sensory avoidance (46.52 ± 10.11) quadrants as compared to the AASP normal range values (Ben-Avi et al, 2012; Brown & Dunn, 2002). The scores indicate that all participants were sensitive to sensory stimuli, and more than most indicated they actively avoid sensory stimulus. Sensory avoidance has been found to be correlated with disruptions to mental health and emotional wellbeing, poor general health and increased experience of pain (Kinnealey et al., 2011). The scores on the participants' AASP were consistent with recent studies which demonstrated that people who had experienced trauma have a lower sensory threshold (sensory sensitive, sensory avoidant) and are more likely to not notice some sensory information in their environment (low registration) (Engel-Yeger et al., 2013). More than half of the participants described having a lower registration for sensory information than other people, meaning they do not notice all the available sensory information in their environment which is believed to be caused by an over-whelmed nervous system that has shut down as a compensatory measure (Jerome & Liss, 2005).

The sensory profiles of the participants describe a group who are more sensitive than most people to environmental stimuli, are more likely to avoid or modify environments so as not to be overwhelmed, and are not perceiving all the available sensory information due to being in a high neural arousal state. When taken in tandem with the participants' demographic and mental health characteristics, the sensory profile further illustrates the complex presentations of people experiencing heightened anxiety and the multi-dimensional clinical approach needed to address the range of issues that are faced.

Hypothesis One (Anxiety)

In the baseline phase most of the participants (71%) indicated they experienced moderate to severe anxiety. During the intervention the BAI scores showed that most participants had experienced a reduction in anxiety to the mild to moderate range (71%) and this persisted through to the three month follow-up. Furthermore an analysis of the mean BAI scores from the three phases showed a significant reduction in anxiety from baseline to follow-up.

This finding supports the results of previous studies which also found that a multi-session sensory approach to be effective in reducing anxiety (Champagne, 2011;

Champagne et al., 2010; Moore & Henry, 2002; Pfeiffer, 2012; Wallis, 2013). Of note is that these reductions in anxiety were achieved with only 3 sessions of intervention, whereas other sensory modulation programmes (Champagne, 2011; Champagne et al., 2010; Moore & Henry, 2002; Pfeiffer, 2012; Wallis, 2013) included four to six sessions and psychological therapies typically involve at least 6 sessions and often more.

The effectiveness of the intervention in reducing anxiety was supported by the qualitative feedback where participants described a reduction in anxiety when using specific sensory tools. Some of the participants described developing a sense of agency with increased self-awareness and confidence that they could manage their symptoms. Consistent with existing knowledge about the fluctuating nature of anxiety, the participants described having more anxiety some days than others, often dependant on external stressors (Wells, 2006). The participants reported they were able to effectively use the sensory tools and strategies to self-regulate when they experienced heightened neural arousal.

Hypothesis Two (Quality of Life)

The participants' scores on the WHOQOL showed no change in any of the four life domains (physical health, psychological, social relationships and environment). In the physical, psychological and social relationship domains the participants' scores were slightly lower than the standard norms, indicating that the participants in this study experienced a lower quality of life than most people. Studies have found that anxiety has a moderate impact on social life, but less of an impact on home maintenance (Wells, 2006). In the domain of 'environment' the participants scored within the normal range which suggests that factors such as safety, money, transport, and access to information have less of an influence on quality of life than physical and psychological wellbeing and social relationships for people experiencing anxiety.

Wallis (2013) used a similar intervention protocol, with the addition of three sessions that addressed occupational functioning and improving performance in life roles, and found some improvement in quality of life. Where time allows the additional sessions may add to the effectiveness of the intervention in improving quality of life.

Hypothesis Three (Participation)

The participants showed a significant reduction in the WHODAS subscales of *getting along with people*, *getting around* and *participation in society* indicating that the impact of anxiety on participants' ability to develop and maintain relationships with others, and participate in their communities had reduced. No significant change was seen in the subscales measuring peoples' ability to communicate with others (concentration, memory and learning), or to perform self-care activities (washing, dressing and eating), however the participants' baseline scores were within the mild to moderate range suggesting these was not substantial areas of difficulty.

Significant results were found in the *getting along with people* subscale indicating people felt more able to make friends and maintain a relationship. People who experience both heightened anxiety and sensory sensitivity are more likely to be socially isolated and are more likely to have depression than those in the wider population (Kinnealey et al., 2011). Not only did the intervention improve the participants' relationships, but it also significantly improved their ability to mobilise within and outside of their home. There was a significant change in the participants' ability to *participate in society*, with the scores moving in a positive direction showing improvement in their ability to join in community activities, and leisure focused occupations. This was supported by the participants' qualitative feedback, which described an increase in confidence as a result of increased self-awareness about their sensory preferences, autonomic responses and coping strategies.

While the participants demonstrated significant improvement in the subscale of *life activities* (household tasks, work) there was a wide variation in scores. On closer inspection the eight questions in this subscale may have been less relevant to some participants as they evaluate a person's difficulty in completing activities at school or work. The pre-treatment responses to the questions relating to work suggest more than half of the participants had no difficulty with performing work activities and almost half had severe difficulties in the same area. Almost half of the participants had indicated they were not employed during the baseline phase, however employment status was not checked at the 3 month follow up. This would have been useful information as most participants reported experiencing no difficulty to mild difficulty

in completing work or study related tasks at this point. Both people diagnosed with anxiety, and those who are found to be sensory sensitive, are more likely to experience difficulty functioning in their work roles (Ben-Avi, Almagor, & Engel-Yeger, 2012; Wagner, Chant, White & Whitford, 2005; Wells, 2006). Therefore this study demonstrated that providing sensory strategies could reduce anxiety across a range of environments and the intervention may provide support for people to engage in work related or educational occupations.

Hypothesis Four (Anxiety and Sensory Threshold)

A strong correlation was found between high anxiety scores at baseline and high scores in the sensory sensitivity quadrant of the AASP. This supports the hypothesis that people experiencing heightened anxiety have an increased sensitivity to sensory stimuli. It also aligns with findings from previous studies that showed a relationship between anxiety and hyper-sensitivity (Ben-Avi et al, 2012; Kinnealey et al., 2011; Pfeiffer & Kinnealey, 2003). While the sample was small in this study, alongside earlier studies, the finding suggests that people who experience anxiety are likely to also have difficulty in processing sensory stimuli and would benefit from education and strategies to regulate their neural arousal. Understanding why they might be responding differently than others to situations or environments appeared to facilitate an increased sense of control for the participants' in this study.

Participants' Qualitative Feedback

Overall, the qualitative feedback illustrates how the participants found the intervention assisted them to manage symptoms of anxiety. A few participants described that trying new sensations was challenging, aligning with literature describing the sensory defensive responses of people with high sensory sensitivity and sensory avoidance (Ben Avi et al., 2012; Engel-Yeger & Dunn, 2011). Most found the intervention relevant and beneficial. Some participants commented on the fluctuating nature of anxiety and the confidence it gave them in having strategies to reduce distress when it occurred. Consistent with other sensory intervention studies, the psycho-education component of the intervention was valued by participants who described that knowing what was triggering their anxiety, and having strategies to

reduce anxiety appeared to support participation in activities and improve quality of life (Engel-Yeger & Dunn, 2011).

Strengths and Limitations

There were four strengths in this study. Firstly, the demographic and sensory characteristics of the participants including diagnoses, ages and gender are generally reflective of the broader population of people who present to community mental health services with anxiety. This increases the generalisability of the findings to this group of people. External validity was increased through the inclusion of participants with multiple diagnoses and co-morbidities, as people accessing mental health services often have complex presentations alongside anxiety. The results therefore provide preliminary insights into the effect of using a sensory intervention to reduce anxiety with a population living in the community with severe mental illness, rather than those who are acutely unwell in an inpatient setting or who have not been diagnosed with a mental illness.

Secondly, the stability of the baseline measures enabled the participants to be used as their own control, and the non-concurrent multiple baseline design enabled participants to receive the intervention with minimal delay. Thirdly, the methodology used in this study provided measurable outcomes of anxiety, quality of life and participation using established instruments.

The fourth strength relates to the delivery of the sensory modulation intervention, which was designed to replicate how this approach is currently used within community based clinical practice. The three week intervention protocol remained the same for all participants and was delivered by the same practitioner ensuring consistency. The protocol also allowed the treatment to be individualised according to participants' needs and participant wellbeing was monitored throughout the study to ensure their safety was not compromised by the intervention.

Three main limitations have been identified with this study. Firstly, the study size was limited by the timeframe and scope of Master's level research. The final participant numbers were determined by the number of people with a primary complaint of anxiety who accessed the two mental health services during a 10 month

period. From this population, not all wished to engage in sensory modulation or the research process. The challenges with a small sample size were compounded by the proportionally large number of dropouts from the study. Another issue related to the sample is the proportion of Maori and Pacific people represented. Despite efforts to recruit a representative sample, only two participants identified as Maori and none were Pacific Islanders. A wider representation of Maori and Pacific people would have provided greater support for the use of the sensory intervention for these cultural groups, who have been found to experience higher rates of anxiety than the rest of the New Zealand population (Wells, 2006). It is likely that with a greater number of participants the results would provide stronger evidence to support the use of the intervention. However, greater time and access to a greater pool of potential participants would be required to address these recruitment and sampling issues. Despite the small sample size the study is useful in indicating the feasibility of the specific measures and procedures for a larger study.

A second limitation was that the scope of this study allowed only for a three month follow up period, which may have reduced the ability to measure the effect of the intervention over time. The effect may have been more apparent in the participant's quality of life and participation scores after six or twelve months.

The third limitation was the potential for response bias due to the researcher providing the intervention and collecting the verbal feedback. This may have influenced the responses given by the participants in an effort to provide favourable outcomes (Domholdt, 2005).

Recommendations

Recommendations for research

While the outcomes of this study support sensory modulation as an intervention to reduce anxiety, recommendations for future research include increasing the size and length of the study. A larger sample size including representative numbers of participants who identify as Maori and Pacific Islanders would further strengthen the generalisability to the New Zealand population. Additionally, expanding the length of the follow up period would allow for the effects

of the intervention over time to be measured and compared with other treatments and interventions for managing anxiety. Future research should consider the use of a control group to add strength to this field of knowledge, however ethical issues regarding withholding of treatment would need to be overcome.

The demographics of the participants in this study revealed some unexpected findings, particularly the number of people who experienced pain. Future studies should endeavour to further explore the relationship between anxiety and pain for people accessing mental health services. The matrix of anxiety, sensory threshold and pain, warrants deeper investigation to gain insight into the neurological and psychological processes at play.

Recommendations for practice

The findings of this study supports the use of sensory modulation as a limited-cost anxiety treatment for people accessing mental health services. The study provides preliminary evidence that this person-centred intervention can enable people experiencing anxiety to develop skills to self-regulate and build resilience. The sample was representative of the complexity of people accessing mental health services, and provides an indication that the intervention could equally be used in addiction and pain services where anxiety is an issue for people. Importantly, sensory interventions in these specialist services should be measured to provide greater understanding of transferability across health settings.

The strong correlation between anxiety and sensory sensitivity, while not unexpected, supports the use of a sensory intervention both independently, and as a prelude to other treatments such as occupational or talking therapies. This would likely provide the people accessing these services with the understanding of the neurological basis of their anxiety and build the skills needed to cope with the challenges of therapy. Furthermore, the findings support the application of sensory interventions for people who have experienced trauma and adds to the capability of health services to provide trauma-informed care. This study also highlighted the role of developing sensory based self-regulation skills in reducing anxiety as well as in improving social relationships and resilience. The positive findings of this study would support the use of sensory modulation as an early intervention to avoid the escalation of anxiety

symptoms often seen in people accessing mental health services and provide some relief from the strain on health services in New Zealand.

Conclusion

Within the context of this study, the brief sensory modulation intervention has shown to have beneficial effects, with a significant reduction in anxiety during the intervention phase that continued over the 3-month follow up. The mean domain scores of the WHODAS 2.0 showed an improvement in the social and community participation domains, although no significant changes were observed in communicating and self-care. The total domain scores of the WHOQOL-BREF did not show any change in overall quality of life. However, the qualitative data gives some indication of improvement in the participants' quality of life as well as some increase in community participation. Although the qualitative feedback received from the participants was limited and potentially positively biased, it did align with the quantitative measures, with common themes including; increased self-awareness, improved confidence, and a reduction in anxiety.

As found in earlier studies, high anxiety scores on the BAI at baseline were found to be correlated with heightened sensory sensitivity on the AASP. This supports further investigation into the use of a sensory based approach to anxiety management independent of, or alongside psychological and pharmacological therapies. This study illustrated the complexity of people accessing support from mental health services with the majority of the sample having experienced trauma, suffering physical pain, and almost half had problem substance use issues.

A key finding related to the delivery of the intervention itself was that it appeared to effectively reduce anxiety within the brief timeframe of three, weekly sessions. This and the fact that the cost of the sensory modalities was low, indicates that the intervention is cost effective and has the potential to be implemented across services relatively easily.

This study was designed to directly test a sensory-based intervention currently used within a community mental health service and the findings provide some evidence to support the use of the approach within clinical practice. The true value of providing a brief sensory modulation intervention early in the illness course for people

experiencing anxiety would be ascertained by further research replicating the methodology of this study on a larger scale, ideally with a separate control group.

While this study has limitations, the findings add to the existing literature examining the relationship between sensory processing and anxiety. By gaining an understanding of their unique sensory processing style and developing strategies to modulate their arousal, the participants experienced a significant reduction in anxiety, increased participation in many activity domains, and some reported improvement to their quality of life. This person-centred intervention may provide an effective and limited-cost approach to reducing the anxiety of people presenting with this disorder in a community mental health service.

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Appendices

Appendix A: Participant demographics form

Participant number:

Age:

Gender:

Ethnicity:

Are you currently employed?

Diagnosis:

Duration of illness:

Length of current contact with MHS:

Have you experienced significant trauma in your life that continues to affect you?

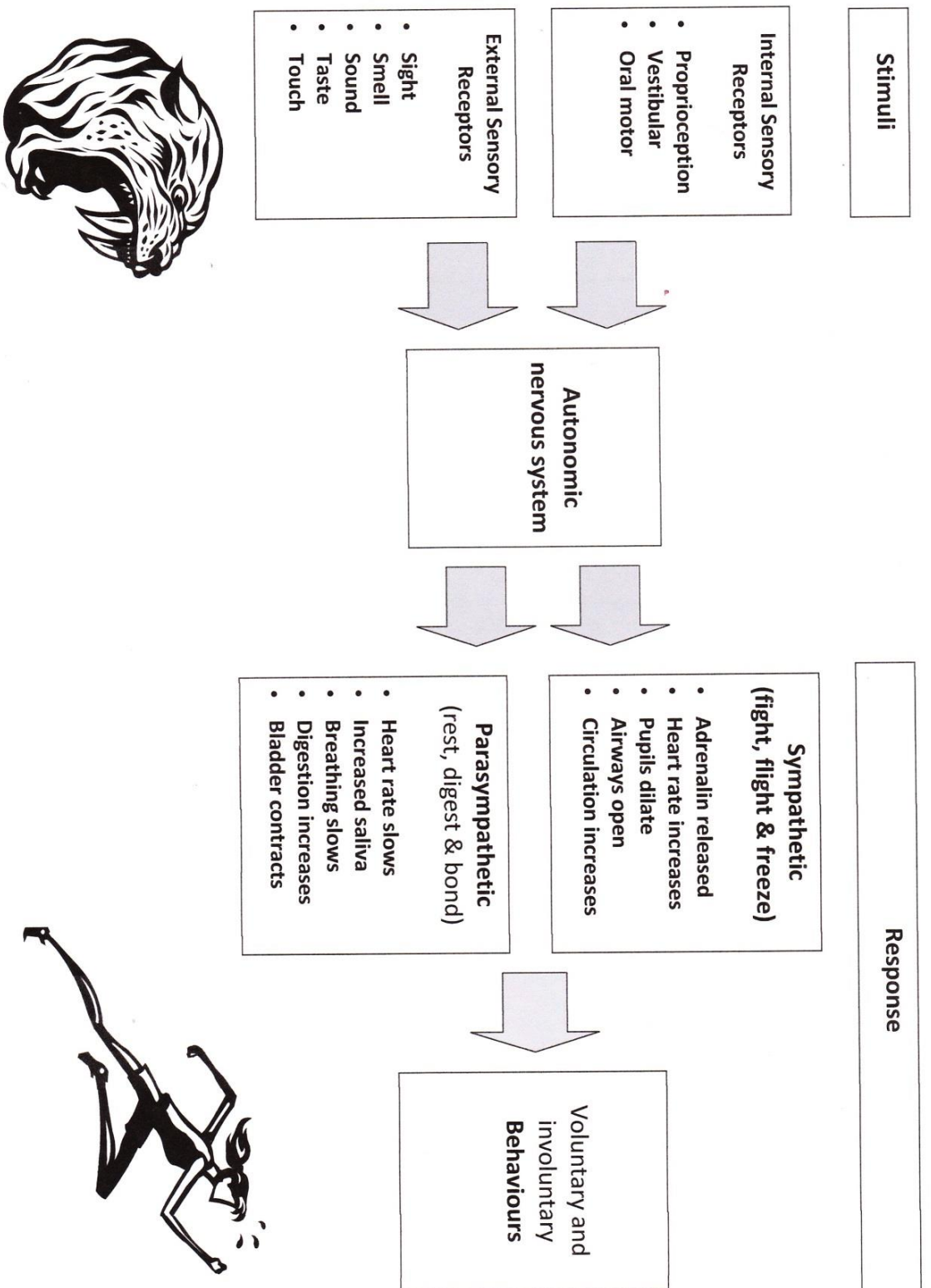
Do you have problems with alcohol use?

Do you have problems with illicit drug use?

Do you have problems with benzodiazepine use?

Do you have problems with physical pain?

Appendix B: Parasympathetic and sympathetic nervous system.



Appendix C: Calming and alerting.

Calming and alerting suggestions

Taste

Alerting	Calming
<ul style="list-style-type: none">• Citrus• soft drinks• coffee• unpleasant• salty• sour• mint	<ul style="list-style-type: none">• fruit juice• home cooking• bread• pleasant• heavy meals• milky drinks• sweet

Smell

Alerting	Calming
<ul style="list-style-type: none">• room fragrances• unpleasant smells• negative associations• citrus• mint• synthetic perfumes	<ul style="list-style-type: none">• cooking• potpourri or spice• positive associations• lavender• beeswax• vanilla

Visual

Alerting	Calming
<ul style="list-style-type: none">• bright light• clutter• strong colours• computer games• fast moving images• peripheral movement	<ul style="list-style-type: none">• neutral colours• orderliness• candlelight• beach scenes• native bush• soft lighting

Auditory

Alerting	Calming
<ul style="list-style-type: none">• loud• whistling• sirens & alarms• unfamiliar noises• shouting• fast music	<ul style="list-style-type: none">• familiar background noise• humming• ocean sounds• bush sounds• slow music

Touch

Alerting (light touch)	Calming (deep touch)
<ul style="list-style-type: none"> • prickly • squishing • sticky • unexpected • cool room temperature • barefoot on grass • ice • pain (rubber band on wrist) • light stroking 	<ul style="list-style-type: none"> • deep massage • heavy blankets • weight on lap (cat or dog) • warmth • hand massage • holding smooth stones • tapping bags • hot water bottle • being held firmly

Proprioception

Alerting	Calming
<ul style="list-style-type: none"> • jumping • jerky movements • quick changes • aerobics 	<ul style="list-style-type: none"> • walking • lifting or pushing weights • yoga or tai chi • walking in water • swimming • joint compression

Vestibular

Alerting	Calming
<ul style="list-style-type: none"> • walking on uneven surfaces • spinning • jogging • fast dancing • sitting on a Swiss ball • rollercoaster 	<ul style="list-style-type: none"> • riding in a car • swinging gently • slow dancing • sitting still • walking • rocking

Oral Motor

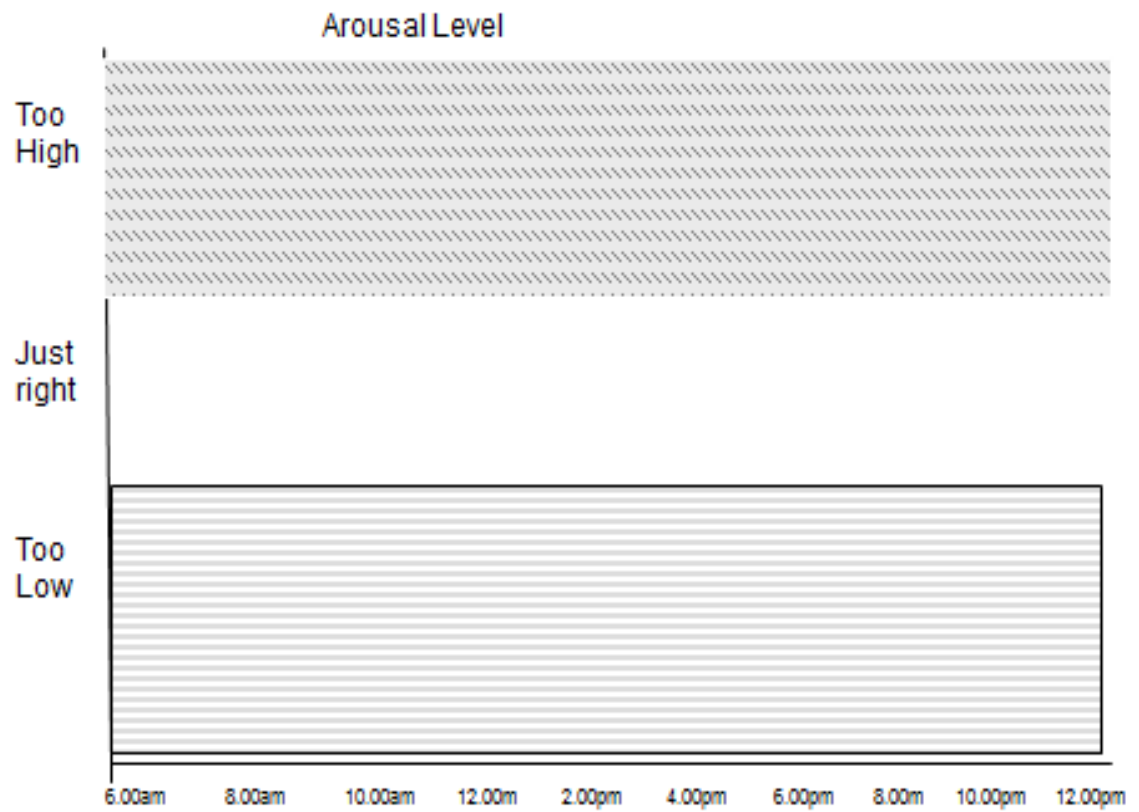
Alerting (Crunchy)	Organising (Chewy)	Calming (Sucking)	Breath support (Blowing)
raw vegetables Popcorn Ice Cereal Pretzels	Gum french stick Toffee dried fruit Wholegrain	Lollipop using a straw orange slices sipper bottle & smoking	Whistling blowing bubbles abdominal breathing Singing

Taken from: The Sensory Connection Self-regulation Workbook: Learning to use sensory activities to manage stress, anxiety and emotional crisis. By Karen Moore (2008)

Appendix D: List of sensory tools.

<u>Item</u>	<u>Responses</u>			
	<u>Calming</u>	<u>Alerting</u>	<u>Don't like</u>	<u>No response</u>
Weighted Blanket 7.5kg				
Weighted Blanket 10kg				
Weighted Blanket 12kg				
Weighted shoulder Blanket 5kg				
Lap Blanket 5kg				
Weighted dog				
Weighted cat				
Lycra wrap				
Rocking chair				
Massage chair				
Lazy Boy chair				
Tapping bag				
Relaxation CD				
Frozen orange/flannel				
Hot face cloths				
Squeeze Balls				
Stretchy Bands				
Powders, soaps				
Scented oils				
Sunglasses				
Mink blankets/pillows				
Bubbles				
Mints, lollies, chewing gum				
Lava lamp				
Other				

Appendix E: Arousal level throughout a typical day



Appendix F: Plan to cope through the week

Plan to cope through the week

The times of the day I find most difficult are:

Morning	Noon	Afternoon	Evening	Night
-----	-----	-----	-----	-----
6am	12am	3pm	6pm	9pm

What I can do at specific times of the day to change how I feel

.....

.....

.....

The environments I find most challenging to be in:

Supermarket	Home	Work	Busy places
Outdoors	Indoors	Quiet places	Car or Bus
Bright places	Noisy places	My room	The mall

Other.....

What I can do to change or tolerate these environments:

.....

.....

.....

The things I do that I struggle with:

Caring for myself	Working	Being with people
Being alone	Driving	Caring for others
Showering	Walking	Preparing meals
Waking	Getting to sleep	Sleeping

Other.....

What I can do to be able to increase my satisfaction and performance:

.....

.....

Appendix G: AUTECH approval letter



AUTECH approval

A U T E C
S E C R E T A R I A T

20 September 2013

Daniel Sutton
Faculty of Health and Environmental Sciences

Dear Daniel

Re: 13/200 An evaluation of a brief sensory modulation intervention to reduce anxiety for people accessing tertiary mental health services.

Thank you for submitting your application for ethical review. I am pleased to confirm that the Auckland University of Technology Ethics Committee (AUTECH) has approved your ethics application for three years until 16 September 2016.

AUTECH requires the Information Sheet to contain the contact details of the Executive Secretary.

AUTECH suggests that the 2nd Information Sheet might read a little clearer with the use of bullet points

As part of the ethics approval process, you are required to submit the following to AUTECH:

- A brief annual progress report using form EA2, which is available online through <http://www.aut.ac.nz/researchethics>. When necessary this form may also be used to request an extension of the approval at least one month prior to its expiry on 16 September 2016;
- A brief report on the status of the project using form EA3, which is available online through <http://www.aut.ac.nz/researchethics>. This report is to be submitted either when the approval expires on 16 September 2016 or on completion of the project;

It is a condition of approval that AUTECH is notified of any adverse events or if the research does not commence. AUTECH approval needs to be sought for any alteration to the research, including any alteration of or addition to any documents that are provided to participants. You are responsible for ensuring that research undertaken under this approval occurs within the parameters outlined in the approved application.

AUTEC grants ethical approval only. If you require management approval from an institution or organisation for your research, then you will need to obtain this. If your research is undertaken within a jurisdiction outside New Zealand, you will need to make the arrangements necessary to meet the legal and ethical requirements that apply within their.

To enable us to provide you with efficient service, we ask that you use the application number and study title in all correspondence with us. If you have any enquiries about this application, or anything else, please do contact us at ethics@aut.ac.nz.

All the very best with your research,

A handwritten signature in black ink, appearing to read 'K O'Connor', written in a cursive style.

Kate O'Connor
Executive Secretary
Auckland University of Technology Ethics Committee

Cc: Andrea Dempsey andrea.dempsey@waitematadhb.govt.nz

Appendix H: WDHB locality agreement. Approval to commence

From: Awhina Research & Knowledge Centre

[mailto:research@waitematadhb.govt.nz]

Sent: Monday, 23 September 2013 10:33 a.m.

To: Andrea Dempsey (WDHB)

Subject: WDHB Approval to Commence

Dear Andrea

Awhina Research & Knowledge Centre has now received the relevant approvals for your study:

Title: An evaluation of a brief sensory modulation intervention to reduce anxiety for people accessing tertiary mental health services Registration #: RM 0980712531

Please continue to forward to us copies of all correspondence regarding ongoing ethics approval for this study (if any). The Research & Knowledge Centre Staffnet site contains further information which may be of use to Waitemata DHB researchers, such as how to access statistical advice.

Good luck with your study.

Regards

Awhina Research & Knowledge Centre

(09) 4868920 ext 2127

www.awhinahealthcampus.co.nz

Appendix I: Maori Research Committee Approval

5 July 2013

Andrea Dempsey

Senior Occupational Therapist

Adult Mental Health Services Group

Waitemata DHB

Re: Evaluating the use of Sensory Modulation for anxiety in a community mental health setting

By way of introduction the Maori research review forms part of the locality assessment. The Maori research review process across the Auckland and Waitematā District Health Boards is overseen by the Auckland and Waitematā Maori Research Committee. The Maori Research Advisor represents the Maori Research Committee and has primary responsibility for reviewing research applications across the Auckland and Waitematā District Health Board.

Within this context the Maori Research Review critiques research proposals for responsiveness to Maori. Ethical, scientific and clinical rigour is reviewed by the respective bodies at each District Health Board.

Thank you for providing the ethics application, the cultural supervision agreement, the participant information forms and the consent form. The intended study evaluates the use sensory modulation for anxiety and will be seeking to recruit participants from the Waitemata District Health Board.

I have read the information and note you have:

- recognised Māori experience of anxiety
- cultural supervision to oversee the study, and
- provided an opportunity for participants to use interpreters if required.

You may find it useful to add the following statements to the information or consent form:

- If you require Māori cultural support talk to your whānau in the first instance. Alternatively you may contact the administrator for He Kamaka Waiora (Māori Health Team) by telephoning 09 486 8324 ext 2324
- If you have any questions or complaints about the study you may contact the Auckland and Waitematā District Health Boards Maori Research Committee or Maori Research Advisor by telephoning 09 4868920 ext 3204

On behalf of the Maori Research Committee at the Auckland and Waitematā District Health Boards I have approved your application.

Heio ano

H.A Wihongi

Dr Helen Wihongi

Maori Research Advisor

He Kamaka Waiora (Maori Health)

Auckland and Waitematā DHB,

Private Bag 93 503,

Takapuna, Auckland

Ph + 64 9 4868920 ext 3204

Cell 021 0203 1167

Email helen.wihongi@waitematadhb.govt.nz

Tereki Stewart

Chairperson

Auckland and Waitematā DHB

Maori Research Committee

PO Box 108040

Symond Street

Ph +64 09 366 1993

email tstewart@tihiora.co.nz

Appendix J: Research Protocol for Clinicians



Evaluating the use of Sensory Modulation for anxiety in a community mental health setting

Principal Investigator	Contact information
Andrea Dempsey	021 245 4176
Academic Supervisors	Contact information
Dr Daniel Sutton	09 921 9999 x 7732
Dr Sandra Bassett	09 921 9999
Cultural Supervisor	Contact information
Te Miringa Tahana Waipouri-Voykovic	09 487 1497

Invitation

Hello. My name is Andrea Dempsey and I am the Senior Occupational Therapist for Adult Mental Health Services at Waitemata DHB. I am undertaking a research project to evaluate the use of sensory modulation for anxiety. This research project is being carried out as part of my Masters of Health Science qualification.

This information sheet will explain the research study to clinicians. Please feel free to ask about anything that you do not understand or if you have questions at anytime. I will provide a short presentation to each team prior to commencement of the study.

What is Sensory Modulation?

Sensory Modulation is an intervention that aims to reduce anxiety by providing the nervous system with signals of safety through strong sensory input, acting as a brake on the 'fight and flight' response. Particular forms of sensory input are known to be associated with calm states (e.g. rocking, deep pressure touch, warm temperature, oral-motor input, slow rhythmic music, sweet aromas), while other forms of sensory input can be used for grounding and alerting individuals (e.g. light touch, cold temperature, upbeat music, acidic aromas). The regulation of sensory input on our nervous system is essential for day to day functioning.

What is the purpose of the study?

We are trying to find out if sensory modulation reduces anxiety and whether an improvement in anxiety symptoms improves quality of life and participation in daily activities. This may help service providers to have a better understanding of how using our senses can help people to feel calmer and think more clearly.

How are people selected to be part of the study?

People are being invited to take part if they meet all the following criteria:

- Are service users of North or West Adult Community Mental Health Services, Waitemata DHB
- Have had anxiety symptoms for minimum of 3 months
- Aged between 18-65 years of age
- Male or female
- Are able to participate for a five month time period. The first 3 weeks they will be seen weekly by their usual clinician, then during the 3 week sensory intervention they will be seen weekly by their usual clinician and myself. Participants will then be followed up monthly by their clinician over the final three months of the study.
- Are fluent in English
- Have had no major medication changes two weeks prior to starting the study and during the study

People will be excluded from the study if they are receiving cognitive therapies, those whose primary issue is psychosis, significant cognitive impairment or alcohol and drugs, and people with limited understanding of English

What happens in the study?

Potential participants will be identified by you and verbal information about the study given. Those who are interested in participating will be given my contact details to self-refer to the study. More detailed verbal and written information will be given by me to the potential participant at that time and if they agree to participate in the study, written consent will be obtained. Participants will then enter the study. This will involve the following:

Baseline Phase - I will meet with the participant to complete the initial baseline measurements, The World Health Organization Disability Assessment Schedule (WHODAS 2.0) the World Health Organization Quality of Life – Brief (WHOQOL-BRIEF), Beck Anxiety Inventory (BAI), and the Sensory Profile. I will require you the usual clinician to meet or phone the participant weekly for the following 3 weeks to complete the Becks Anxiety Inventory in order to gain three scores on the Becks in total.

Intervention Phase – I will meet with the participant weekly for the next three weeks to deliver the sensory modulation intervention. This involves education on the nervous system and senses, trialling and finding sensory tools that they like, and discussion around using these tools and strategies in everyday situations. You will not be required to meet with the client over this time.

Follow up Phase – This phase is three months. It is to ascertain whether the intervention is effective over time. Your contact will be required at this time to complete the Becks Anxiety Inventory at one month intervals. Functional measures will be repeated at the end of this phase, by me. A half hour interview will be undertaken by myself at the end of the study to get the participants thoughts and experience of the intervention.

What are the risks of this study?

There is a risk that the participant's mental health may decline over the time period of the study.

How will these discomforts and risks be alleviated?

Participants have the option of withdrawing from the study at any time, this includes if medication needs to be changed. Where the participant withdraws from the study they may still choose to continue with the intervention. They also have the option of not participating in the intervention on a particular day and the intervention can be postponed up to two weeks. You will be notified if this occurs to follow up as required in your role as the participant's usual clinician.

How will this study help?

The information from this study will be used to increase the understanding of service providers in the use of sensory modulation as an intervention to reduce anxiety and increase quality of life and participation in daily activities.

How will the service user's privacy be protected?

The researcher will not be required to look at participant's health data (notes, documents, reports, forms) for the purposes of this study, however all contact with participants will be recorded as per usual practice in their electronic file. Outcome measures will be kept in their hard file. All other material (consent forms and data) will be kept in a locked cupboard at AUT. No material that could personally identify the participants will be used in any reports on this study. Documentation in the participant's electronic file will not disclose their participation in the study.

What will happen with the results?

The results of this study will be used to inform health professionals to understand how sensory modulation can reduce anxiety and enhance quality of life and function. This will guide planning for ways sensory modulation can be used in practice settings. The results will be published in a journal article.

If you have any concerns or questions?

Participants are advised to have a friend, family or whānau support to help them understand the risks and/or benefits of this study and any other explanation that may be required. If you have any questions please feel free to discuss these with me or the cultural supervisor, Te Miringa Tahana Waipouri-Voykovic.

If you have any queries or concerns regarding the service user's rights in this study, you may wish to contact an independent health and disability advocate:

Free phone: 0800 555 050

Free fax: 0800 2 SUPPORT (0800 2787 7678)

Email: advocacy@hdc.org.nz

Statement of Ethical Approval

This study has received ethical approval by AUTECH and endorsed by Waitemata District Health Board Locality agreement.

RM: 0980712531

Date: 23.09.13

Appendix K: Information sheet for participants



Evaluating the use of Sensory Modulation for anxiety in a community mental health setting

Principal Investigator	Contact information
Andrea Dempsey	021 245 4176
Academic Supervisors	Contact information
Dr Daniel Sutton	09 921 9999 x 7732
Dr Sandra Bassett	09 921 9999
Cultural Supervisor	Contact information
Te Miringa Tahana Waipouri-Voykovic	09 487 1497

Invitation

Hello. My name is Andrea Dempsey and I am the Occupational Therapy Professional Advisor for Adult Mental Health Services at Waitemata DHB. You are invited to take part in a study to examine the use of sensory modulation for anxiety. This research project is being carried out as part of my Masters of Health Science qualification.

Your participation in this study is entirely voluntary (your choice). You do not have to take part in this study and if you choose not to take part this will in no way affect your current or future health care. If you do agree to take part you are free to withdraw at any time, without having to give a reason. Even if you choose to withdraw from the study you may choose to continue with the intervention.

This information sheet will explain the research study. Please feel free to ask about anything that you do not understand or if you have questions at anytime.

What is Sensory Modulation?

Sensory Modulation is an intervention that aims to reduce anxiety by providing the nervous system with signals of safety through strong sensory input, acting as a brake on the 'fight and flight' response. Particular forms of sensory input are known to be associated with calm states (e.g. rocking, deep pressure touch, warm temperature, oral-motor input, slow rhythmic music, sweet aromas), while other forms of sensory input can be used for grounding and alerting individuals (e.g. light touch, cold temperature, upbeat music, acidic aromas). The regulation of sensory input on our nervous system is essential for day to day functioning.

What is the purpose of the study?

We are trying to find out if sensory modulation reduces anxiety and whether an improvement in anxiety symptoms improves a person's quality of life and daily

functioning. This may help service providers to have a better understanding of how using our senses can help people to feel calmer and think more clearly.

How are people selected to be part of the study?

People are being invited to take part if they meet all the following criteria:

- Are service users of Waitemata DHB
- Have had anxiety symptoms for minimum of 3 months
- Aged between 18-65 years of age
- Male or female
- Are able to participate five month time period with weekly input from either their usual clinician, or person delivering the sensory intervention.
- Are fluent in English
- Have had no medication changes two weeks prior to starting the study and during the study period.

What happens in the study?

If you agree to take part, you will be asked to record your anxiety levels weekly for three weeks by your usual clinician. You will then participate in a three week sensory modulation intervention which will require you to attend the community mental health service building each week for one hour. You will also be asked to record your anxiety levels monthly for three months after the intervention is completed. A quick interview no longer than half an hour will be offered to you at the end of the study to find out your thoughts on the sensory modulation intervention. The interview will be recorded on an audio recorder. You are able to ask the researcher questions you may have at any stage. Only the researcher will have access to your information from the interviews. You can withdraw from the study at any stage and may continue with the intervention if you chose to do so.

What sensory tools will I be trialling?

Below is a list of sensory tools to trial

Lycra wrap	Weighted lap blanket (5kg & 10kg)
Weighted blanket (10kg, 12kg & 7.5kg)	Squeeze balls & Stretchy bands
Weighted Dog (6kg)	Relaxation CD
Weighted cat (2kg)	Deep touch and proprioception
Scented oils (Orange, lavender, bergamot)	Powders, soaps
Frozen orange and/or hot flannel	Sunglasses
Rocking chair	Blankets/pillows
Massage chair	Bubble mixtures
Tapping bag	Mints, lolly's, chewing gum

What are the risks of this study?

There is a risk that the intervention may not benefit you and that your anxiety may increase or your mental health may decline over the time period of the study

How will these discomforts and risks be alleviated?

You have the option of withdrawing from the study at any time, this includes if medication needs to change. You also have the option of not participating in the intervention on a particular day and the intervention can be postponed up to two weeks. Your usual clinician will be notified for follow up.

How will this study help?

The information from this study will be used to increase the understanding of service providers in the use of sensory modulation as an intervention to reduce anxiety and increase quality of life and participation in daily activities.

What are the costs of taking part in this study?

There will not be any cost to you to take part in this study except for your time.

How will my privacy be protected?

All contact with you will be recorded as per usual practice in your personal health file with Waitemata District Health Board but will not indicate your involvement in the study. Your usual clinician and psychiatrist will be aware of your involvement in the study and will be advised of any findings that may be helpful to you in the future. No material that could personally identify you will be used in any reports on this study. All the information and responses you give in the interview will be kept completely confidential and your name will not be known to anyone but the researcher and the supervisors. All information will be kept in a secure file at AUT University.

What will happen with the results?

The results of this study will be used to inform health professionals to understand how sensory modulation can reduce anxiety and enhance quality of life and participation in daily activities. This will guide planning for ways sensory modulation can be used in practice settings.

Will I be able to have a copy of the results?

A summary of the results will be sent to you at the end of the study if requested. This may take up to six months after taking part in the study.

What will happen to the data after the study is complete?

After the completion of this study, all information will be stored in a secure file at AUT University for ten years. After ten years, the data will be destroyed.

If you have any concerns or questions?

You may have a friend, family or whānau support to help you understand the risks and/or benefits of this study and any other explanation you may require. If you have any questions please feel free to discuss these with the researcher, supervisor Daniel Sutton, or the cultural supervisor Te Miringa Tahana Waipouri-Voykovic, or your usual clinician.

If you require Māori cultural support, talk to your whānau in the first instance. Alternatively you may contact the administrator for He Kamaka Waiora (Māori Health Team) by telephoning 09 486 8324 ext 2324. If you have any questions or complaints about the study you may contact the Auckland and Waitemata District Health Boards Maori Research Committee or Maori Research Advisor by telephoning 09 4868920 ext 3204

If you have any queries or concerns regarding your rights as a participant in this study, you may wish to contact an independent health and disability advocate:

Free phone: 0800 555 050

Email: advocacy@hdc.org.nz

If you have any concerns about the way this research is conducted, please contact the Executive Secretary at Auckland University of Technology Ethics Committee

Phone: 921 9999 x6038

Email: ethics@aut.ac.nz

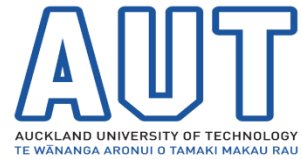
Statement of Ethical Approval

This study has received ethical approval by AUTEK and endorsed by Waitemata District Health Board Locality agreement.

RM: 0980712531

Date: 23.09.13

Appendix L: Consent form.



Evaluating the use of Sensory Modulation for anxiety in a community mental health setting

Research Supervisors	Cultural Supervisor
Dr Daniel Sutton	Te Miringa Tahana Waipouri-Voykovic
Dr Sandra Bassett	

Principal Investigator
Andrea Dempsey

- ☐ I have read/had read to me and I understand the information sheet dated 1st August 2013 for volunteers taking part in the study designed to evaluate the use of sensory modulation for anxiety in a community mental health setting. I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.
- ☐ I have had the opportunity to use whānau support or a friend to help me ask questions and understand the study.
- ☐ I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time. This will in no way affect my current or future health care.
- ☐ Where a major medication change is necessary during the duration of the study I will tell the researcher and understand that I may be withdrawn from the study but will continue to receive the intervention.
- ☐ I have had this project explained to me by a researcher.
- ☐ I understand that the confidentiality regarding my agreement to participate in this study will be maintained, however it is a requirement for my key worker and psychiatrist to be informed of my involvement in the study.
- ☐ I agree that a letter will be sent to my psychiatrist and key worker informing them of my participation in the study.
- ☐ I understand that my progress will be recorded in my clinical notes held electronically at Waitemata DHB.

- ☐ I understand that all answers and responses I give are confidential and that no material that could identify me will be used in any reports on this study.
- ☐ I understand that the sensory modulation intervention will be stopped if it should appear harmful to me or if my mental health deteriorates
- ☐ I have had time to consider whether to take part in the study.
- ☐ I know who to contact if I have any questions about this study.



	Please Tick	
I agree to take part in the study by completing anxiety rating scales weekly throughout the course of the study	<input type="checkbox"/> Yes	<input type="checkbox"/> No
I agree to take part in the study by participating in the sensory modulation intervention	<input type="checkbox"/> Yes	<input type="checkbox"/> No
I consent to my interview being audio taped.	<input type="checkbox"/> Yes	<input type="checkbox"/> No
I wish to receive a copy of the results.	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Alternatively, I would like the researcher to discuss the outcomes of the study with me.	<input type="checkbox"/> Yes	<input type="checkbox"/> No

Evaluating the use of Sensory Modulation for anxiety in a community mental health setting

I, (Full name) hereby consent to take part in this study

Date:

--

Signature:

--

Participant contact details:

--

Full name of researcher:

Andrea Dempsey

Researchers contact number:

021 245 4176

Project explained by:

--

Project role:

--

Signature:

--

Date:

--

Consent witnessed:

--

Name and Signature.

--

Date:

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