Description designed to restore effective neurological processing

Description and definition of chosen interventionSensory Integration Therapy (SIT) a form of occupation therapy in which the therapist uses special exercises to strengthen three domains – tactile (sense of touch), vestibular (sense of balance) and proprioceptive (sense of where the body and its parts are in space). It is designed to restore effective neurological processing and increase the individual's ability to integrate sensory information by enhancing the three systems. Activities involved requires the individual to use their most advanced, adaptive skills and encourage them to compensate for their sensory deficits. It can benefit individuals with movement disorders or hypersensitivity or hyposensitivity to sensory input. Hypersensitivity is characterized by intense, negative responses to typical daily life experiences, affecting alertness, attention, social interaction and level of activity and self-care. Hyposensitivity is characterized by delayed or reduced responses to daily sensory events, affecting level of alertness, attention, posture, movement, motor coordination and social interaction. The therapy is based on occupational therapist and psychologist, A.

Jean Ayres' theory of Sensory Integration (ASI). It describes how the brain processes and integrate sensory information from the body and the environment that contributes to responses in learning, emotions and behavior. Dr. Ayres wrote " Sensory Integration is the organization of sensations for use. Our senses give us information about the physical conditions of our body and the environment around us.

The brain must organize all of our sensations if a person is to move and learn and behave in a productive manner" Children with Autism display symptoms that include difficulty in processing sensory information, especially textures,

sounds, smells, taste, brightness and movement. As a result, they find regular situations overwhelming which can interfere with their daily functions. Sensory Integration Therapy aids to ease this difficulty by changing the brain’s reactions towards sensory information through a variety of carefully selected games. Intervention’s definition of improving quality of lifeThe DSM-5 includes sensory perception disorders as a new diagnostic criterion for autism spectrum disorder, in which a child diagnosed with ASD are prone to experience differences in their sensory processing patterns when compared to expected patterns. Children with Autism Spectrum Disorder (ASD) often show symptoms of sensory processing dysfunction, where the brain finds it difficult to regulate responses to external stimuli and may use self-stimulation methods to compensate for hypersensitivity or hyposensitivity to sensory input. This is displayed by repetitive movements that have no specific purpose and often have social, personal and educational implications on the child’s daily life, hindering them from their normal life routines.

Such responses suggest poor sensory integration in the central nervous system and could be the cause of inattention and arousal, which interferes with the child’s ability to engage or learn from activities. It can affect day-to-day activities like feeding, whereby a hypersensitivity to different tastes and textures of food can restrict the child’s food intake. SIT is a commonly used treatment approach for children with ASD.

Studies have should that SIT is shown to be effective in reducing self-stimulating behaviors and increasing functional behaviors like social interaction and play skills. A decrease in self-stimulating behaviors can lead

to an increase in attention, which can be a great influence towards completing tasks related to academia and self-help. According to Pfeiffer et.

al. (2017), SIT intervention is effective in producing significant decrease in autistic behavior related to social responsiveness and significant progress towards individualized sensory processing and regulation goals, social-emotional functions and fine-motor skills. It is also supported by previous studies (Smith et al., 2005; Watling & Dietz, 2007), whereby children with ASD were assessed on the reduction of their self-stimulatory behaviors after SIT. Reduction in self-stimulatory behaviors can improve quality of life by improving attention and engagement for the child to carry out their necessary daily tasks. It also helps to increase acceptance within the peers in their environment.

Watling and Dietz (2007) found that engagement behaviors that are often disrupted by undesirable stereotypical movements in four children with ASD improved over a latency period. Another study by Smith et. Al. (2005) found that self-stimulatory behaviors significantly decrease when subjects went through occupational therapy using sensory integration methods. Even though the sample sizes from the studies are small, it shows effectiveness of SIT in real subjects, which suggests that SIT is an individualized method of therapy which can help regulate self-stimulatory behavior and thus help children with ASD function better in daily adaptive tasks. Scores for tests measuring sensory processing disorders did not show significant differences.

However, measurement issues are often present in studies assessing children with ASD due to their wide variety of behavioral and developmental

levels, which might result in noncompliance or unresponsiveness. This suggests that the test scores obtained might differ from their actual level of functioning which place the test scores as fairly unreliable. This also shows that SIT is an effective intervention method to help children with ASD cope with sensory difficulties, but does not reduce the child’s hypersensitivity or hyposensitivity to sensory input. The ability to cope with such sensory difficulties can help to regulate the child’s behaviors helping them to carry out daily functions and academic performances with less difficulty. Often, stereotypical behavior in children with ASD are not socially accepted by neurotypical people. It is perceived as inappropriate behaviors and can cause a barrier to communications and acceptance in the mainstream society. The reduction of stereotypical behaviors shows the ability to self-regulate guarantees a better quality of life by ensuring that children with ASD can complete functional tasks and blend into their environments through interaction with others without any interference. Research behind interventionSensory Integration Theories are originally developed by A.

Jean Ayres to focus on the neurological processing of sensory information. It is based on the understanding that our senses give us information about the interaction between our bodies and the environment and our brain must organize that information and respond in a productive manner. According to Ayres (1973), SI is required for a person to have proprioception and to perform activities that require planning and attending to the environment and language abilities. An impairment results in disturbances in vestibular, proprioceptive and tactile systems, resulting in difficulties in daily activities. Problems with sensory integration are often present in individuals with

disabilities like cerebral palsy and ASD. Though SIT is a widely used intervention to regulate the sensory dysfunctions in children with ASD, there is little empirical evidence to prove its effectiveness.

Most studies had different limitations including methodological limitations and small sample sizes with inadequate experimental controls. Some examples of methodological limitations are failure to use dependent measures to establish reliability, apply appropriate statistical techniques and incorporate control groups. Small sample sizes with inadequate experimental controls suggests that it is difficult to generalize the results. Of the many studies conducted to measure the effectiveness of SIT, only a randomized controlled trial (RCT) methodology incorporated scientifically rigorous methodology. A group of ASD children were randomly divided into a SIT group and a control group that received instruction on fine motor skills. Information gathered form teachers and parents concluded that the SIT group made more progress towards individualized intervention goals as compared to a control group.

The group that received SIT also had parents reporting reduced ASD symptoms in a parent questionnaire that assessing those symptoms. However, both groups did not produce any differing results on questionnaires assessing sensory processing after receiving SIT. This study shows that SIT can help reduce ASD symptoms that might not be related to our primary discussion, sensory integration therapy. Other RCTs also did not show and effectiveness of SIT on sensory integration dysfunction. Overall, Arendt et. al. (1988) also concluded that SIT has limited scientific support in its effectiveness. In spite of this lack of supporting evidence, sensory

integration-based activities continue to be recommended by occupational therapists and are used by educators in public schools.

It is reported that interventionists perceive that children show improvement as a result of sensory integration-based therapy or that positive changes in behavior are attributed to the sensory integration strategies. Critical thinking and evaluation of researchMost research on SIT aimed to measure the effectiveness of SIT on alleviating the symptoms of sensory integration dysfunction. However, most research have found that SIT is not effective in alleviating the symptoms of sensory integration dysfunction, but is effective in reducing ASD symptoms. This could be a contributing factor towards the popularity of SIT. Smith and Bryan (1999) used a single subject AB design to evaluate the effects of SIT on behaviors of preschool children with ASD or pervasive developmental disorders (PDD), which include engagement, play and social behaviors, and found that SIT increases play behavior and engagement in 3 out of 5 participants. However, generalization of play skills was lacking. Schilling and Schwarts (2004) evaluated the use of a therapy ball for children with ASD and found higher engagement when the ball is used as an alternative form of seating, as compared to a chair, bench or carpet floor.

The two studies show that SIT is an effective method of intervention for ASD symptoms like engagement, play and social skills, which are not directly related to sensory integration dysfunction. There is research to show that sensory integration dysfunction amplifies social deficits. Hilton et. al (2010) found a strong relationship between sensory responsivity and social responsiveness, independent from a child’s cognitive functions.

This suggest that sensory integration dysfunction is an indirect cause of ASD behaviors, which further suggests that SIT's effectiveness of decreasing ASD behaviors could be its ability to regulate sensory dysfunctions. Another behavior that is linked with sensory dysfunction in autism is restricted repetitive behaviors. It has been suggested that these inappropriate behaviors represent an attempt to relieve stress produced by difficulty in processing sensory information. There is growing evidence of the relationship between sensory dysfunction and restricted repetitive behaviors. Chen et. al.

(2009) found a significant relationship between the frequency and intensity of routine behavior (using the Childhood Routines Inventory) and tactile, visual and auditory sensitivity in 29 children with Asperger Syndrome. Joosten and Bundy (2010) also found that children with autism and intellectual disability were significantly more sensitive to sensations and went to greater means to avoid sensation as compared to children with intellectual disability alone. This shows that sensory dysfunction is a big contributor to the stereotypical behaviors of children with ASD. However, SIT does not directly alleviate the sensory issues that children with ASD face, which shows the limitations of the therapy. Educators and therapists who work in public schools are currently expected to use " evidence-based" practices. However, the lack of supporting evidences have made SIT a controversial topic amongst researchers.

SIT is used because of its effectiveness in reducing ASD behaviors which greatly improves the lives of these children in aspects of daily functioning and academia. Since it is an effective method, it should be a topic that

should gather more research despite the limitations that are faced. Betty Hasselkus, previous editor of the American Journal of Occupational Therapy, wrote that best evidence can be determined by quasi-experimental designs including single-subject designs. The Council for Exceptional Children Task Force on Quality Indicators for Special Education Research also agrees that single-subject designs with a set of criteria can be used to determine effectiveness of a practice.

A single-subject research by Bonggat and Hall (2010) show that sensory integration activities had no better effect on the participants' ability to remain on task and reduce the number of disruptive behaviors as compared to attention control activities. All three participants chosen for this study had been prescribed " sensory diets" by an occupation therapist for sensory defensiveness and difficulty with attention, yet there was no obvious benefit to starting their day with a " sensory diet" compared with an attention control activity. Future directionsOne challenge faced by many in evaluating the effectiveness of SIT was the ability to measure progress of sensory integration dysfunction in children with ASD. Due to the nature of their behavior, it is challenging for them to provide consistent responses on standardized tests.

Studies have implemented different assessment tools, including standardized tests, structured observations or interviews with parents and teachers, to examine disorders of sensory processing. The most commonly used tools to determine sensory processing include the Sensory and Integration Praxis Tests (SIPT), the Sensory Profile 1 or Sensory Profile 2 (SP and SP2) and the Sensory Processing Measure (SPM). The tools mentioned

provide a measure for a child’s sensory processing abilities related to their physiological and cognitive functions, praxis and sensory modulation. These functions enable a child to attend to stimuli in the environment and the ability to modulate helps to avoid overload in sensory information. The ability to self-regulate complements this by altering a child’s behavior to suit the demands of specific situations. Hence, with sensory processing dysfunctions, it hinders the child in the tasks performed during their daily lives. However, there are some disadvantages to the tests described as above.

The SP and SP2 comprises of questionnaires completed by parents of teachers of the children with Autism which may affect the scores due to biasness or misinterpretation of the child’s response. SP2 also provides guidelines for intervention that focus on environmental strategies which might not be individualized for the needs of each child with Autism. The SPM evaluates sensory processing in school environment and has been cross-culturally translated to Danish, Finnish, Norwegian, Swedish and Chinese. It shows to be most valid and reliable for Chinese children aged 5-12. THE SIPT is only validated in the North American population which limits its application to other population and have never been revised since 1989. This means that it cannot be generalized and it will not be providing information aligned to the current symptoms of sensory processing dysfunction in the diagnosis of ASD.

In measuring the effectiveness of a given therapy method, the reliability, validity and accuracy of measurement tools are critical. These factors can be manipulated by proper design of the measurement tools or using tools that would complement each other to provide the best results in evaluating the

effectiveness of SIT. Especially the SIPT, it is considered the “ gold standard” in measuring sensory processing, it would be useful to have an updated version, given the latest evidence to assess proprioceptive, vestibular and tactile sensory discrimination and praxis. Finally, although there is much evidence and research of the effectiveness of SIT, randomized controlled trials, systematic reviews, and meta-analyses for children with different abilities should be performed consistently to continue strengthening the effectiveness SIT. Future studies should consider the duration and intensity of interventions as it is important to determine the most appropriate frequency and duration for SIT to guide individualized intervention planning.