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Measuring Physiological Responses to Sensation in Typical Adults

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This project was written under the candidates' faculty advisor and approved by the chair of the Master's program, has been presented to and accepted by the faculty of the Occupational Therapy Department in partial fulfillments of the requirements for the degree of Master of Science in Occupational Therapy. The content presented in this work represents the works of the candidates alone.

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Abstract

Objective: Sensory processing issues can have a negative impact on the ability to participate in daily occupations such as ADLs, access to work, school and leisure environments, and social interactions (Dunn, 2001). The evidence documenting sensory processing issues in adults is sparse. Physiological information can be used as objective evidence to support the claim that those with over-responsivity to sensations are experiencing their environment differently than the typical population. Understanding more about sensory processing in adults may lead to increased recognition of the problem and more opportunities for intervention to increase occupational participation. The purpose of this quantitative study is to compare the physiological responses to sensation in people who self-report as high in sensory sensitivity, to people who self-report as low in sensory sensitivity.

Method: A quasi-experimental design was used to compare physiological responses to sensation using a Sensory Challenge Protocol between adults who reported HIGH sensory responsiveness versus LOW sensory responsiveness on the Adolescent and Adult Sensory Profile assessment (AASP). Physiological response included electrodermal responses (EDR).

Results: No significant differences were shown between experimental and control groups in EDR responses to stimuli. Lack of significance may be due to two factors: wide variability in the LOW group and a possible suppression effect by the HIGH group. There were significant correlations between AASP scores of low registration and sensory sensitive, sensory avoidant quadrants and a sensory defensive composite for the HIGH group supporting the idea that people who have sensory sensitivities may also suppress their responses to sensation. However, the

HIGH groups also had larger EDR responses to more the salient sensations, such as the sound of a lawn mower, the feeling of a feather, and the smell of camphor.

Conclusion: There are differential, meaningful patterns observed in how people with sensory sensitivities are responding to sensations. There is high variability in individuals' personal understanding of their own sensory sensitivities and what sensory stimuli they are responding to. Therefore, it is important to know and understand what people in the general population do to cope because overtime it can lead to maladaptive behaviors in daily functioning.

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From our team:

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Introduction

Every human body responds physiologically to stimuli from the environment. Physiological responses range from an increase in heart rate, a drop in blood pressure to a spike in neural activity. Physiological responses then determine how each individual will react to his or her surrounding environment. Physical behaviors are elicited from the responses and typically assist each person to effectively cope with and participate in his or her environment. An example of this phenomenon would be a person who covers his/her ears in a noisy environment. People who respond to non-threatening environmental information in a maladaptive manner, may have difficulty leading functional, occupationally rich lives (Kinnealey, Oliver & Wilbarger, 1995). Often these are the individuals who are overly sensitive to one or more of the body's sensations, such as auditory, visual or tactile input and are described as having sensory over-responsivity or sensory defensiveness. Those who experience sensory difficulties are able to identify their problems through self-report and qualitative data (Kinnealey et al., 1995), but empirical and more objective measures are more rare (McIntosh, Miller, Shyu & Hagerman, 1999).

Additional quantitative data is needed to further the understanding of physiological responses to sensation in overly sensitive individuals. Qualitative studies have shown that studying typical adults, who are without clinical diagnoses, is still imperative as this population faces many challenges daily to cope with their over-sensitivities (Kinnealey et al., 1995). The present study hopes to find the link between the qualitative and quantitative data of adults with sensory over-responsivity to determine how closely the different types of data reflect each other. Specifically, this study will compare the physiological response to sensation in people who self-report as high in sensory sensitivity compared to people who self report as low in sensory sensitivity.

Background and Review of the Literature

The present literature review will outline and discuss the current state of knowledge on sensory responsiveness, specifically people with over-responsivity, and the physiological measures used to objectively examine this phenomenon. For the purposes of this paper we will be using the term sensory over-responsiveness or over-responsivity. Sensory over-responsiveness is characterized by responses to various stimuli that is greater than what would be expected for a typical response. In comparison, a typical response matches the intensity of the stimuli and the environmental context. Review of the current existing research focuses primarily on clinical populations, pointing to a greater need to examine physiological responses to sensation in typical adults. The first section will begin with relevant background information on sensory processing, Sensory Integration Theory, and Sensory Modulation Disorder. These concepts are important for consideration, as they provide the base of knowledge needed to understand sensory over-responsivity. The second section will cover the different assessment tools that are used to measure sensory processing. Lastly, the third section will focus on the current research involving understanding physiological and behavioral responses to sensations in individuals.

Sensory Processing

Sensory processing is the nervous system’s ability to process sensory information from the environment and create a behavioral response to sensory stimuli (Miller, Anzalone, Lane, Cermak, & Osten, 2007). Sophisticated sensory processing occurs when the brain develops adaptive responses to sensory input in a more complex manner. An adaptive response is appropriately responding to challenges in the environment (Parham & Mailloux, 2015). Development of adaptive responses enables an individual to organize sensory input and allows him/her to be more prepared for sensory experiences (Ayres, 1973). Adaptive responses to sensory stimuli and exposure to sensory enriched environments change the structure and function of the brain via neural plasticity (Ayres, 1973). The parts of the brain that develop first (i.e. thalamus and brainstem) process, filter, and relay sensory information to the cortex. Efficient brain functioning in these areas are the foundations to higher order function tasks, i.e. developing skills and problem solving (Parham & Mailloux, 2015).

Sensory Integration Theory

Dr. A. Jean Ayres originally created Sensory Integration (SI) theory to describe the effect that sensory processing had on academic and motor learning. Ayres' research focused on the deficits in interpretation of sensory stimuli that contribute to difficulties in learning (Bundy, Lane, Murray, & Fisher, 2002). Ayres (1979) defined sensory integration as: "the organization of sensations for use" (p. 5). Sensory Integration Theory analyzes why individuals respond differently to sensations, helps to plan interventions to alleviate the sensory challenges in the environment, and predicts the behavioral response to interventions. Sensory Integration Theory has been researched extensively, with the ongoing work of many scholars and practitioners that has lead to the discovery of diverse patterns in sensory processing (Parham & Mailloux, 2015).

Sensory Integration Problems

Sensory integration problems occur when there are impairments in the neural processing of sensations in the central nervous system (CNS), which can negatively affect development and functional abilities. These problems can manifest in various ways with some individuals categorized as having a sensory integration dysfunction (Parham & Mailloux, 2015). There are many ways to categorize the different types of sensory integration dysfunctions, or what we now refer to as sensory processing disorders (SPDs). The broad categories based on Ayres' work are sensory discrimination disorders, somatodyspraxia, vestibular-based postural/ocular disorders, and sensory modulation disorders. Variations and updates have been made to SI based on Ayres' original sensory processing concept (c.f. Miller et. al., 2007). The variations in SPDs affect 5-10% of the typical population and 20-80% of the population with developmental disabilities (Parham & Mailloux, 2015). For the purposes of this study, we will be focusing on a subtype of sensory modulation disorder.

Sensory modulation disorder. The capacity to process and adapt to sensory changes in one's environment is a critical component of human functioning. Thought of as usually automatic and effective, modulating sensory input requires the successful use of the CNS to either attune to a stimulus or to ignore it (Parham & Mailloux, 2015, p. 267). Sensory modulation disorder refers to the complex processes of perceiving relevant sensory information and producing responses that are appropriate for the situation (McIntosh, Miller, Shyu, & Haggerman, 1999). Within sensory modulation disorder, three subtypes have been identified: over-responsivity, under-responsivity, and sensory seeking (Miller et. al., 2007)

Sensory over-responsivity. Sensory over-responsivity is a subtype of sensory modulation disorder (SMD). Sensory defensiveness lies within the category of sensory over-responsivity and is defined as a "tendency to react negatively or with alarm to sensory input which is generally considered harmless or non-irritating" (Wilbarger & Wilbarger, 1991). For example, a person may be over-responsive to textures, certain sounds, bright light or colors, or movements and react with discomfort, avoidance, or anxiety. Over-responsiveness can be observed in multiple sensory systems or in one particular system. The varying systems affected by sensory over-responsivity are commonly tactile, vestibular, auditory, visual, and olfactory. Tactile defensiveness is observed when an individual is aversive to certain textures or is defensive to certain types of touch. Vestibular defensiveness, or gravitational insecurity, is seen when a person is sensitive to changes in movement or head position, resulting in generalized fears of falling or when they are in a position that they are not accustomed to (Ayers, 1979). Auditory defensiveness affects those who are hypersensitive to auditory stimuli, particularly loud noises. The other senses that are affected by people with defensiveness might also include olfactory, proprioceptive, visual, and gustatory.

For people with sensory over-responsivity, adapting to sensory input and producing appropriate responses is limited, especially if the stimulation is unanticipated. Physiological and behavioral changes in those who are over-responsive can include aggressive or passive withdrawal, as well as sympathetic nervous system activation as an indicator of sensory over-responsivity (McIntosh et al., 1999). Physiological testing can indicate that the inability to adapt to stimuli means there is a disruption in the mechanisms of familiarization and sensitization in the CNS. Furthermore, children with SMD showing a hypersensitive pattern have a heightened sensitivity to various stimuli, habituate to stimuli more slowly, and produce more abnormal responses (McIntosh et al.,1999). Findings from this study validate that children with SMD differ in their responses to stimuli compared to typical children and children with disorders other than SMD (McIntosh et al., 1999).

Assessment Tools

There are multiple ways of measuring sensory processing in various populations. The most common assessment tools used are behavioral, self-reported measures that obtain useful information for subjects and health professionals. Physiological measures are beneficial assessment tools to use because they provide quantitative, objective data on sensory processing and can be used for any population. The assessment tools highlighted in the following section will be used for the present study, where behavioral and physiological testing will be utilized and will provide the necessary information needed to validate sensory over-responsivity in a typical adult population. The first published self-report assessment, the Sensory Profile, will be used for the pre-test portion of the research. This assessment will help in identifying potential participants who score high and low in sensory over-responsivity. The outcome (dependent) measure, the sensory challenge protocol, will use physiological sensation testing to quantity the participant's responses to stimuli.

Sensory profile. Self-reported measures for gathering specific information about adults' sensory processing gives the individual detailed descriptions of their own sensory processing. One measure that is commonly used is the Adolescent and Adult Sensory Profile (AASP). This instrument gives subjects personal information about sensory processing behaviors and educates and increases their understanding of sensory preferences and responses to various stimuli (Brown, Tollefson, Dunn, Cromwell, & Filion, 2001). The AASP was developed using Dunn's Model of Sensory Processing, utilizing the four patterns she described; low registration, sensation seeking, sensation avoidance, and sensation sensitivity (Brown et al., 2001). The constructs of sensory processing preferences that are interpreted using the profile can have multiple intervention applications and helps service providers develop effective intervention strategies (Brown et al., 2001).

Sensory challenge protocol. The Sensory Challenge Protocol is a non-invasive laboratory procedure that assesses physiologic reactivity when subjects are exposed to various sensory stimuli. The protocol was designed by researchers to enhance the understanding of subjects' sensory processing and their physiological responses (McIntosh et al., 1999). The sensory challenge protocol can be thought of as a method to measure physiological responses to sensation and will vary based on the specific research design. Electrodermal responses (EDR) are recorded and obtained after the subject is presented the stimuli for three seconds with approximately 15 to 19 seconds in between each stimulus. The results are recorded and can be interpreted to measure a person's specific physiological responses, identifying those that have specific sensory sensitivities (McIntosh et. al., 1999).

Physiological Responses to Sensation

When considering bodily sensations, objective measurement of physiological activity is important. Individuals' self reports can identify themes in sensory processing differences but it is imperative to obtain non-subjective information as well. This information is difficult to acquire without direct measurement of a body's sensory systems. Physiological information can be used as objective evidence to support the claim that those with over-responsivity to sensations are experiencing their environment differently than the typical population. For example, McIntosh and colleagues (1999) found that children who reported with sensory over-responsivity showed larger and more frequent physiological (EDR) responses to sensation than typical controls.

Electrodermal activity (EDA) is one measure that can be empirically observed during response to sensation. EDA is the change in the electrical conductance of the skin associated with eccrine sweat-gland activity. Measuring EDA includes observing the slow, tonic change that occurs across many discrete stimuli and the quick, phasic changes imposed on shifts in tonic level in conductivity (McIntosh et al., 1999). These tonic and phasic changes are known as electrodermal responses (EDR) to stimuli. EDR can be used to assess either strength of responsiveness or strength of habituation to sensory stimuli (Reynolds, Lane & Mullen, 2015). EDR is recorded using electrodes that are attached to the test subject's skin. EDR is thought to be one way to measure the activity of the sympathetic nervous system. The eccrine sweat glands are innervated solely by the sympathetic nervous system. Parasympathetic nervous system activity can be measured by examining heart rate variability through ECG measurements. Different electrodes can measure the subject's heart rate and respiration activity, data that will indicate the arousal levels of the parasympathetic nervous system within the subject's body (Reynolds, Lane & Mullen, 2015).

Electrodermal responses in addition to increases in heart rate and respiration occur in an individual in response to alerting, startling or threatening stimuli, aggressive or defensive feelings, and during positive and negative emotional events (Reynolds, Lane & Mullen, 2015). In the typical adult, innocuous stimuli such as a touch of a feather or brush will cause a slight reaction in the body but will not cause a significant increase or decrease in heart rate, respiration or EDA. On the other hand, a person with over-responsivity to tactile stimuli may be dramatically affected by this feather touch. His or her self-report of the feather touch may speak about how the feather feels like a needle on the skin, for example, and it is hypothesized that this individual's physiological data will read much differently than that of an individual without tactile over-responsivity. Testing and recording these physiological responses can help researchers understand how individuals with sensory over-reactivity view certain non-noxious sensory stimuli as threatening or dangerous.

Behavioral Responses to Sensations

When presented with environmental sensory stimuli, typical adults are able to modulate, regulate and process the information in an organized manner (Kinnealey et al., 1995). These adults regularly receive input from tactile, visual, auditory, olfactory, gustatory, vestibular and proprioceptive senses. This sensory information usually causes little to no impairment on daily functioning or participation in society for these individuals.

People with sensory over-responsivity, on the other hand, struggle with the input and organization of environmental stimuli. The individuals are initially unaware that their responses to sensations are any different than other people. Many of these adults may fail to meet the criteria for other medical or psychological diagnoses, leaving them to believe they are similar to others (Reynolds & Lane, 2007). Kinnealey and colleagues (1995) performed a qualitative study to explore how sensory over-responsivity affected daily lives of participants. The study subjects reported that as they discovered they were indeed different than other adults, they sometimes doubted their perceptions or the appropriateness of their reactions to stimuli and withdrew socially (Kinnealey et al., 1995). The subjects' defensiveness affected them so severely that many were forced to alter their daily behavior and routines. These adults created behavioral strategies, which they used to cope with the discomfort caused by sensation. Researchers discovered the coping mechanisms most commonly used are avoidance, predictability, mental preparation, talking through, counteraction and confrontation (Kinnealey, 1995). The ways in which individuals utilize these mechanisms may not be deemed socially acceptable. A person sensitive to all loud sounds may find comfort in his quiet home and remain there for years. This is an example of a defensive coping behavior, which causes social and physical withdrawal, isolation and decreased sensation seeking. Avoidant behaviors such as these could potentially lead to depression. In fact, increased symptoms of depression have been found in people who report as being sensory defensive (Kinnealey & Fuiek, 1999).

The high number of individuals in society with sensory over-responsivity indicates a need for intervention to assist with everyday functioning. The above-mentioned coping strategies are time consuming and emotionally exhausting. They negatively affect the choice of a person's life activities, as well as the type and amount of those activities. Defensive mechanisms also have the potential to decrease the quality of life of individuals with sensory over-responsivity. Additionally, strategies of coping may impinge on the interpersonal experiences one has with his or her loved ones (Kinnealey et al., 1995). Time spent with family or friends may be reduced or cause stress for an individual and result in emotionally negative or even harmful interactions.

For the large majority of adults who experience over-responsiveness or impairments in sensory modulation, intervention is necessary. Disruptions in quality of life and increased psychological stress was observed in a study examining atypical sensory modulation and its relationship to psychological distress (Bar-Shalita & Cermak, 2016). The participants who completed the self-report, 12.7% of the total sample met criteria for sensory modulation disorder, with 11.3% as over-responsive. The over-responsive participants demonstrated reduced quality of life and experienced greater psychological distress than others; demonstrating a potential risk factor for mental illness (Bar-Shalita & Cermak, 2016). Findings suggest limited opportunities to enhance quality of life and reduce psychological stressors for typical adults demonstrating impairments in sensory modulation, specifically over-responsiveness.

Summary and Conclusion

An individual's ability to process, organize, and react to environmental stimuli determines how they respond and perceive sensory information. As the study of sensory integration has evolved, there has been a significant increase in knowledge and research on brain function and responses to sensory stimuli. Qualitative, self reported data on sensory processing is available through a variety of assessments and provides a person with subjective information. As previously discussed, this data reveals applicable information but is not entirely sufficient in measuring responses to sensation. There is limited research on physiological responses to sensation and how to link this data with participants' self-reports. Further research is necessary to match the self-reports of over-responsive individuals with their physiological reactions to similar sensations.

Purpose Statement

Currently, evidence-based research is limited in the area of sensory over-responsivity. It is important to examine physiological responses to sensation in typical adults because those that experience sensory over-responsiveness experience similar challenges to clinical populations and have to make necessary adaptations. The purpose of this study will address the differences in physiological responses in individuals who report high levels of sensory over responsivity and low levels of sensory over responsivity. Utilizing a self-report measure (AASP) followed by physiological (EDR) measures using the Sensory Challenge Protocol, information will be gathered to identify and quantify sensory responses. We hypothesize that individuals who report high levels of sensory over-responsivity based on the AASP will have increased physiological responses (EDR) compared to the individuals who report low levels of over responsivity.

Operational Definitions

Sensory Over-Responsivity: A subtype of sensory modulation disorder characterized by aversive responses to sensory stimuli greater than what would be expected for typical responsiveness.

Physiological sensation: Any sensory stimuli such as touch, smell, taste, sound, sight felt by the human body.

Theoretical Framework

Our study on physiological responses to sensation uses the theory of sensory integration developed by Dr. A. Jean Ayres. This theory will help in guiding the research as it directly relates to the processing and subsequent responses from sensory information. The following section will address the key concepts of sensory integration and how the theory relates to and supports our study.

Sensory integration is the process the body uses to organize sensory information coming in from the surrounding environment. The seven senses in the body, which are tactile, olfactory, gustatory, visual, auditory, vestibular and proprioceptive, provide the central nervous system (CNS) with information about the world (Ayres, 2005). The CNS must then sort and order the sensory information to make sense of it all. When working properly, the CNS is able to process sensory information and therefore send appropriate neuronal messages to the rest of the body in response. Disorganization during sensory integration, however, leads to varying degrees of difficulties during daily life (Ayres, 2005). These difficulties, when occurring in typical adults, are what our study is investigating.

There are five main sensory integrative abilities that lead to successful processing and adaptive responses to stimuli that have been adapted from Ayres' original work. The factors that determine dysfunction in an individual's sensory integration are praxis, discrimination, modulation, postural-ocular and vestibular control, and bilateral integration and sequencing. (Parham & Mailloux, 2015). Praxis consists of ideation, which is the conceiving of ideas, motor planning, which is organization of motor actions, and execution of motor skill (Ayres, 2005). Discrimination of the senses is achieved when a person effectively recognizes and interprets differences or similarities of stimuli. Sensory discrimination deficits can result in an inability to identify objects without looking or locating sensory stimuli.

Postural-ocular control is the ability to control and stabilize the body when it is in motion or at rest. For those that experience poor postural-ocular control, they will have issues maintaining equilibrium, balance, and stabilization of the trunk and proximal joints. This category integrates the vestibular, proprioceptive, and visual systems to coordinate effective responses. Issues surrounding postural-ocular control will also affect successful bilateral integration and sequencing. The ability to coordinate both sides of the body for functional tasks and demonstrate adequate postural control is disrupted from poor bilateral integration (Ayres, 2005).

Sensory modulation is the "brain's ability to regulate it's own activity" (Ayres, 1979). Individuals with effective sensory modulation can modulate sensory information, attending to the relevant stimuli and producing responses that are graded to match the demands of the environment. When the brain does not have the capacity to increase or decrease the amount of sensory information coming in, the result is then an imbalanced and disorganized system. Within sensory modulation, there are different subcategories of modulation dysfunction that include sensory under-responsiveness, sensory seeking, and sensory over-responsiveness. An under-responsive individual will appear to be unaware of typical sensory input in his or her environment and will demonstrate a low level of arousal. A person who is sensory seeking needs exaggerated levels of sensory input in order to respond. Sensory over-responsiveness is the main focus of this study and presents when an individual over-responds to various stimuli that is greater than what would be expected.

Ayres defined dysfunction in sensory integration as the brain's inability to process sensory information in a manner that gives precise, accurate feedback about what is occurring in the environment (Ayres, 2005). Based on this definition, sensory over-responsivity to tactile, olfactory or auditory stimuli will occur when an individual misinterprets stimuli they touch, smell or hear and responds in an exaggerated or negative way to that stimuli. Participating and thriving in everyday life is difficult with sensory over-responsivity and leaves the individual feeling uncomfortable, out of control, and unable to cope with the ordinary demands and stresses of life (Ayres, 2005). Our study predicts that the self-reports from our over-responsive research subjects will also reveal difficulty participating in daily life, which will reflect the findings from Ayres' research.

In addition to self-reports, we will be investigating the physiological responses to sensation that our participants experience. Sensory integration theory discusses the body's ability to inhibit, or hinder, and facilitate, or help, neuronal messages sent to the brain from the environment (Ayres, 2005). When an individual experiences difficulties with over-responsivity to sensation, Ayres believed he or she may be lacking the ability to inhibit sensory information, which leaves the person feeling overwhelmed and agitated. The theory being investigated in our study is based on the idea that the physiological responses of individuals with sensory over-responsiveness are identical to the response seen in typical adults when fear-inducing stimuli is experienced. In over-responsive individuals, there is simultaneous activation of the sympathetic nervous system and the hypothalamic-pituitary axis, which releases the stress hormone, cortisol (Reynolds, Lane & Mullen, 2015). Sensory over-responsiveness is therefore hypothesized to be based on certain sensory signals rather than intensity of the stimuli or simply poor inhibition, as Ayres and others have proposed. Our study is an opportunity to explore the theory related to the underlying mechanisms of sensory over-responsiveness.

Ethical and Legal Considerations

The research study was approved by the Institutional Review Board for the Protection of Human Subjects (IRBPHS) at Dominican University of California (DUC) prior to contact with participants. Dominican University of California gave researchers consent to use room 304 of Meadowlands as a testing room. Physiological testing equipment and procedures were obtained from a previous study by the faculty advisor.

The researchers ensured compliance with The American Occupational Therapy Association (AOTA) code of Ethics throughout the study. All principles of the code of ethics were maintained and acknowledged. To protect participants, researchers ensured that only innocuous sensations were provided and a safe and secure testing location was used. Participants were informed of their rights to discontinue the study at any time and were accurately instructed on all procedures and conditions prior to testing in an informed consent form (see Appendix A) and welcome letter (see Appendix B). Accommodations for disabilities were acknowledged and addressed. Confidentiality was maintained by storing all documentation in a secure location that was only accessible to the researchers and faculty advisor. All documentation will be destroyed one year after the study concludes. The researchers upheld commitments made with participants and provided equal and professional treatment.

Methodology

Design

A quasi-experimental design was used to compare physiological responses to sensation using a Sensory Challenge Protocol between adults who reported HIGH sensory responsiveness versus LOW sensory responsiveness on the Adolescent and Adult Sensory Profile assessment (AASP). The independent variable was the categorization of HIGH sensory responsiveness versus LOW sensory responsiveness as measured by the Adolescent and Adult Sensory Profile. The dependent variables were individual's physiological response to briefly presented auditory, tactile, and olfactory as measured by EDR.

Participants

Participants of this study included a convenient sample of 16 typical adults ranging in age from 18-64 years old who identified as either high or low in sensory over-responsivity. Fourteen of the participants were female and two were male. Participants who scored HIGH in sensory over-responsivity on the AASP were placed in the experimental group and those who scored LOW in over-responsivity were placed in the control group. Ten participants qualified for the experimental group and six in the control group.

Participants were recruited with the use of flyers (see Appendix C) posted throughout Marin County, through word of mouth, and social media. Interested participants contacted the researchers by email or phone. Participants were included if they were typical adults in the 18-64 year age range and English speaking. Exclusion criteria were subjects with cognitive, mental, or physical disabilities. The research study was approved by the Institutional Review Board for the Protection of Human Subjects (IRBPHS) at Dominican University of California (DUC) (IRB#10530)

Measurement Instruments.

Sensory Profile. The self reported measure used for this study was the AASP developed by Dr. Catana Brown and Dr. Winnie Dunn (Brown et al., 2001). The scores of AASP assessment categorizes individuals along dimensions of four quadrants. The four different quadrants include low registration, sensation seeking, sensation avoiding, and sensory sensitivity. Within these quadrants individuals are classified as a range from much less than most people to much more than most people in each quadrant. A person may score the same in more than one quadrant, demonstrating for instance that they are more than most people for sensory sensitivity (SS) and sensation avoiding (SA). For the purpose of the study the two categories were combined to create a composite score of sensory defensiveness (SD). Thereafter, all of our participants who self-report as high in SD and low in SD will be examined and tested further through physiological measures.

Electrodermal Response. Electrodermal responses (EDR) was used to quantify an individual's response to a particular stimuli, indirectly measuring sympathetic nervous system activity (McIntosh, et al., 1999) EDR was measured during the first trial of each stimulus presentation during the Sensory Challenge Protocol described below. A change is EDR was measured by calculating difference between the electrodermal level at the time of stimulus presentation and the highest level within an eight second window after stimulus presentation. EDR peaks was within 2 to 5 seconds after stimulation. (McIntosh et al., 1999). (See below for procedures and details).

Data Collection Procedures

Interested participants who identified as HIGH or LOW in sensory sensitivity were contacted via telephone to participate in a five-item questionnaire screening (see Appendix D). Participants who met the questionnaire requirements of being either HIGH or LOW in sensory sensitivity were invited to participate in the study. Participants completed the AASP as an additional screening to determine if they were HIGH or LOW in sensory over-responsivity and a background information questionnaire (see Appendix E). Thereafter, physiological sensation testing utilizing the Sensory Challenge Protocol was ensued. Consent was obtained to participate in the study and to videotape the procedures. The videotapes were used to record facial expressions, body movements, and extraneous movements during the physiological recording procedures.

Sensory Challenge

Participants were exposed to three different sensory modalities including tactile, olfactory, and auditory through different sensory stimuli. Each sensory stimuli had three levels, varying in intensity and/or pleasantness of sensation. In preparation for the physiological measurements, small sensors with conducting gel were placed on the right and left wrists and recorded cardiac activity. Electrodermal activity was recorded from the third and fourth digit of the non-dominant hand.

Each stimulus was presented four to seven times for two to four seconds each. There was a 10 to 25 second interval between each repeated exposure to a stimulus and a period of one to three minutes between each different kind of stimuli. The stimuli were intended to vary on dimensions of intensity, and/or pleasantness of the sensation. The procedures have been adapted and expanded from research by Baranek, et al. (2002) & McIntosh, Miller & Shyu (1999). After the application of each stimuli, participants were asked to rate their experience of pleasantness on a nine point Likert- type scale.

Tactile. The tactile stimuli included three different textures presented on the right cheek (feather, cotton ball, and a nuk brush). The stimuli presented in a three-inch stroke with approximately two ounces of pressure. The stroke was applied along the jawline beginning below the earlobe and ending at the chin.

Auditory. Participants listened to pure tones and sounds from everyday life. Pure tones and sounds were presented at 80 db volumes through sound attenuating headphones. Pure tones were presented in 400 Hz, 1,000 Hz, and 3,000 Hz. The everyday sounds came from a collection of International Affective Digital Sounds (IADS). The sounds make up different categories, including children's noises (baby crying), nature (crickets), and everyday noises (lawnmower).

Olfactory. Participants smelled different odors presented in varying concentrations. Three milliliters of concentration was placed in a vial with an approximately ½ inch opening. The vial was held under the participant's nose for a maximum of two seconds each. The odors include both pleasant and unpleasant smells found in everyday life such as orange, camphor, and isopropyl alcohol.

Stimulus Presentation. The E-prime program (version 2) controlled all stimulus presentations on a PC computer. Stimulus presentation procedures were adapted and expanded from research by McIntosh and colleagues (1999). Main categories of stimuli were presented in the same sequence for each participant and followed the order: pure tones, real sounds, tactile, and olfactory. Tones, real sounds, and tactile modalities were presented in a random order. However, the order of the olfactory stimuli remained the same and were as followed: orange, camphor, and isopropyl alcohol. Participants were offered a five-minute break after pure tones and real sounds were presented.

Prior to any stimuli presentations, a three-minute baseline period was conducted where the participant was instructed to sit quietly. After the baseline period, each stimulus was presented and were rated for pleasantness on the first and last trials using a nine-point Likert-type scale with a graphic component (i.e., facial representations of the ratings). The duration between trials varied randomly between 10, 12, or 15 seconds for one individual stimulus. There was a 30 second break between stimuli within one stimulus block (e.g., 30 seconds between two different real sounds). At the end of each stimulus block, there was a 20 second rest period, presentation of instructions for the next stimulus block, and then a 30 second rest period before stimulus presentations in the subsequent block.

Data Analysis

Electrodermal response was measured in microseimens. EDR magnitude was determined using the first trial of each stimulus presentation. Data was collected using AcKnowledge software and transferred into SPSS (v.17) software for analysis. Psychophysiological data was screened for movement and noise artifacts through visual analysis and videotape review of each participant. The groups were compared for the magnitude of response using an Independent Samples *t*-test. A significance level of $p = .05$ will be set.

Results

A total of 16 participants from Marin County, California were included in the study: ten of which were in the experimental group and six in the control group with fourteen females and two males participating. The mean age of the control group was 35 with SD of 13.93. The mean age of the experimental group was 42.2 with a SD of 19.01. The participants were divided into either HIGH sensory responsive or LOW sensory responsive groups based on their AASP scores. From the AASP, those who scored "more than most" or above were included in the experimental or HIGH group and those who scored "similar to most" or lower were included in the control or LOW group.

A t-test was run that determined mean AASP scores demonstrated in Table 1, which showed the experimental and control group differed significantly in AASP scores. The experimental group scored significantly higher mean average for AASP Sensory Avoiding (SA) and Sensory Sensitivity (SS) quadrant scores and the Sensory Defensiveness Composite (SD). The t-test scores are presented in Table 1, indicating the differences between the two groups in regards to their varying responses to sensations.

Table 1

Comparison of typical to more than most

AASP Score	Group	N	Mean	Std. Deviation	t	df	p
Low Registration	LOW	6	35.	4.51			
	HIGH	10	36.6	8.55	-.289	14	.777
Sensory Seeking	LOW	6	48.5	4.46			
	HIGH	10	46.0	7.96	.700	14	.495
Sensory Sensitivity	LOW	6	38.8	4.07			
	HIGH	10	48.5	8.53	-2.579	14	.022*
Sensory Avoiding	LOW	6	37.8	3.87			
	HIGH	10	49.8	9.16	-3.626	13.10	.003*
Sensory Defense	LOW	6	76.7	7.06			
	HIGH	10	98.3	16.58	-3.616	13.12	.003*

*Significant at $p<.05$

Comparison of EDR Responses

As seen in Table 2, the experimental and control group mean, standard deviation, and t-test scores are represented. The independent t-tests were conducted to test the difference in EDR magnitude between the HIGH and LOW groups. The EDR group comparisons that are represented demonstrate some interesting findings that were not expected. The groups did not differ significantly in the mean log of the peak-to-peak EDR responses to any of the stimuli. While we had originally expected the HIGH group to have higher response rates to all stimuli, the control or LOW group demonstrated higher response ratings for the majority of stimuli.

Table 2

EDR means, SD's and results of T-tests of group responses to stimuli

	Control		Experimental		*t*-test		
Stimuli	M	SD	M	SD	*t*	*df*	*p*
400Hz	1.75	0.96	1.56	1.41	0.28	14	0.78
1000Hz	*1.35*	*1.08*	*0.92*	*0.67*	*0.98*	*14*	*0.34*
3000Hz	1.48	0.88	1.45	0.68	0.08	14	0.93
Mower	1.87	1.29	1.35	0.96	0.92	14	0.37
Cry	1.66	1.37	1.24	0.92	0.07	14	0.48
Cricket	1.20	1.19	0.85	0.39	0.70	5.68	0.51
Feather	1.64	0.80	1.77	2.32	-.13	13	0.90
CottonBall	1.71	1.13	1.44	0.65	0.61	14	0.55
Nuk	1.22	0.77	1.15	0.68	0.20	13	0.85
Camphor	1.80	0.91	1.72	1.29	0.14	13	0.90
Orange	1.34	0.77	0.91	0.42	0.88	5.88	0.41
Alcohol	1.73	1.33	0.93	0.46	1.43	5.79	0.21

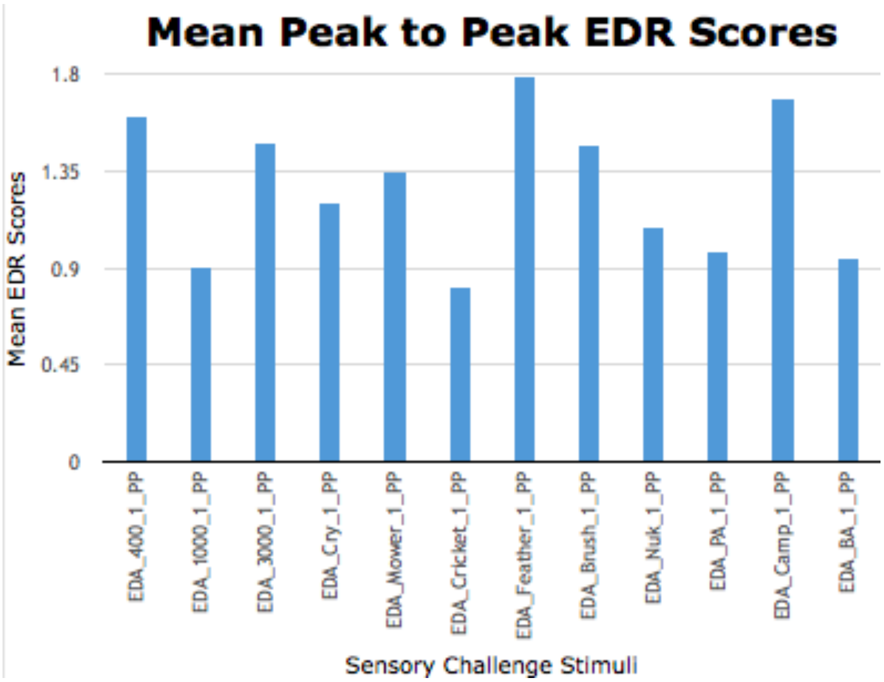
Note. $p < 0.0$

Follow-up Analyses to Further Explore the Results of the Main Analysis

Higher responses from experimental group. Mean and standard deviation scores were highest in both groups for similar stimuli including the 400 Hz tone, the mower sound, the feather stimuli, and the camphor scent. For the HIGH group, these interesting patterns of response from the various stimuli were highlighted. Outlined in Figure 1, four sensory stimuli; the 400 Hz tone, the mower sound, the tactile feather stimuli, and the camphor scent evoked the largest responses. Participants in the HIGH group had larger EDR responses to these more intense sensations than the others in those modalities, as evidenced by the responses. This finding is consistent with one of the hypotheses of the study that certain stimuli would produce greater responses in the HIGH group.

Figure 1

Mean EDR peak-to-peak scores for experimental group

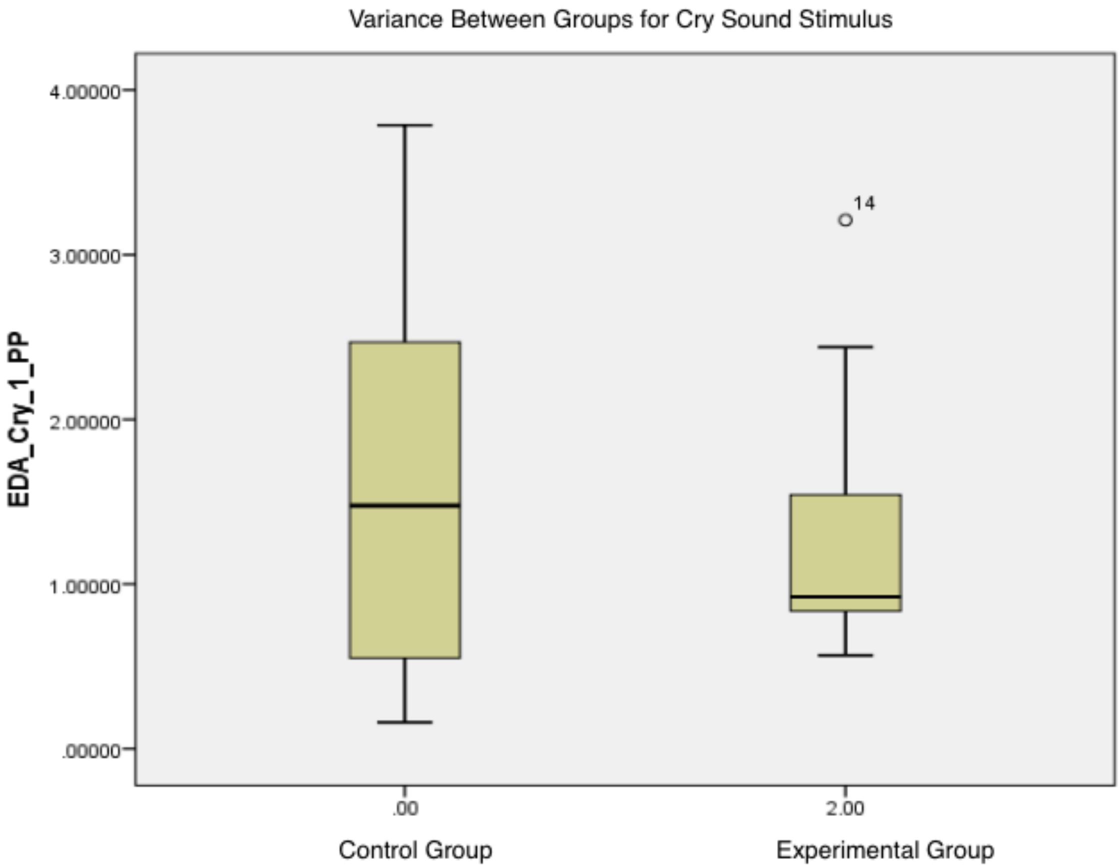


Note. *Average EDR response for experiment group = 1.27. EDA 400, EDA Mower, EDA Feather, and EDA Camphor also elicited highest responses from control group.*

Variability in LOW group. Variability of between group differences demonstrate that the LOW group had much greater variability of response. Figure 2 shows an example of this variability trend with the results for the cry sound stimulus as an example. The variability that was observed in the control group was an unexpected phenomenon and therefore we determined that we would focus primarily on EDR comparisons for the experimental group.

Figure 2

Example of variability in experimental and control groups for cry sound stimulus



Note. Variance between groups for cry sound. Variability within control group notably more significant than that of experimental group. This phenomenon was observed across all stimuli.

HIGH group sensory profile correlations. After findings were made comparing group differences based on the AASP, a Pearson Product Moment Correlation was conducted on only the experimental group to determine whether there was a relationship between any of the scores on the subcategories of the AASP. The test indicated a significant correlation between low registration and sensory sensitive, sensory avoidant and sensory defensive categories. These findings were particularly interesting because they support the previously stated idea that people who have sensory sensitivities may also suppress responses to sensation. Table 3 shows the results of this correlation for the experimental group.

An observation made during testing was that the HIGH group seemed to use several self-organizing strategies to manage their responses to the stimuli and perhaps suppress their responses. The suppression effect was additionally supported by the AASP scores for the HIGH group, which indicated a correlation between AASP quadrants. The suppression effect combined with the high variability in the control or LOW group contributed significantly to the results, further explaining why there were no significant differences between the groups as was originally expected.

Table 3

Pearson product moment correlation for experimental group

Experimental Group Correlations

AASP Quadrant		AASPLow	AASPSeek	AASPSens	AASPAvod	SensDef
AASPLow	Pearson Correlation	1	-0.344	.678*	.847**	.817**
	Sig. (2-tailed)		0.330	0.031	0.002	0.004
	N	10	10	10	10	10
AASPSeek	Pearson Correlation	-0.344	1	-0.244	-0.358	-0.323
	Sig. (2-tailed)	0.330		0.497	0.310	0.362
	N	10	10	10	10	10
AASPSens	Pearson Correlation	.678*	-0.244	1	.757*	.932**
	Sig. (2-tailed)	0.031	0.497		0.011	0.000
	N	10	10	10	10	10
AASPAvod	Pearson Correlation	.847**	-0.358	.757*	1	.942**
	Sig. (2-tailed)	0.002	0.310	0.011		0.000
	N	10	10	10	10	10
SensDef	Pearson Correlation	.817**	-0.323	.932**	.942**	1
	Sig. (2-tailed)	0.004	0.362	0.000	0.000	
	N	10	10	10	10	10

Note. * *Correlation is significant at the 0.05 level (2-tailed).* ** *Correlation is significant at the 0.01 level (2-tailed). Significance found between AASPLow and AASPSens, AASPLow and AASPAvod, and AASPLow and SensDef.*

Discussion

The objective of this study was to compare the physiological responses to sensation in people who self-report as high in sensory sensitivity to people who self-report as low in sensory sensitivity. We hypothesized that individuals who qualified as HIGH in sensory over-responsivity based on the AASP would have higher physiological responses (EDR) to sensations compared to individuals who qualified as LOW in over-responsivity. Based on the results of our study, our hypothesis was not confirmed, and unexpected and contradictory patterns of responses occurred. The experimental group did show a pattern of increased responses to certain more intense stimuli as predicted partially supporting the initial hypothesis.

Due to the conflicting results, this discussion will focus on possible reasons for the discrepancy found between our research and previous research, which has consistently found differences in physiological responses between individuals with sensory processing differences and those described as typical. The factors influencing the results include possible technical errors, great variability in control group, participant suppression or coping strategies, or complete "shutdown" of reception to sensation. Lastly, the discussion addresses limitations and barriers in our study, and addresses the significance of the results as it pertains to the field of occupational therapy.

High Variability in LOW Group

The LOW group displayed a large variability in physiological responses, with some participants responding much higher or much lower to stimuli in comparison to the HIGH group. This finding is different from the HIGH group in that these individuals responded more consistently to the sensations, and their mean responses were paradoxically lower overall than the LOW group. The large variability in EDR responses of the LOW group may be due to poor accuracy in self-report of sensory processing experiences by the LOW group. The self-reported scores of the individuals in the low group differed greatly from their EDR responses during the Sensory Challenge. These individuals may believe their bodies' responses to certain sensations are low when, in reality, their physiology indicates high sensitivity.

Another possible explanation for this paradoxical phenomenon may be that there was not enough of a physiological difference between the low and high groups. The results of the participants' AASP scores may have indicated to our researchers that a large difference existed between the control and experimental groups when there was no difference to be found. Self-report by the individuals in the LOW group qualified them as "same as most" but not particularly low. The high group's self-report revealed these individuals to truly be "more than most". A more significant difference may have been observed in our physiological findings had our control group been individuals who qualified as "less than most" in sensory sensitivity based on the results of their AASPs.

As seen from both the control and experimental groups, the self reported measure that was used, the AASP, was a questionable indicator of sensory responses in relation to the objective data that was measured using physiological responses. The high variability in the control group, the physiological data, and the correlations between varying quadrant scores on the AASP, bring up questions regarding the sensitivity of the AASP. The findings of the current study call for the self report measure to be further analyzed for its accuracy in attaining individuals' precise sensory experiences. Additional behavioral self-reported measures are needed to analyze and interpret individuals' responses to sensation.

Nature of responses in the HIGH group. The HIGH group had less variability in EDR responses, in addition to their EDR responses being recorded as lower than those of the control group. One explanation for the smaller EDR responses by the HIGH group is that they may have began the Sensory Challenge with an elevated EDR baseline prior to exposure to the stimuli. This may have occurred simply as a result of participation in the study. These individuals could have anticipated the discomfort they were about to experience and therefore, already had high EDR levels. Since EDR was measured from onset of the stimuli to the peak level after the stimuli, participants who had high EDR levels prior to the stimuli had less of a range to possibly respond. In other words, EDR may have already been close to maximum at the onset of the stimuli.

Another explanation may be that the adults with sensory over-responsivity habitually suppress response to stimuli. A significant correlation was found between the HIGH group's low registration scores and their SS, SA and SD quadrant scores. This relationship was not seen in the LOW group's AASP results and may be an indication that individuals in the HIGH group have learned, over time, to suppress their responses to certain sensations or shut down when overloaded with sensory stimuli. These participants may have scored themselves in the subcategory of low registration on a number of the AASP items, believing to not notice certain aspects of their environments when really, their sensory system has become accustomed to being overwhelmed a majority of the time and have since acquired learned behaviors to ignore their environment when over-stimulated. This hypothesis would explain why these individuals scored as low registration on some items of the assessment while scoring as SS or SA on other items. The significant correlation between the HIGH group's AASP low registration scores and their

SS, SA and SD scores may indicate that they have developed coping strategies to deflect and endure their sensitivities in the environment.

Additional explanations. The physiological measurements obtained from this study created more questions than answers about the phenomenon of sensory over-responsivity. Our study's findings contributed to a need for objective, quantifiable data to measure sensation. However, a significant amount of additional quantitative data is necessary to answers all of the questions and contradictions raised by the results of our study. Discrepancies between individuals' self-reported sensory experiences and their physiological reactions to sensation need to be explained. The AASP is commonly used by occupational therapists to gather information about individual's sensory processing, but it is one of the only behavioral measurements available. The results from the present research generate questions about individuals' abilities to accurately complete the AASP and the AASP's ability to correctly categorize individuals. Due to differing perceptions, perspectives and individual understanding, there could be inconsistencies with how individuals approach each question on the assessment and relate it to their own daily lives.

Errors in assessment, however, are likely to be found in the current method of physiological testing. Based on the physiological findings, some participants that self-reported as LOW in the sensory sensitive quadrant ended up having higher EDR responses to various stimuli than those who self-categorized as HIGH. For these LOW individuals, it could be that they are either not as aware of their sensory sensitivities or the AASP was not the most accurate measure to use as a preliminary screening tool.

Implications for occupational therapy. The findings from our research emphasize the need for occupational therapy professionals to focus on the many sensory differences experienced by typical adults, not simply the difficulties reported by the clinical population. One key takeaway is support for the overall understanding that individuals process sensory information differently and these individual differences should be taken into account when working with clients. Understanding an individual's sensory preferences benefits the strategies and interventions implemented as well as creates a more client-centered, meaningful relationship. The possible suppression that was noted in the experimental group is important for occupational therapists to consider and pay attention to because, for those individuals who are sensory sensitive, the agitation and discomfort experienced may not be apparent. Participation in meaningful occupations can be impacted by negative responses to sensations, and this discomfort can make daily life difficult to manage.

The participants who were categorized in the HIGH group for sensory sensitivity shared personal experiences and reactions to stimuli in their everyday lives. In communication with the researchers and through the comment section on the AASP self-report measure, participants in the experimental group provided additional information identifying sensitivities that impacted their everyday lives. Examples of these included sensitivities to perfumes, avoidance of loud environments, and even turning clothing inside out due to tags, lining, etc. The personal, qualitative information shared gave more insight into the challenges people with sensory sensitivities experience daily, challenges that typical or people with low sensory sensitivities can either ignore or process more easily in order to have an adaptive response.

Limitations

The current study has several limitations. The generalizability of our study is low due to the nature of our population. Our participants were collected via a convenience sample and all came from one geographic location of Marin County, CA. Our sample was also small, consisting of 16 individuals, some of whom had prior experience with one of our assessment measures, the AASP. This may have led to some bias in the participants as those with prior experience were more knowledgeable than other participants in general information about the nature of overall sensory experiences. Various participants may also have had past, negative experiences with certain stimuli presented during the study, causing these individuals to have adverse reactions. In the future, participants can be screened for these possible sensitivities.

Another limitation experienced during our study was the possibility of human error and technology malfunctions during the administration of the Sensory Challenge Protocol. Two examples of this is the feedback we received from several participants that they could not smell one of our olfactory stimuli very well, and that volume of the auditory stimuli volume was not consistent. A way to avoid this in the future would be to acquire stronger, longer lasting scents and to ensure consistency in volume of pure tones and sounds for their respective portions of the Sensory Challenge. Finally, our study utilized one subjective, qualitative measure of sensory responses, the AASP. We believe it would have been beneficial to use multiple assessments to gather behavioral data on the participants to allow for further analysis and comparison with the quantitative results we obtained.

Future Directions

Currently, there is a paucity of treatment techniques for typical adults who struggle with oversensitivity. This void of intervention strategies is directly linked to the absence of research on how sensory over-responsiveness affects adults in the typical population. Without understanding the physiological foundation behind sensory differences, it is difficult to structure interventions to help those who are struggling address their sensitivities. As Kinnealey et al. identified, there are different ways sensitive adults learn to cope with and adjust to their daily environments but the lack of hard evidence via quantitative, physiological data is problematic (1995). Current treatment of sensory over-responsiveness in children and the clinical population is backed by extensive research, thanks to the work of Dr. Ayres and others (Parham & Mailloux, 2015). Now is the time to focus research on typical adults, to discover treatment techniques that will decrease the need for the emotionally exhausting and time consuming coping strategies and defense mechanisms that adults with sensory sensitivities are currently utilizing (Kinnealey et al., 1995).

Future research involving a larger sample size of participants who did not have previous experience with the AASP and are from diverse geographical locations would better support generalizability. Overall, an increase of research and evidence in sensory processing in the adult population will be crucial to providing adequate sensory treatment and interventions. Subsequently, additional empirical qualitative and quantitative assessments will be needed to better identify and treat sensory sensitivities.

Summary and Conclusions

The purpose of the current study was to identify the ways in which different individuals physiologically respond to various types of sensation. Though our hypothesis was not confirmed, our research discovered a significant difference between how some individuals qualitatively report sensory experiences and the ways in which their bodies respond to similar sensations. The research also brought into question the nature of self-report measurements to truly quantify individuals' responses to sensation. The contributions made from our research help to inform those interested in understanding more about sensory over-responsivity, measuring over-responsivity physiologically and using a typical adult population. The findings of this research additionally generate more questions about the phenomenon of over-responsivity and the differences in how adults behave, process, and respond to sensory stimuli. Finally, more research needs to be allocated toward the understanding of sensory processing in the adult population. A greater understanding of this phenomenon has the potential to improve the lives and occupational participation of numerous individuals.

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Appendix A

PARTICIPANT WELCOME LETTER

Dear Participant,

Thank you for your interest and participation in the Sensory Psychophysiology research being conducted at Dominican University of California (DUC). The completed research is part of the requirements for the Occupational Therapy master's program at DUC. Information attained in this study will remain confidential and you may refuse to participate at any time.

This packet includes:

- 2 Consent forms
- Sensory Profile: This self-report will give you information about your personal sensory processing patterns and effects on functional performance.
- Map of Dominican University

In order to ensure that all information will remain confidential, please do not include your name on the sensory profile. Please answer all questions as honestly as possible. We will contact you within the next few weeks to schedule an appointment. All appointments will be held at DUC in Meadowlands room 304. Appointments will take approximately 1 hour.

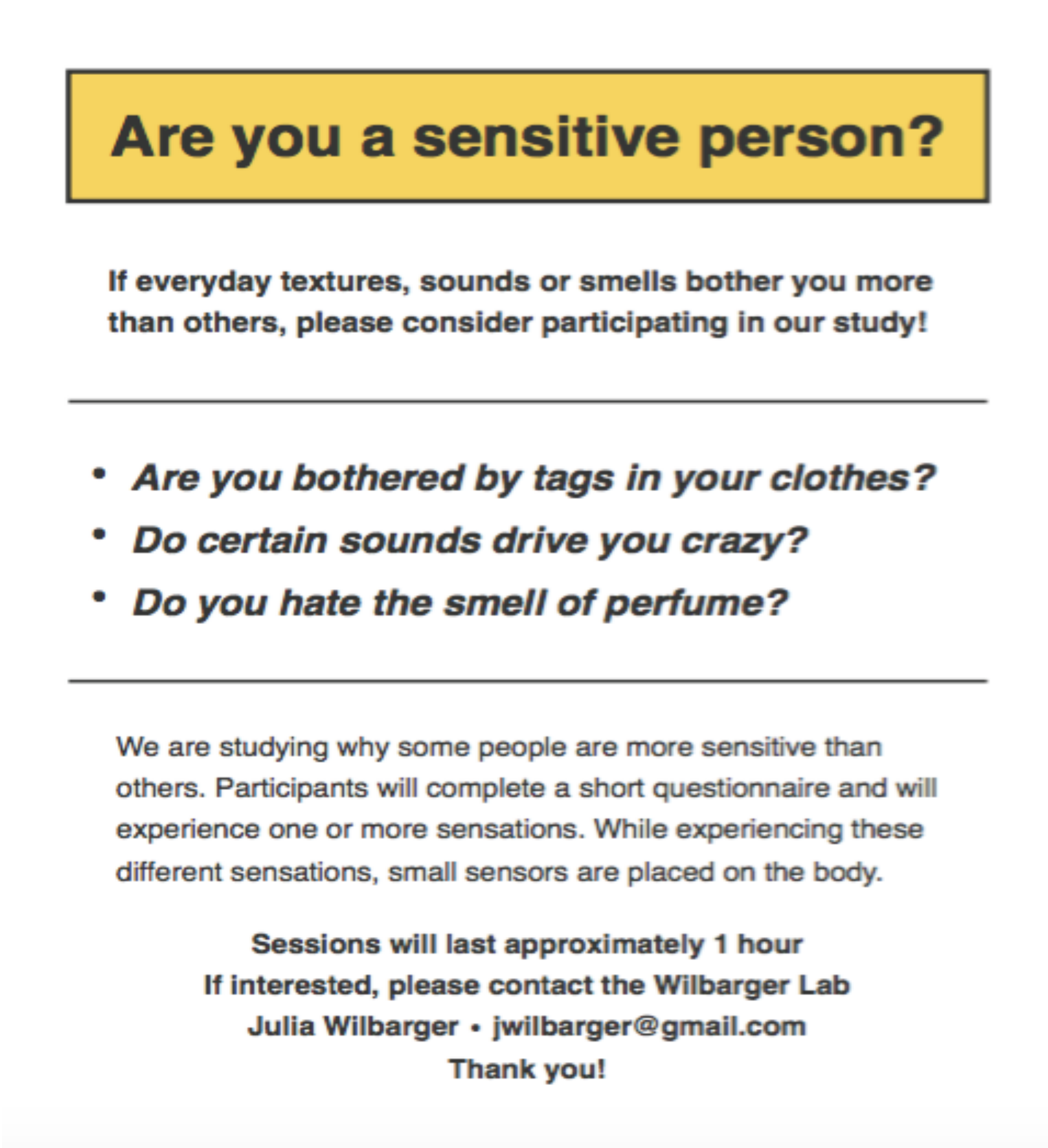
Please bring a signed copy of the consent form and your completed sensory profile on your scheduled appointment time.

Thank you again for participating in our research and we look forward to meeting you!

Sincerely,
Sarah Button, OTS
Kristen Christensen, OTS
Emily Minor, OTS
Julia Wilbarger, OTR/L

Appendix B

RECRUITMENT FLYER



Are you a sensitive person?

If everyday textures, sounds or smells bother you more than others, please consider participating in our study!

- ***Are you bothered by tags in your clothes?***
- ***Do certain sounds drive you crazy?***
- ***Do you hate the smell of perfume?***

We are studying why some people are more sensitive than others. Participants will complete a short questionnaire and will experience one or more sensations. While experiencing these different sensations, small sensors are placed on the body.

Sessions will last approximately 1 hour
If interested, please contact the Wilbarger Lab
Julia Wilbarger • jwilbarger@gmail.com
Thank you!

Appendix C

PARTICIPANT PRE-SCREEN PHONE CALL
Phone Intake Procedure – Sensory Responsiveness Studies

"Hello. I'm calling from the Wilbarger lab at the DUC. I am calling because you have indicated an interest in participating in research here at Dominican University of California. I'd like to talk to you about a study we are currently conducting."

"Do you have about 5 minutes for me to tell you more about the study, or should I call later?"

"We are interested in how people respond physically to different kinds of sensations.

Participants will:
- Complete a short questionnaire sensory responses to every day life experiences.
- Experience a number of different sensations: touch, sound, and smell.
- While experiencing these sensations, he/she will wear small sensors on his/her cheek, brow, fingers, and wrist. These will record physical responses to the different stimuli.
- Rate the pleasantness or unpleasantness of each of the stimuli.

"The study takes about an hour. The participant can choose to stop at any time during the session.

"Do you have any questions so far? Are you interested in participating?"

IF NO
"Is there anything we can clarify for you? Would you be interested in participating at some other time? " Thank them for their time and give them our number in case they change their mind.

IF YES
"Great. I need to ask you a few question to see if you are a good match for this study" Ask the questions on the short sensory responsiveness questions.

People vary greatly in the level to which they enjoy sensory experiences. Some people love to experience all kinds of sensations or seek out intense experiences. Others do not. Some individuals are very/extremely sensitive and have a hard time tolerating sensations that others find harmless or even pleasant. This is called **sensory defensiveness**. People with sensory defensiveness dislike or avoid everyday experiences (or sensations) such as the feeling tags in clothing or seams in socks, the sound of air conditioners or blenders, the smell of some perfumes or foods, the sight of bright sunlight, or the feeling of swinging or riding in elevators.

Given the description above how would you respond to the following statements?

1) Do you think you have sensory defensiveness? Would you say..

extremely untrue	quite untrue	slightly untrue	neither true nor false	slightly true	quite true	extremely true

2) Do you think you avoid sensations others seem to enjoy or ignore

extremely untrue	quite untrue	slightly untrue	neither true nor false	slightly true	quite true	extremely true

Can you give examples? Probe for touch, sound and smell.

If all the information looks good, schedule them for a 1-hour session. You may have to get several possible times that they are available and get back to them.
SenResp: Phone Intake Procedure

Appendix D

Background Information

Thank you for your interest and participation in the Sensory Psychophysiology research being conducted at Dominican University of California (DUC).

Please fill in the following information to provide us with some background information about yourself. All information will remain confidential and do NOT include your name.

Gender
I'm a (Check one):
[ ] Female
[ ] Male
[ ] Rather not say
[ ] Other (please specify:____________________)

Age
I'm (Check one):
[ ] between the ages of 18-24
[ ] between the ages of 25-34
[ ] between the ages of 35-44
[ ] between the ages of 45-54
[ ] between the ages of 55-64

Ethnicity
I'm (Check one):
[ ] White
[ ] African American
[ ] Asian/ Pacific Islander
[ ] Hispanic/ Latino
[ ] American Indian
[ ] Middle Eastern