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Physiological Responses & Coping Strategies of Sensory Defensive Adults

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Physiological Responses & Coping Strategies of Sensory Defensive Adults

by

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A culminating capstone project submitted to the faculty of Dominican University of California in partial fulfillment of the requirements for the degree of Master of Science degree in Occupational
Therapy

Dominican University of California

San Rafael, CA

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Abstract

Purpose: The purpose of this study was to learn how adults cope with their sensory defensiveness (SD) and how physiological responses differ between adults who self-report as high SD versus low SD. *Methods:* In this continuation study participants (age 18-64; n=23) were categorized as low SD (control group; n=9) or high SD (experimental group; n=14) via their Adolescent Adult Sensory Profile (AASP) scores and Sensory Response Questionnaire (SRQ) scores (Brown, & Dunn, 2002 & Wilbarger, 2009). The last nine participants also completed the Coping Strategies Questionnaire (CSQ). All participants partook in the sensory challenge protocol which examined their electrodermal activity (EDA) responses to auditory, tactile and olfactory stimuli. *Discussion:* Overall, high SD group had higher EDA responses, but not all were statistically significant. The high SD group had significantly higher EDA ($p < 0.1$) responses when the Nuk brush and lawnmower were administered. The CSQ results found mental preparation/talking through was the most frequently used coping strategy. There was a strong correlation between AASP & CSQ, but not statistically significant. *Limitations:* With a larger sample size, the results of higher EDA responses between the low and high SD groups could become statistically significant. Difficulty with recruiting participants who self-report as low SD could influence the overall outcome. *Conclusion:* Adults with high SD have higher physiological responses to sensory stimuli compared to adults with low SD and these adults utilize time consuming coping strategies frequently. Occupational therapists can facilitate a more targeted intervention for adults with SD.

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Physiological Responses & Coping Strategies of Sensory Defensive Adults

Sensation occurs when the body comes into contact with an outside stimulus and as a result, nerve cells are activated which initiate a neural process (Ayres, 2005). Our many senses are joined together in a process called Sensory Integration (SI). When the body detects a specific sensation, the brain interprets and organizes the information to create an adaptive response that is appropriate to the sensory input.

SI is often taken for granted because it is unconscious. When SI problems occur, they are obscure in the way they are presented, and often lead to misdiagnosis (Ayres, 2005). SI dysfunction can cause intellectually capable individuals to have difficulty learning or face behavioral challenges (Ayres, 2005). Researchers estimate that 5-15% of children in the U.S. have sensory dysfunctions that result in learning and behavioral challenges (Ahn, Miller, Milberger and McIntosh, 2004). As children with SI dysfunction become adults, they may continue to exhibit learning difficulties and maladaptive coping strategies. While research on adults with SI dysfunction is sparse, existing studies indicate that they are impacted in the following ways: those with SI dysfunction have co-occurring difficulties with mental illness; they face challenges with effective coping strategies; and they experience myriad emotional and behavioral responses.

Current research studies commonly use self-report or qualitative measures within their methodology (Kinnealey, Oliver, & Wilbarger, 1995). While these methods can reveal personal narratives, they lack objectivity. Therefore, as part of a continuation study, we conducted a quasi-experimental study to analyze physiological responses to sensations among neurotypical adults who rate themselves as high in sensory defensiveness (SD). The purpose of this study was to address the following two questions: How do neurotypical adults with SD respond

physiologically when exposed to tactile, olfactory and auditory sensory stimuli. Also, we sought to learn, “What coping strategies do adults with SD utilize and how does it impact their occupational participation?”

Theoretical Framework

SI theory was developed and researched by Dr. A. Jean Ayres (Bundy, Lane & Murray, 2002). According to Ayres, SI is a neurological process that organizes sensory input from a person's body and their environment to produce effective interactions and experiences (Ayres, 2005). These effective interactions are adapted responses, or an appropriate and successful reaction to a sensory experience (Ayres, 2005). SI organizes information detected by the senses including taste, visual, auditory, tactile, olfactory, proprioception and vestibular (Ayres, 2005). Once the information is detected, the brain uses that knowledge to direct the body and mind through learning, movement and behaviors (Ayres, 2005). Without well-organized sensory processing, the brain is unable to break down the sensory input resulting in disorganization known as SI dysfunction. SI is important in development because it leads to adaptive responses: purposeful, goal-directed response to sensory experience. Such responses build upon each other to allow for function and development.

SI consists of four categories: discrimination, praxis, modulation and postural-ocular-vestibular control which includes bilateral integration and sequencing (Ayres, 2005). Discrimination allows individuals to create distinctions between co-occurring stimuli. It provides individuals the input to accurately perceive their surroundings and therefore, act functionally and appropriately to a stimulus. Praxis allows individuals to organize, plan, and execute their movements. From praxis, individuals can learn and develop motor skills. Postural-ocular-vestibular control provides an integration of the visual, vestibular, and proprioceptive inputs in order to gain spatial awareness. Finally, modulation allows individuals to regulate the stimuli in order to achieve optimal performance in the environment. Within sensory modulation lies SD, a negative or avoidant response to non-noxious stimuli due to poor sensory processing (Wilbarger

& Wilbarger, 2002). Individuals who have SD avoid or withdrawal from these sensory experiences, thus hindering their occupational participation (Kinnealey, Koenig, & Smith, 2011). In past studies, children were the focus of research and fewer studies were conducted on adults with SD. As a result, our study was an opportunity to investigate Ayres' theory, and more specifically, SD among adults. Terms such as hyper-responsivity or sensory over-responsive (SOR) have been used interchangeably with SD (Ayers, 2005). For the purposes of this paper, we used the terms SI and SD.

Literature Review

Physiological Responses to Sensation

During a sensory experience, a person's limbic system activates their sympathetic nervous system (SNS) or parasympathetic nervous system (PSNS) which causes physiological responses (Kushki et al., 2013). Threatening stimuli will activate a person's sympathetic "fight or flight" responses, while non-threatening stimuli will activate a person's parasympathetic "rest and digest" responses (Kushki et al., 2013). Individuals with high SD experience increased autonomic activity such as "fight or flight" responses due to a trigger of their limbic system which leads to poor habituation of sensory stimuli. This may cause increased levels of fear, anxiety and stress. Conversely, individuals with low SD have lower activation of their limbic system and may not recognize or respond to danger.

Physiological responses can be measured by observing a person's eccrine sweat gland activity and recording their electrodermal response (EDR). EDR occurs via the SNS and during a change in stimuli which alerts the person (Kushki et al., 2013). McIntosh, Miller, and Hagerman (1999) stated that EDR happens due to startling stimuli, a defensive feeling, or a positive or negative event. Results from past studies obtaining EDR measurements among participants with sensory challenges showed higher response to stimuli, lower PSNS regulation, and poorer adaptive behaviors (McIntosh, Miller, & Hagerman, 1999; Chang et al., 2012; Schaaf et al., 2010).

Coping Responses

Coping responses are behavioral strategies used to manage discomfort and can be adaptive or maladaptive (Kinnealey, Oliver & Wilbarger, 1995). Self-stimulating or stereotypic behavior is a coping response that is defined as repetitive and has no apparent purpose for

navigating the external environment (Smith, Press, Koenig, & Kinnealey, 2005). Although self-stimulating and stereotypic behavior seem without purpose, it can assist the individual to self-regulate through utilization of their other senses (Smith et al., 2005). However, these types of coping responses can often hinder a person's performance in occupational tasks, independence, or cause harm (Smith et al, 2005).

Adults have the capacity to pre-plan and develop coping strategies to combat unwanted stimuli in order to facilitate occupational participation. For instance, an adult can minimize the distracting effects of a noisy room by wearing earplugs, noise cancelling headphones, or by simply walking out of the room. Nevertheless, adults who experience SD may appear irritated, overwhelmed, disorganized, distracted or isolated. As a result, adults with SD may spend an exorbitant amount of time creating strategies to minimize or avoid adverse stimuli (Kinnealey, Koenig & Smith, 2011).

Children with Autism and Sensory Integration Dysfunctions

Past studies regarding SI are mainly focused on children. Baranek, Foster, and Berkson (1997) measured tactile defensiveness in children with developmental disabilities and autism spectrum disorder (ASD). Children who had higher levels of tactile defensiveness showed repetitive actions and more rigid behaviors (Baranek, Foster, & Berkson, & Berkson, 1997). The authors concluded that rigid behaviors and repetitive actions could be a way of coping with stimuli that may be overwhelming to the participants in this study (Baranek, Foster, & Berkson, & Berkson, 1997). Similarly, Chang et al. (2012) found that children who have ASD have a higher resting skin conductance and a stronger reactivity when experiencing different stimuli. Chang et al. (2012) concluded that this may explain the behavioral responses shown in children with ASD.

A research study by McIntosh, Miller, & Hagerman (1999) indicated that children with SMD did show higher electrodermal responses (EDR) compared to the control subjects (children without diagnosed disorders). Parents of the children with SMD who exhibited higher EDR reported that their children also show “abnormal behavioral responses”, which affect their daily life. Additionally, children with SMD were more reactive and had a higher physiological arousal to a sensory stimulus than the children with ASD (Schoen et al., 2009).

Collectively, these studies show that children with SMD are affected by stimuli both physiologically and behaviorally. When presented with a stimulus, children show atypical physiological responses and then possibly present with certain behaviors to try to cope with the sensation. Although these past studies focus on children, the results do align with those of studies focusing on adults with SI disorder.

Adults with SI Dysfunctions and Defensiveness

Though sensory-related research on adults is scarce, many existing studies investigate the responsiveness of adults with SD and their outcomes. Outcomes include identifying coping strategies as well as emotional, behavioral and psychophysical implications.

A phenomenological study by Kinnealey, Oliver & Wilbarger (1995) explored SD among five adults and their various coping strategies. The adult interviewees provided a detailed description of how SD impacts their roles, routines and overall occupational performance. The participants also identified their methods of coping with the discomfort. Based on their responses, six common behavioral strategies were identified: avoidance, predictability, mental preparation, talking through, counteraction, and confrontation (Kinnealey, Oliver & Wilbarger, 1995). Avoidance, counteraction, and confrontation were strategies closely associated with the choice to participate in certain activities. For example, the decision to attend a large gathering

required careful consideration of the size, location, food options, and potential noise level of the gathering. Meanwhile, prediction, mental preparation, and talking through strategies related more to controlling situations and the ability to be spontaneous. In cases where overwhelming sensory situations were unavoidable, participants underwent mental preparations and talked themselves through the situation. As beneficial as these coping strategies may be to their survival, the process is onerous. Many participants report these strategies are time consuming, energy depleting and emotionally draining, greatly impacting their social interaction and participation (Kinnealey, Oliver & Wilbarger, 1995). A study by Oliver (1990) found a correlation between SD and social withdrawal. Results suggest that SD often leads to social and physical withdrawal, isolation and decreased sensation seeking, which contributes to depression. Adults with SD have a tendency to feel anxious and uneasy in social situations and need to either adapt or avoid such activities due to their over-reactions to the adverse stimuli.

SD also has emotional and behavioral implications. Kinnealey & Fuiiek (1999) revealed that symptoms of anxiety, depression and social-emotional issues are significantly higher among adults with SD. Ayres (1961) was the first to explain the relationship between SD and emotional and behavioral responses, as it pertains to tactile defensiveness among children. She postulated that there is a constant exchange occurring between anxiety and an imbalance of the nervous system, specifically the somatic afferent system (Ayres, 1972). This led to her belief that anxiety could be the causal and the resultant factors of the nervous system's imbalance which ultimately give rise to emotional instability (Ayres, 1961).

In a quasi-experimental study of psychophysical correlates among adults with SMD, the authors found that, compared to a control group, individuals with SMD “showed significantly

higher pain intensity to prickle stimuli, and marginally higher pain intensity to pinprick stimuli” (Bar-Shalita, Vatine, Parush, Deutsch and Seltzer, 2012).

While research on adults is limited, current literature does show the significant impact that SI dysfunction has on daily occupations. Few studies examine adults’ arduous, time and energy consuming coping strategies. Because this is shown to be a challenge for adults with SD, further research is needed. Thus, the aim of this study is to examine the differences in physiological responses to various sensory stimuli between adults with SD and explore coping strategies employed to manage adverse stimuli.

Methods

Design

A quasi-experimental design was conducted using the Sensory Challenge Protocol to examine the differences in physiological responses to various sensory stimuli between adults who report as low and high SD. The specific physiological responses measured were variability in heart rate and EDR between the two groups. As a primary measure, participants completed the Adolescent and Adult Sensory Profile (AASP) to identify where participants were along the SD continuum (high vs low). The independent variable was adults who self-reported as SD, as measured by the AASP. The dependent variable was the physiological responses of the adult participants when exposed to tactile, olfactory and auditory sensory stimuli, as measured by EDR.

Participants

Participants were a convenience sample that consisted of 23 neuro-typical adults ranging in age from 18 to 64 who identified as either high or low in SD. There were 16 female participants and 7 male participants. Participants who self-reported as “less than most people (-)” on the AASP were included in the control group (low SD) and those who scored “more than most people (+)” “much more than most people (++)” on the AASP were placed in the experimental group. Adults with SD scores falling between low and high SD in the Sensory Sensitivity quadrant on the AASP were excluded.

Participants were recruited through flyers and word of mouth from Marin County and surrounding areas. Interested participants were contacted and screened by someone from the research team by email or phone. Only English-speaking, neurotypical adults between the ages of 18-64 were considered for the study. The exclusion criteria were participants with

neurological, cognitive and developmental disorders; having experienced a brain injury/trauma or taking medications that may alter their physiological responses. This research study was approved by the Institutional Review Board for the Protection of Human Subjects (IRBPHS) at Dominican University of California (DUC) (IRB#10655).

Measurement Instruments

Adolescent/Adult Sensory Profile (AASP).

The self-reported measure used for this study was the AASP developed by Dr. Catana Brown and Dr. Winnie Dunn (Brown et al., 2001). Scores on the AASP categorized individuals along dimensions in four quadrants. The four quadrants are named: low registration, sensation seeking, sensation avoiding, and sensory sensitivity. Within each quadrant, individuals were classified on a continuum from “much less than most people” to “much more than most people”. For the purpose of this study, the two quadrants, sensation avoiding, and sensory sensitivity, were combined to create an SD score. Higher scores indicate more sensory symptoms.

Reliability and validity of the AASP has been well-established. Alpha values for all age groups and quadrant scores ranged from .639 to .775, with 0 representing no consistency and 1 representing perfect consistency (Pearson Education, 2008). Validity for the AASP was established through the use of an expert panel and data collected from pilot studies. Convergent validity was established through a study which compared scores of the AASP to those of the NYLS Adult Temperament Questionnaire and through comparisons with skin conductance responses (Pearson Education, 2008).

Coping Strategies Questionnaire (CSQ).

This study uses the CSQ developed by Benjamin Cohen, Alexandria Donaldson, Jenny Park-Chan, and Jessica Valenzuela (Cohen et al., 2019). The CSQ was created based on six

behavioral coping strategies identified during a previous study by Kinnealey, Oliver & Wilbarger (1995). Those coping strategies are avoidance, predictability, mental preparation, talking through, counteraction, and confrontation. For this study, mental preparation and talking through were combined due to the similar nature of the strategies.

To analyze the three senses throughout the CSQ, each sense (auditory, tactile and olfactory) was represented by three scenarios (See Appendix D). The nine total CSQ scenarios were developed to reflect common daily occupations that include high sensory engagement. While validity was not formally tested for this instrument, consensus between the research team was used to ensure that CSQ scenario questions findings would represent what they aim to measure. The CSQ asks participants to read the scenario and answer how often they employ each of the following five coping strategies: avoidance, predictability, mental preparation/talking through, confrontation and counteracting. Response options ranged from never, rarely, usually, always (e.g. never = 0, rarely = 1, usually = 2, always = 3). Additionally, a qualitative component asking, “What other strategies would you use?” was included at the end of each scenario.

Electrodermal Response (EDR).

EDR was measured to quantify subjects’ responses to stimuli because electrodermal response indirectly measures sympathetic nervous system activity (McIntosh, et al., 1999). EDR was measured during the Sensory Challenge Protocol during the first trial presentation of each stimulus, and then during each subsequent trial. Changes in EDR measurements showcased the difference between electrodermal level at the time of stimulus presentation and the highest level within an eight second window after stimulus presentation.

Procedures

Tactile.

Tactile stimuli included three different textures: a feather, cotton ball, and a Nuk training toothbrush. Each textural stimulus was presented to the subject's right cheek. The stimulus was applied along the jawline beginning below the earlobe and ending at the chin. The stimuli were presented in a three-inch stroke with approximately two ounces of pressure.

Auditory.

Participants listened to pure tones and common sounds from everyday life. Pure tones and sounds were presented at 80 db through sound attenuating headphones. Pure tones were presented at 400 Hz, 1,000 Hz, and 3,000 Hz. The common sounds that were presented are: a crying baby, crickets, and a lawnmower. These sounds were sourced from a collection called the International Affective Digital Sounds (IADS).

Olfactory.

Participants were exposed to three different scents: orange, camphor, and butyric acid. Each scent was presented in varying concentrations. Concentrations of scents were placed into a vial with an half-inch opening. Scent vials were held under each participant's nose for a duration of two seconds.

Stimulus presentation.

The E-prime computer program (version 2) controlled auditory and tactile stimulus presentations on a PC computer. Presentation procedures were adapted and expanded from research by McIntosh and colleagues (1999). The main categories of stimuli were presented in the same sequence for each participant, in the following order: pure tones, real sounds, tactile, and olfactory stimuli. Within each category of stimuli (tones, real sounds, and tactile) modalities

were presented in random order. In an effort to avoid the confounding variable of olfactory desensitization, olfactory stimuli were presented in the following controlled order: orange, camphor, then butyric acid. Participants were offered a five-minute break in between each auditory and olfactory stimuli.

Prior to any stimuli presentations, a two-minute baseline period was conducted wherein the participant was instructed to sit quietly. Following this baseline period, each stimulus was presented and rated for pleasantness on the first and last trials using a 10-point, graphic Likert scale using facial expressions as representations of the ratings. Alternatively (in conjunction with the Likert scale) we used a visual analog scale where participants marked their response on a line continuum and experimenters measured the location of the mark along that continuum.

The duration between individual stimulus trials were 15 seconds. There was a 20 second break between presentations of different stimuli within one stimulus block (e.g., 20 seconds between two different real sounds). At the end of each stimulus block, there was a 20 second rest period, followed by instructions for the next stimulus block, and then a 20 second rest period before stimulus presentations in the subsequent block.

Data Analysis

Electrodermal activity (EDA) was measured in micro siemens. EDA 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. We compared the magnitude of electrodermal responses between experimental groups using an Independent Samples t-test, with a level of significance $p = .05$.

Ethical Considerations

As a continuation of an existing study, the ethical considerations will remain the same and were discussed. 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), background questionnaire (see Appendix B) and welcome letter (see Appendix C). 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 were destroyed one year after the study concludes. The researchers upheld commitments made with participants and provided equal and professional treatment.

Part II:

Coping Strategies of Sensory Defensive Adults

by

Benjamin Cohen, Alexandria Donaldson, Jenny Park-Chan, & Jessica Valenzuela

A culminating capstone project submitted to the faculty of Dominican University of California in partial fulfillment of the requirements for the degree of Master of Science degree in Occupational
Therapy

Dominican University of California

San Rafael, CA

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Abstract

Background: Adults with sensory defensiveness (SD) exhibit negative responses to non-noxious stimuli and report coping strategies negatively impact their occupational participation. *Objective:*

This study compares coping strategies among participants with high or low SD to learn how adults cope with SD, and how coping strategies impact their occupational participation.

Methodology: Participants (age 18-64; n=9) were categorized as low or high SD via their Adolescent, Adult Sensory Profile (AASP) scores (Brown, & Dunn, 2002). Participants completed the Coping Strategies Questionnaire (CSQ) to examine their coping strategies (Cohen et al., 2019). *Findings:* CSQ results show mental preparation/talking through was the most frequently used coping strategy. There was a moderate correlation between AASP & CSQ results, but not statistically significant. *Implications:* Adults with high SD utilize coping strategies frequently. By understanding the coping strategies of adults with SD, occupational therapists can facilitate a more targeted intervention for clients.

Key words: Sensory Defensive Adults, Coping Strategies, Sensory Integration Dysfunctions, Behavioral Science

Coping Strategies of Typical Adults with Sensory Defensiveness

For adults with sensory defensiveness (SD), the world is a sensory landmine. Imagine being on the subway during commuter hours. As you step on the subway, you are smashed between dozens of people. Their bodies are pressed against you. Smells merge between body odor and cologne/perfume. Sounds erupt from crying babies to screeching railings. For a person with a typical nervous system this would be challenging, but for people with SD it's nearly intolerable. Because of this, people suffer, and they isolate themselves from social situations causing their overall social participation to decrease.

Sensory defensiveness (SD) produces aversive or avoidant responses to sensation across all sensory modalities and can have a negative impact on every aspect of life (Wilbarger & Wilbarger, 2002). Researchers estimate that 5-15% of children in the U.S. have sensory modulation disorders (Ahn, Miller, Milberger and McIntosh, 2004). While there are no clear statistics, sensory integration (SI) dysfunction continues to affect their lives as children develop into adults. Adults with sensory modulation disorders, such as sensory defensiveness, continue to exhibit disruption in daily function, including the emergence of adaptive and maladaptive coping strategies (Kinnealey, Oliver, & Wilbarger, 1995). While research on adults with SI dysfunction is sparse, existing studies indicate that they have enduring unpleasant experiences and they may be using coping strategies that are time consuming and exhaustive (Kinnealey, Oliver, & Wilbarger, 1995). While currently used strategies may be adaptive or maladaptive in nature, adults have the capacity to pre-plan and develop coping strategies to combat unwanted stimuli. For instance, an adult can minimize the distracting effects of a noisy room by wearing earplugs, noise cancelling headphones, or by simply walking out of the room.

Past research used self-report or qualitative measures which reveal personal narratives (Kinnealey, Oliver, & Wilbarger, 1995). To increase objectivity, we conducted a mixed method study to analyze the frequency of coping strategies used among neurotypical adults who rate themselves as high in sensory defensiveness (SD). In order to explore this question, we created a questionnaire, Coping Strategies Questionnaire (CSQ), that examines five coping strategies based on the work of Kinnealey, et al. (1995).

SI Among Adults

SI consists of four categories: discrimination, praxis, modulation and postural-ocular-vestibular control which includes bilateral integration and sequencing (Ayres, 2005). For the purpose of this research, we will focus on sensory modulation, the ability to appropriately grade one's response to the valence of a stimulus in the environment (Miller, Wilbarger, Stackhouse & Trunnell, 2002). Sensory modulation allows individuals to achieve optimal performance of their occupations within their given environment. Challenges with sensory modulation often result in SD - a negative or avoidant response to non-noxious stimuli due to poor sensory processing (Wilbarger & Wilbarger, 2002). Individuals who have SD avoid or withdrawal from these sensory experiences, thus hindering their daily occupational participation across many domains (Kinnealey, Koenig, & Smith, 2011).

Oliver (1990) found that individuals with sensory defensiveness had high rates of social withdrawal. The results suggest that SD often leads to social and physical withdrawal, isolation and decreased sensation seeking, which contributes to depression. Adults with SD have a tendency to feel anxious and uneasy in social situations and need to either adapt or avoid such activities because of their over-reactions to the adverse stimuli.

SD can also have emotional and behavioral implications. Kinnealey & Fuiiek (1999) found that symptoms of anxiety, depression and social-emotional issues are significantly higher among adults with SD. Ayres (1961) was the first to explain the relationship between SD and emotional and behavioral responses, as it pertains to tactile defensiveness among children. She postulated that there is a constant exchange occurring between feelings of anxiety and an imbalance of the somatic afferent nervous system (Ayres, 1972). This led to her belief that anxiety could be both the causal and the resultant factors of the nervous system's imbalance,

which ultimately gives rise to emotional instability (Ayres, 1961). The postulate that SD is disruptive to the nervous system is substantiated by research on the physiological responses of people with SD or SMD.

Physiological Responses to Sensation

Individuals with high SD experience increased autonomic activity, such as “fight or flight” responses due to a trigger of their limbic system, which leads to poor habituation of sensory stimuli (Kushki et al., 2013). This may cause increased levels of fear, anxiety and stress. Conversely, individuals with low SD have lower activation of their limbic system and may not recognize or respond to danger.

Past studies have measured physiological responses to stimuli among participants with SD by measuring a person’s eccrine sweat gland activity and recording their electrodermal response (EDR). Findings among adults with SD include higher response to stimuli, lower PSNS regulation, and poorer adaptive behaviors (McIntosh, Miller, & Hagerman, 1999; Chang et al., 2012; Schaaf et al., 2010). Research by Datu, Or, Valentine and Velcich (2018) indicated EDR scores were generally higher for all stimuli (auditory, olfactory and tactile) among participants in the high SD group compared to the low SD group.

Coping Strategies Among Adults with SD

Adults who experience SD may appear irritated, overwhelmed, disorganized, distracted and/or isolated. As a result, they may spend an exorbitant amount of time creating strategies to minimize or avoid adverse stimuli (Kinnealey, Koenig & Smith, 2011; Kinnealey, Oliver, Wilbarger, 1995). Coping strategies are behavioral strategies used to manage discomfort and can be adaptive or maladaptive. (Kinnealey, Oliver & Wilbarger, 1995).

In a phenomenological study, Kinnealey et.al. explored the coping strategies of five adults with SD (Kinnealey, Oliver & Wilbarger, 1995). Based on participant responses, six common behavioral strategies were identified: avoidance, predictability, mental preparation, talking through, counteraction, and confrontation (Kinnealey, Oliver & Wilbarger, 1995). Participants expressed that while their coping strategies are beneficial for survival, the process is onerous, time consuming, energy depleting and emotionally draining, greatly impacting their social interaction and participation (Kinnealey, Oliver & Wilbarger, 1995). Techniques for diminishing the effects of SD in these adults include therapeutic interventions to reduce the aversive responses and a sensory diet (Kinnealey, Oliver, Wilbarger, 1995).

Types of Coping Strategies

Definitions for the coping strategies found by Kinnealey, et al. (1995) are as follows: Avoidance is not placing oneself in a situation where the stimuli occur. Counteraction is participating in activities, typically proprioceptive, to reduce or negate the effects of the disturbing input. Confrontation is “identifying the problematic response to the stimuli and creating a plan to overcome the negative reaction” (p.445). Predictability means organizing and controlling the sensory situation so the person feels more comfortable. Mental preparation is planning and preparing for the unavoidable stimuli that will make them uncomfortable

(Kinnealey et al., 1995). Talking through is using self-talk to rationalize with oneself before encountering the unavoidable stimuli.

Kinnealey et.al. (1995) found that avoidance, counteraction, and confrontation were coping strategies closely associated with the choice to participate in certain activities. For example, the decision to attend a large gathering required careful consideration of the size, location, food options, and potential noise level of the gathering. Meanwhile, prediction, mental preparation, and talking through strategies related more to controlling situations and the ability to be spontaneous. In cases where overwhelming sensory situations were unavoidable, participants underwent mental preparations and talked themselves through the situation.

Measuring Coping in Adults

While there are a multitude of ways coping has been measured, existing tools often focus on how people cope with stress, relationships or social situations. These tools include: Coping Orientation to Problems Experiences to measure different coping strategies people use in response to stress (Carver et al., 1989); Coping Self-Efficacy Scale to measure an individual's confidence in using their coping strategies during stressful situations (Chesney et al., 2006); Brief Resilient Coping Scale to measure individual's adaptive coping strategies towards stress (Sinclair, & Wallston, 2004); Proactive Coping Inventory to measure coping reactions to daily events (Greenglass, 1998); Dyadic Coping Inventory to measure coping strategies among close relationships when one or both partners experience stress (Bodenmann, 2008); The Coping Styles Questionnaire for Social Situations (Antony, McCabe, & Fournier, 2014). Currently, none of the created assessment tools specifically measure coping strategies with regard to SD.

Therefore, for the purpose of this study, a coping questionnaire called Coping Strategies Questionnaire was created based on findings from Kinnealey et al. (1995). The Coping Strategies

Questionnaire asks participants to rate how frequently they use five different coping strategies in the context of nine different 'sensory challenging' scenarios. More information regarding the Coping Strategies Questionnaire is discussed within the Measurement Instruments section.

Methods

Design

This research is a mixed methods study that used quantitative data from the Coping Strategies Questionnaire (CSQ) and Adolescent and Adult Sensory Profile (AASP) questionnaires and limited qualitative information from the CSQ. As a primary measure of SD, participants completed the AASP to identify where participants fall along the SD continuum (high vs low). Participants completed the CSQ to examine which six behavioral responses are used to cope with common sensory stimuli for adults who report as SD. The independent variable was adults who self-reported as SD, as measured by the AASP. The dependent variable was the frequency of coping strategies chosen for various sensory scenarios, as measured by the CSQ.

The purpose of this study is to examine which of the six behavioral coping strategies adults with SD employ to manage adverse stimuli in daily life and its impact on their social participation. We will also compare the relationship between the AASP with the CSQ.

Participants

Participants included ten English-speaking, neurotypical adults between the ages of 18-64 who identify as either high or low in SD. The exclusion criteria were: having a neurological, cognitive or developmental disorder; having experienced a brain injury/trauma; or taking medications that may alter their physiological responses. Participants completed the AASP and were placed into the experimental or control group based on SD score. An SD score was made by summing “sensory sensitivity” and “sensation avoiding” scores from the AASP. Participants who scored >83 in the SD level were considered high SD (n = 8). Participants who scored <83 in the sensory defensiveness level were categorized as low SD (n = 1). Of the ten participants, only

nine participants completed the CSQ and therefore only nine were included in the study. Of the nine participants, six were female (six were high SD, zero low SD) and three were male (two were high SD, one was low SD). Two participants identified as white, three identified as Asian, two identified as Hispanic and three identified as other.

Measurement Instruments

Adolescent-Adult Sensory Profile (AASP).

The self-report measure of SD used for this study was the Adolescent-Adult Sensory Profile (AASP) developed by Dr. Catana Brown and Dr. Winnie Dunn (Brown et al., 2001). The AASP is a 60-item behavioral assessment that provides individuals with specific insight into his or her sensory processing. Scores on the AASP categorized individuals along dimensions in four quadrants. The four quadrants are named: low registration, sensation seeking, sensation avoiding, and sensory sensitivity. Within each quadrant, individuals were classified on a continuum from “much less than most people” to “much more than most people.” The sensation avoiding and sensory sensitivity quadrants were combined to create an SD score. Higher scores indicate more SD symptoms.

Reliability and validity of the AASP has been well-established. Alpha values for all age groups and quadrant scores ranged from .639 to .775, with 0 representing no consistency and 1 representing perfect consistency (Pearson Education, 2008). Validity for the AASP was established using an expert panel and data collected from pilot studies. Convergent validity was established through a study which compared scores of the AASP to those of the NYLS Adult Temperament Questionnaire and through comparisons with skin conductance responses (Pearson Education, 2008).

Coping Strategies Questionnaire (CSQ).

This study uses the CSQ developed by Benjamin Cohen, Alexandria Donaldson, Jenny Park-Chan, and Jessica Valenzuela (Cohen et al., 2019). The CSQ was created based on six behavioral coping strategies identified during a previous study by Kinnealey, Oliver & Wilbarger (1995). Those coping strategies are avoidance, predictability, mental preparation, talking through, counteraction, and confrontation. For this study, mental preparation and talking through were combined due to the similar nature of the strategies.

To analyze the three senses throughout the CSQ, each sense (auditory, tactile and olfactory) was represented by three scenarios (See Appendix D). The nine total CSQ scenarios were developed to reflect common daily occupations that include high sensory engagement. While validity was not formally tested for this instrument, consensus between the research team was used to ensure that CSQ scenario questions findings would represent what they aim to measure. The CSQ asks participants to read the scenario and answer how often they employ each of the following five coping strategies: avoidance, predictability, mental preparation/talking through, confrontation and counteracting. Response options ranged from never, rarely, usually, always (e.g. never = 0, rarely = 1, usually = 2, always = 3). Additionally, a qualitative component asking, “What other strategies would you use?” was included at the end of each scenario.

Procedures

This research study was approved by the Institutional Review Board for the Protection of Human Subjects (IRBPHS) at Dominican University of California (DUC) (IRB#10655). Through convenience sampling, participants were recruited with flyers and by word of mouth from Marin County and surrounding areas. Upon intake, interested participants were contacted

and screened by someone from the research team by email or phone. Once screened, all approved participants received the AASP questionnaire, the CSQ questionnaire, and a consent form via email or in person. Of the ten approved participants, nine participants returned all forms completed. Forms were returned in person and any questions answered. Confidentiality of participant information was maintained throughout the study.

Data Analysis

Descriptive statistics were used to analyze the demographics, means, standard deviation and frequency of each measure on the CSQ and the AASP. Relationships were found using the Spearman Rho correlation. The data was analyzed and computed using a combination of Statistical Package for the Social Sciences (SPSS) and Microsoft Excel.

Results

Frequency and means of coping responses

We compared the mean score (e.g. never = 0, rarely = 1, usually = 2, always = 3) and frequencies of the five coping strategies against the degree of SD on the AASP. Mental preparation/talking through had the highest mean and frequency ($m = 1.63$, $f = 84$), followed by predictability ($m = 1.37$, $f = 83$). This is outlined in Table 1. Based on these results, it can be inferred that adults are more inclined to use cognitive strategies (e.g. mental preparation/talking through and predictability) rather than physical strategies (e.g. avoidance and counteracting).

Table 1

Coping Strategies Mean and Frequency

Coping Strategies	n = 9		
	Mean	Frequency	Standard Deviation
Avoidance	1.16	81	.40
Predictability	1.37	83	.40
Mental Preparation/ Talking Through	1.63	84	.68
Confrontation	.914	82	.57
Counteract	.98	81	.62

Relationship between coping and degree of SD

Comparing the total coping scores to SD scores revealed a moderate correlation (.577) with no statistical significance ($p = .104$). This suggests that people with more SD more frequently use coping strategies. Additionally, the qualitative short answer responses in the CSQ endorsed the five presented coping strategies, and they did not endorse the use of any other coping strategies.

Analysis also revealed a moderate statistically significant correlations between the frequency of use of avoidance and predictability strategies, and the AASP SD scores. The other three coping strategies: mental preparation/talking through, confrontation, and counteracting showed little correlation. Comparison with AASP SD scores and all coping strategies is outlined in Table 2.

Table 2

Correlation Between Coping Strategies and SD scores on the AASP

Coping Strategies	SD Score	
	Correlation Coefficient	p-value
Avoidance	0.711*	.032*
Predictability	0.762*	.017*
Mental Preparation/ Talking Through	-0.472	.915
Confrontation	.008	.983
Counteract	.183	.637
Total	.577	.104

*Note: Correlation is significant at $p < 0.05$

Discussion

The purpose of this study was to investigate the patterns of coping strategies among adults with SD. Results were found through sensory challenging scenarios presented in the newly created coping strategies questionnaire, the CSQ. Our findings indicated that adults with SD frequently utilize coping strategies that are time consuming in nature which impacts their participation in daily occupations. It confirms past studies have shown adults with SD face functional challenges engaging in occupational participation because their current coping strategies can be time consuming, energy depleting, and emotionally draining (Kinnealey, Oliver, Wilbarger, 1995). An occupation that is commonly impacted is social participation. For instance, socializing with friends was avoided by one participant because she felt defensive about the strong odor at a friend's house.

Adding to past data, our data reveals that mental preparation and talking through are the most used coping strategies, with participants endorsing either frequently or always using these strategies. It can be inferred that adults are more inclined to use cognitive strategies (e.g. mental preparation/talking through and predictability) rather than physical strategies (e.g. avoidance and counteracting). While these cognitive coping strategies tend to be more conducive than physical strategies in facilitating occupations performance, their responses show participation in occupations is still impacted.

We discovered a lack of coping questionnaires that analyze the coping patterns of adults with SD. As a result, we created the CSQ. This is a step towards understanding the impact of coping strategies for adults with SD. However, further research is required to fully understand the extent to which participants' coping strategies affect their engagement in various daily occupations.

The results show adults with SD have created their own coping strategies for these stressful sensory situations. These findings emphasize the need for skilled occupational therapy (OT) interventions. OT's should address time constraints experienced and help facilitate a client's successful participation in their occupations. A strength of OT is the ability to use a client-centered and holistic methodology to tailor interventions and teach specific strategies that cater to the client's specific sensory needs and improve their occupational experiences. Currently, OTs have created intervention strategies for SD that are heavily catered to the pediatric population, such as fidget toys and weighted blankets. However, a focus on how to skillfully work with SD adults to facilitate and increase their occupational participation is still needed. Intervention strategies need to go beyond pediatric based sensory diets and create strategies that are more adult appropriate. Therefore, this further emphasizes the need for continued research on adults with SD to learn how to diminish the effects of SD so these individuals can be more engaged when participating in their activities of daily living.

Limitations

Due to the small sample size among low and high SD adults, this study did not accurately represent the population of adults with SD or their coping strategies. As a result, there was only one participant categorized as low SD, and we were unable to compare the low SD and high SD groups. Lastly, only three sensory modalities were included in the CSQ. This could have been expanded to vestibular, proprioception and vision to understand if the coping strategies used may differ from the rest of the modalities. The CSQ has potential for clinical utility, however, further validity of this tool will have to be examined in future studies.

Conclusion

This study is the first in providing insight and background to the current coping strategies of adults with SD using a quantitative research methodology. Additionally, a discussion for research on treating adults with SD and how they are coping is a need because it is evident that this population needs skilled OT interventions to help them create more effective coping strategies that will support greater occupational participation.

Appendix A

Consent Form

DOMINICAN UNIVERSITY of CALIFORNIA
Consent Form

Purpose and Background

Dr. Julia Wilbarger, Associate Professor, Department of Occupational Therapy at Dominican University of California, Mr. Cohen, Ms. Park-Chan, Ms. Valenzuela and Ms. Donaldson, occupational therapy graduate students, are doing a study on the differences in physiological responses in individuals who report high and low levels of sensory responsivity. The researchers are interested in obtaining self-reports and objective measures to quantify and study physiological responses to sensation in adults. This study will further the understanding of sensory processing differences.

You are being asked to participate because you report that you are either high or low in sensory responsivity.

Procedures

If you agree to be in this study, the following will happen:

1. I will complete a background questionnaire.
2. I will complete three self-report sensory assessments (Adolescent/Adult Sensory Profile, Sensory Response Questionnaire and Coping Strategies Questionnaire) about my sensory sensitivities. These will take approximately 10 minutes to complete.
3. I will participate in a Sensory Challenge Protocol and physiological testing at Dominican University of California, Meadowlands, Room 304. This will take approximately 30 minutes
 - The researchers will apply small sensors to the face, wrist, and fingers.
 - I will be observed through a one-way mirror
 - I will experience three sensory modalities: tactile, auditory, and olfactory
 - The researchers will review and evaluate responses to the stimuli through physiological measurements and coding of behavioral responses

Risks and/or discomforts

1. You may become uncomfortable as a response to sensory stimulation. If this becomes overly uncomfortable, additional efforts will be made to reduce discomfort or cease testing and participants may decline to participate in the study at any time.
2. Mild physical discomfort may arise from the preparation, attachment and removal of the sensors for measuring electrophysiological response.
3. Study records will be kept as confidential as is possible. No individual names will be used in any reports or publications resulting from the study. All personal references and identifying information will be eliminated when the data are processed, and all participants will be identified by numerical code only, thereby assuring confidentiality regarding the subject's responses. The master list for these codes will be kept by Dr. Wilbarger in a locked file, separate from the data. Only the researchers and faculty advisors will have access to the data. One year after the completion of the research, all written and recorded materials will be destroyed.

Benefits

There will be no direct benefit from participating in this study. All participants will receive a summary of the study results if they desire.

Costs/Financial Considerations

Potential cost include transportation to Dominican University and time allotted to complete the study.

Payment/Reimbursement

You will not be reimbursed for participation in this study.

Questions

I have talked to Mr. Cohen, Ms. Park-Chan, Ms. Valenzuela or Ms. Donaldson about this study and have had my questions answered. If I have further questions about the study, I may email the researchers or faculty advisor at dominicansensorylab@gmail.com. If I have any questions or comments about participation in this study, I should first talk with the researchers. If for some reason I do not wish to do this, I may contact the Dominican University of California Institutional Review Board for the Protection of Human Subjects (IRBPHS), which is concerned with protection of volunteers in research projects. I may reach the IRBPHS Office by calling (415) 482-3547 and leaving a voicemail message, or FAX at (415) 257-0165, or by writing to IRBPHS, Office of Associate Vice President for Academic Affairs, Dominican University of California, 50 Acacia Avenue, San Rafael, CA 94901.

Consent

I have been given a copy of this consent form, signed and dated, to keep.

PARTICIPATION IN RESEARCH IS VOLUNTARY. I am free to decline to be in this study, or to withdraw at any point.

My signature below indicates that I agree to participate in this study.

Signature of Participant

Date

Appendix B

Background Questionnaire



Measuring Physiological Responses to Sensations in Typical Adults

Background Questionnaire

Printed Name		Date	
--------------	--	------	--

Signature

1 Date of Birth:

2 Gender:	
<input type="checkbox"/> Male	
<input type="checkbox"/> Female	
<input type="checkbox"/> Other	

3 Ethnicity:

<input type="checkbox"/> White	
<input type="checkbox"/> Black or African American	
<input type="checkbox"/> Asian	
<input type="checkbox"/> Pacific Islander	
<input type="checkbox"/> Hispanic	
<input type="checkbox"/> Other	

4 Highest Level of Education Completed:

<input type="checkbox"/> GED	
<input type="checkbox"/> High School Diploma	
<input type="checkbox"/> Associates	
<input type="checkbox"/> Bachelors	
<input type="checkbox"/> Graduate	
<input type="checkbox"/> Other	

5 Yes/No Any chronic medical conditions?

If yes, please specify:

6 Yes/No Currently taking any medications?	
If yes, please specify:	

Appendix C

Welcome Letter

Date

Dear _____,

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 obtained in this study will remain confidential and you may refuse to participate at any time.

This packet includes:

- 2 Consent forms
- Background questionnaire
- Adolescent/Adult Sensory Profile, Sensory Response Questionnaire & Coping Strategies Questionnaire: These self-report forms will give us information about your sensory processing patterns, it's effects on daily life and your coping strategies.
- Map of Dominican University

In order to ensure that all information will remain confidential, please do not include your name on the sensory questionnaires. Please answer all questions as honestly as possible. We will contact you as soon as possible 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 Adolescent/Adult Sensory Profile & Sensory Response Questionnaire to your scheduled appointment.

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

Sincerely,

Ben Cohen, OTS

Jenny Park-Chan, OTS

Jessica Valenzuela, OTS

Alexandra Donaldson, OTS

Appendix D

Coping Strategies Questionnaire

Coping Strategies Questionnaire

A measure of coping strategies used during stressful sensory encounters.

Instructions: Read each situation below. Indicate the extent to which you've used the described coping strategy by checking one of the options or explaining a different coping strategy that you might use.

Never	Rarely	Usually	Always
0	1	2	3

Tactile				
Situation 1: Imagine a situation where you need to attend a formal event. You put on your dress attire and you feel the tag on your neck.				
	Never	Rarely	Usually	Always
I cut off or remove the tag.				
I only wear clothes I know I like and can tolerate.				
I tell myself I only need to wear this for a while and can take it off right after.				
I wear the item and try to deal with the feeling.				
I rub my neck where the tag is located.				
What else would you do to manage this experience?				
Situation 2: Image a situation where you and your friends go to the beach to hangout. When you arrive, your friends begin to take off their socks and shoes and run out onto the sand.				
	Never	Rarely	Usually	Always
I keep my socks/shoes on and join my friends				

on the beach.				
I talk to myself about why I should take my shoes/socks off and tell myself the situation will eventually be over.				
I take my socks/shoes off and just deal with it.				
I know that I don't like sand on my feet so I would not go to the beach.				
I vigorously rub the sand off of my feet.				
What else would you do to manage this experience?				
Situation 3: Image a situation where you are going to travel by subway. When the train arrives, the cars are packed full of people, and all the passengers are standing shoulder to shoulder.				
	Never	Rarely	Usually	Always
I tell myself why I need to take this train and that I can get through this. (<i>Mental Preparation/Talking Through</i>)				
I know the train schedule and only take the train when I know there will be fewer people. (<i>Predictability</i>)				
I choose another form of transportation so I don't have to stand in contact with the other people on the train. (<i>Avoidance</i>)				
I board the train and ask people to give me space. (<i>Confrontation</i>)				
I press myself against the wall of the subway or give myself deep pressure hugs. (<i>Counteracting</i>)				
What else would you do to manage this experience?				
Olfactory				

Situation 1: Image a situation where you are invited to a friends house. When you arrive you notice they have several indoor cats and the smell in the house is strong.				
	Never	Rarely	Usually	Always
I remind myself that our friendship is more important to me than the discomfort of the noxious smells and that I can get through this.				
I suggest we meet someplace else instead.				
In the moment, I tell the friend that they need to do something about the smell.				
I put on a perfume/cologne with a calming scent to counteract the cat odor.				
I decline the offer.				
What else would you do to manage this experience?				
Situation 2: Imagine as situation where you board an airplane and find your seat is right next to the lavatory (toilet). You smell the odor everytime the door opens.				
	Never	Rarely	Usually	Always
I would tell the flight attendant to move me.				
I anticipate this issue and always book ahead so I can pick where I sit.				
I book another flight that has better seating availability.				
I tell myself that I can handle the smell.				
I put on a perfume/cologne with a calming scent to counteract the odor.				
What else would you do to manage this experience?				

Situation 3: Imagine a situation where you in a cafe and a person wearing very strong cologne sits at a table near you.				
	Never	Rarely	Usually	Always
I tell the person to please sit somewhere else because their fragrance is too strong.				
I only go out to eat when I know the cafe is not busy or there is a place to sit with lots of fresh air.				
I get up and move to a different table.				
I tell myself that I can handle the smell.				
I bury my nose in my coffee mug to counteract the scent.				
What else would you do to manage this experience?				
Auditory				
Situation 1: Imagine a situation where you're at a home working on an important presentation and suddenly you hear a continuous beeping noise coming from your neighbors apartment.				
	Never	Rarely	Usually	Always
I move to the room furthest from the neighbors and close the door.				
I ask the neighbors if they can turn off whatever is beeping.				
I deal with it knowing that the neighbors have a right to do what they want in their own home and it the beeping will eventually subside.				
I decide to work on the presentation either early in the morning or late in the evening when there is less chance for distractions.				

I start humming loudly to myself to block out the noise.				
What else would you do to manage this experience?				
Situation 2: Imagine a situation where you're at your apartment building and your landlord has a fire alarm exercise to make sure everything is working properly.				
	Never	Rarely	Usually	Always
I would make sure that I am not in the building when the fire alarm exercise happens.				
I crank up the radio to block out the noise.				
I find out the fastest route possible to get out of the building during the exercise.				
I would go tell the landlord to arrange another time to do the exercise.				
I tell myself that the beeping will only last for a couple of minutes.				
What else would you do to manage this experience?				
Situation 3: Imagine a situation where you are reading in the library and you hear small irritating noises such as pen tapping, foot tapping, or noise music coming from someone's head phones.				
	Never	Rarely	Usually	Always
I gather my things and move to a quieter area.				
I put headphones on and continue reading.				
I always seek out the quiet section to avoid this situation.				
I tell myself that it's not a big deal.				

I walk over to the person and tell him/her to quiet down.				
What else would you do to manage this experience?				

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