

EFFECTS OF SENSORY PROCESSING PATTERNS ON SOCIAL SKILLS AND PROBLEM
BEHAVIORS

By

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Abstract

Sensory processing affects daily life activities including social participation. Numerous research studies have examined the effects of sensory processing on socialization in children with conditions, while limited research examined these effects in children from the general population including typical children. Drawing from a national sample, this study included 54 children aged 3-14, and investigated how sensory processing patterns predicted social skills and problem behaviors. This study focused on shared sensory patterns rather than sensory patterns specific to children with conditions. Multiple linear regression models showed that sensory processing predicted social skills and problem behaviors with sensory avoiding having significant negative partial effect on the social skills outcome. Canonical correlation models revealed strong relationships between sensory processing patterns, and social skills and problem behaviors domains. Findings suggest sensory processing preferences should be considered for all children, not just those with conditions, to enhance social skills and reduce problem behaviors.

Keywords: sensory processing, social behavior, adaptive behavior

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Introduction

BACKGROUND

As an occupational therapist from Jordan, I was dreaming of pursuing my postgraduate studies to improve and support the occupational therapy profession in my country. While earning my Master of Science degree in Occupational Therapy at the University of Kansas, I developed an interest in studying pediatric occupational therapy because I enjoyed working with children and their families during my fieldwork practice. My Master's thesis investigated gender and sensory processing differences in children's play (Ismael & Mische Lawson, 2012). I further increased my knowledge through teaching entry level students in Jordan theory and practice in occupational therapy for pediatric conditions before I returned back to Kansas City to pursue my PhD. During my PhD studies, I focused my course work and research skills in learning more about children's occupational performance and participation.

Before I started my first comprehensive exam paper, I was interested in studying how children's sensory processing affects their participation, as well as learning more about Autism Spectrum Disorders ASD. I also wanted to develop the skills necessary to conduct a rigorous systematic review of literature. So, I conducted a systematic review on studies that investigated the relationship between sensory processing and participation in ASD, and used the sensory profile to measure sensory processing using established systematic review guidelines. Conducting the review allowed for in-depth exploration of my topic as I read and reviewed many articles for potential inclusion in this systematic review. Besides learning more about the topic, I learned how to utilize the library resources, and how to collaborate with professionals in the library to complete this paper. This systematic review concluded that the evidence about the relationship between sensory processing and participation in ASD is limited and that more

research is needed focusing on participation areas other than education and leisure (Ismael, Mische Lawson & Hartwell, 2016).

This led me to my second comprehensive exam paper titled “The relationship between children with ASD’s sensory processing patterns and their activity participation patterns.” In this study, we examined how sensory processing was associated with a variety of home and community activities. Not only did conducting the study allow me to learn more about sensory processing and participation, I also expanded my research skills through submitting to the university’s Institutional Review Board (IRB), designing a Research Electronic Data Capture (REDCap) survey for the activity participation measure, collecting data, and analyzing data in Statistical Package for the Social Sciences (SPSS). Initial survey response was low, so I also learned methods for increasing response rate for this and future studies. This study concluded that specific sensory patterns were associated with different activities (Ismael, Mische Lawson & Little, 2017).

While I was completing my second comprehensive exam paper, I started to ask myself, “what do I want to learn more about?”, and “what other factors influence the daily lives of children with ASD?” I began considering environmental factors related to children’s participation, and became interested in their caregivers. So, my third comprehensive exam paper was “Coping strategies among caregivers of children with ASD: A cluster analysis.” In this paper, I had the opportunity to do a secondary data analysis on a large data set that included information about caregiver coping strategies, and caregiver strain levels. In this paper, I learned how to manage a large data set. I also learned new research skills, including how to do cluster analysis. We found that groups of caregivers of children with ASD utilized different coping strategies to successfully manage daily life challenges (Ismael, Mische Lawson, Moqbel, &

Little, 2017). After considering the results of my third comprehensive exam paper, I questioned my focus on the autism condition. With my expanded knowledge of sensory processing, I wondered if I should refocus on children's sensory processing preferences and patterns.

The self-reflection that occurred as I completed my three comprehensive exams led me to be more interested in the role of sensory processing in children's everyday life. I'm honored that I had the opportunity utilize the Sensory Profile 2 data set which included children with and without disabilities from the general population. In my dissertation study, I expanded my knowledge about sensory processing, and how different sensory patterns influenced children's social functioning. I focused on studying shared sensory experiences rather than sensory patterns specific to children with ASD. My dissertation study concluded that sensory processing predicted social skills and problem behaviors. Also, different sensory processing patterns were associated with specific social skills and problem behaviors domains (Ismael, Mische Lawson, Dean, & Dunn, 2017). My future research will continue to examine the effects of children's sensory processing preferences at home, school and community.

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Chapter 1

THE RELATIONSHIP BETWEEN SENSORY PROCESSING AND PARTICIPATION IN
DAILY OCCUPATIONS FOR CHILDREN WITH AUTISM SPECTRUM DISORDERS: A
SYSTEMATIC REVIEW OF STUDIES THAT USED DUNN'S SENSORY PROCESSING
FRAMEWORK

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Abstract

Previous research showed variability in measuring sensory processing in ASD in terms of measures used and population's age which contribute to difficulty in interpreting and summarizing findings of these studies. In an attempt to clarify the status of the literature, this systematic review was limited to studies that focused on participation in daily occupations, and evaluated sensory processing in children with ASD aged 5-13 years based on Dunn's sensory processing framework. Evidence from nine studies showed that sensory processing significantly impacted children's with ASD participation in daily life. Included studies demonstrated medium and low levels of evidence. Additional research is needed using more robust scientific methods

Keywords: sensation, autistic disorder, participation

The relationship between sensory processing and participation in daily occupations for children with Autism Spectrum Disorders: A systematic review of studies that used Dunn's sensory processing framework

Introduction

Occupational therapy emphasizes participation in daily life occupations for children with Autism Spectrum Disorder (ASD) and their families as an important service outcome. Families of children with ASD often identify participation goals related to activities of daily living, social participation, and play areas of occupation (Schaaf, Cohn, Burke, Dumont, Miller & Mailloux, 2015). Teachers and care providers at schools often identify participation outcomes for children with ASD related to learning and classroom activities (Ashburner, Ziviani & Rodger, 2008). Evidence suggests that sensory processing is a significant factor that affects participation in ASD (Askari, Anaby, Bergthorson, Majnemer, Elsabbagh & Zwaigenbaum, 2015; Ausderau, Sideris & Baranek, 2015; Tomchek, Little & Dunn, 2015). Understanding sensory processing patterns in children with ASD enhances the understanding of children with ASD's and their families' experiences of everyday life, and how sensory patterns may shape participation in different daily occupations. Therefore, this systematic review aims to summarize evidence about sensory processing's contribution to participation in children with ASD.

Sensory Processing in ASD

There is strong evidence that sensory processing is different than expected in children with ASD in patterns of hypo- and hyper-responsivity to sensory stimuli (Ben-Sasson, Hen, Fluss, Cermak, Engel-Yeger & Gal, 2009; Tomchek, et al., 2015). Multiple models have been used to describe sensory processing, with general agreement in these models regarding patterns of sensory hypo- and hyper- responding and another of seeking sensory input (Ashburner,

Ziviani, & Rodger, 2008; Ben-Sasson et al., 2008). Dunn's sensory processing framework (Dunn, 2014) grounds these patterns in participation, and considers individuals' neurological thresholds, self-regulation strategies, and the interaction between thresholds and self-regulation strategies. According to this model, a person's reactions to daily sensory events reflects both a particular threshold (high or low) and a self-regulation or responding strategy (passive or active). The resultant four patterns of sensory processing are shown in Figure 1: 1. *Registration*, representing high thresholds and a passive self-regulation strategy. Individuals with registration sensory pattern do not notice sensory events when others easily do; 2. *Sensation Seeking*, representing high thresholds and an active self-regulation strategy. Individuals with sensation seeking enjoy and extend their sensory experiences; 3. *Sensory Sensitivity*, representing low thresholds and a passive self-regulation strategy. Individuals with sensory sensitivity pattern notice more sensory events than others usually do; 4. *Sensation Avoiding*, representing low thresholds and an active self-regulation strategy. Individuals with sensation avoiding pattern find ways to limit sensory events, and prefer creating rituals for their daily routines.

There are multiple instruments used to measure sensory processing with varying ages, conceptual frameworks and purposes. For example, the Sensory Experience Questionnaire (SEQ; Baranek, 2009) is a parent report instrument to characterize sensory features in children with ASD and/or developmental disabilities ages 2-12 years (Ausderau et al., 2014). The SEQ is designed for children with ASD and has a primary use in research. The Sensory Processing Measure forms (SPM; Ecker & Parham, 2010; Miller Kuhaneck, Henry & Glennon, 2010) are parent/caregiver or teacher/daycare provider questionnaires to measure sensory processing. These forms are designed to measure performance skills related to sensory processing in young children (2-5 years). Other sensory processing measures include the Sensory Sensitivity

Questionnaire (Talay-Ongan & Wood, 2000) which provides scores for one sensory pattern and the Sensory Questionnaire (Saulnier, 2003) which has been used sparingly in research and practice.

The Sensory Profile (SP; Brown & Dunn, 2002; Dunn, 1999; 2002; 2006) has been widely used to measure sensory processing based on Dunn's sensory processing framework. Early studies (e.g., Kientz & Dunn, 1997; Watling, Deitz & White, 2001) have shown that the Sensory Profile discriminates sensory processing patterns of children with and without ASD. In a meta-analysis investigating sensory modulation patterns in individuals with ASD (Ben-Sasson et al., 2009), eleven of the fourteen studies that were included in this analysis used the Sensory Profile. The meta-analysis showed that there is a significant difference between ASD and typical groups of different age ranges in the presence and frequency of sensory hypo-responsivity, followed by hyper-responsivity and sensation seeking. Besides ASD, a number of studies used the Sensory Profile to understand sensory processing of different populations including individuals with ASD (Dunn, Myles & Orr, 2002; Myles, et. al., 2004) and dozens of other conditions as well (Dunn, Little, Dean, Robertson & Evans, 2016). The Sensory Profile allows caregivers, teachers and/or professionals to understand sensory processing patterns of children with ASD and how these patterns affect children's participation at home and school (Dunn, 2014).

Previous research showed variability in measuring sensory processing in ASD in terms of instruments used and sample age ranges, which contribute to difficulty in interpreting and summarizing findings of these studies. In an attempt to clarify the status of the literature, this systematic review was limited to studies that evaluated sensory processing in children with ASD based on Dunn's sensory processing framework (Dunn, 2014). Dunn's sensory processing

framework (Dunn, 2014) focuses on activity demands and environmental aspects' of participation rather than emphasizing performance skills and client factors as outlined in the Occupational Therapy Practice Framework (OTPF) 3rd (2014). Further, Dunn's sensory processing framework emphasizes a strength-based perspective to use sensory patterns to highlight children's assets and support children's participation in daily life. This systematic review also aimed to summarize literature about participation in ASD. The review used a clear definition of participation based on OTPF: "Engagement in desired occupations in ways that are personally satisfying and congruent with expectations within culture" (p S35). According to this definition, participation included different areas of occupation and in natural contexts. The research question asked: What is the relationship between sensory processing and participation in daily occupations in children with ASD?

Methods

Literature Search

This systematic review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher, Liberati, Tetzlaff, & Altman, 2009). A research librarian was consulted to improve search terms and conduct the electronic search. The electronic search included the following databases: CINAHL, PubMed, ProQuest, Cochrane, Eric, and OT seeker. Table 1 summarizes implemented search terms' of population (e.g., autism, Asperger and pervasive developmental disorder), sensory (e.g., sensory processing, hypo-sensitivity, hyper-sensitivity and seeking), and participation (e.g., activities of daily living, routines and social participation) terms that were used to find potentially related articles. Hand search of reference lists in some studies obtained from the electronic search, and the American Journal of Occupational Therapy allowed for locating additional potential studies.

Inclusion and Exclusion Criteria

To locate evidence since the evolution of Dunn's sensory processing framework, the search was limited to peer reviewed research articles, available in full-text to allow for direct accessibility, and published in English between 1997 and 2015. The search was also limited to studies that included children with an ASD diagnosis aged 5-13. Limiting age range allowed focusing on patterns of participation for elementary school-aged children. Potential studies for selection evaluated sensory processing based on Dunn's sensory processing framework, and used The Sensory Profile series: The Sensory Profile Caregiver Questionnaire (Dunn, 1999); The Sensory Profile School Companion (Dunn, 2006); and The Adolescent/Adult Sensory Profile (Brown & Dunn, 2002). Outcomes included participation in different daily occupations based on Occupational Therapy Practice Framework (OTPF 3rd ed.; AOTA, 2014): Activities of Daily Living (ADLs), Instrumental Activities of Daily Living (IADLs), rest and sleep, education, work, play, leisure, and social participation. Excluded studies did not meet the inclusion criteria as described previously: used tools to measure sensory processing other than the Sensory Profile, focused on specific skills rather than participation, focused on sensory processing disorder, and the sample did not include children with ASD.

Defining Measures

The Sensory Profile Series (SP; Brown & Dunn, 2002; Dunn, 1999; 2006). The Sensory Profile evaluates children's sensory processing patterns in the context of everyday life. Table two illustrates the characteristics of different pediatric Sensory Profiles.

Participation. The review focused on participation components that relate to different areas of occupations (ADLs, IADLs, rest and sleep, education, work, play, leisure, and social

participation) and in natural contexts as covered in OTPF. The review excluded studies that solely evaluated person factors (client factors and performance skills) as outcome measures.

Analysis

After scanning titles and abstracts for inclusion and exclusion criteria, critical analysis of eligible studies included assigning a level of evidence (Law & MacDermid, 2015), and assessing studies' strengths and limitations. According to the Oxford Center for Evidence-Based Medicine (OCEBM), the Standard Levels of Evidence System is composed of five levels of evidence; level one is the highest (e.g. systematic reviews and meta analyses) and level five is the lowest (e.g. expert opinion) (Law and MacDermid, 2015). Levels one, two and three are further subdivided to a, b and/or c sub-levels of evidence.

Results

Results of the systematic search of literature identified 608 articles after removing duplicates (see Figure 2). Screening titles and abstracts yielded 25 potential articles for full-text eligibility assessment. Seven studies met the inclusion criteria: studies included children with ASD and ages 5-13 years, and measured sensory processing based on Dunn's sensory processing framework. Full-text eligibility assessment excluded eighteen studies for the following reasons: Used tools to measure sensory processing other than the Sensory Profile (n=6), focused on client factors or performance skills rather than participation (n=2), focused on sensory processing disorder (n=1), sample did not include children with ASD (n=3), intervention studies (n=2), and not available in English or in full-text (n=4). All seven studies that met the inclusion criteria were quantitative, and formed the quantitative synthesis of this systematic review. Table three summarizes the seven studies.

Participants

Collectively, the seven studies investigated the impact of sensory processing of a total of 277 children of ASD. About eighty three percent (n= 230) were male and about seventeen percent (n= 47) were female. The age range was 3-12 years in which one study (Brown & Dunn, 2010) included children between five and eleven years. All seven studies reported that children had an official ASD diagnosis from a professional provider.

Research Methodology and Level of Evidence

Three studies (Ashburner, et al., 2008; Hochhauser & Engel-Yeger, 2010; Zobel-Lachiusa, Andrianopoulos, Mailloux & Cermak, 2015) utilized a case-control research design in which the control group included typically developing children that were matched on age. The remaining four studies implemented descriptive correlational (Brown & Dunn, 2010; Watson, Patten, Baranek, Poe, Boyd, Freuler & Lorenzi, 2011) or cross-sectional (Reynolds, Bendixen, Lawrence & Lane, 2011; Reynolds, Lane & Thacker, 2012) research designs.

Two researchers independently assigned levels of evidence for included studies. Studies investigating the relationships between sensory processing and participation, and met the inclusion criteria in the current systematic review, demonstrated medium and low levels of evidence. Case-control studies (Ashburner, et al., 2008; Hochhauser & Engel-Yeger, 2010; Zobel-Lachiusa, et al., 2015) are considered level 3b; whereas, descriptive studies (Brown & Dunn, 2010; Reynolds, et al., 2011; Reynolds, et al., 2012; Watson, et al., 2011) are considered level 4.

Key Findings

Participation outcomes. Included studies varied in measuring participation outcomes by investigating the impact of sensory processing on different occupations and in a variety of contexts. One study (Ashburner et al., 2008) measured educational outcomes in classroom by

implementing two teacher-reported questionnaires: the Conner's Teacher Rating Scale-Revised Long Version (CTRS-R;L; Conner's, 1997) and the Achenbach System of Empirically Based Assessment: Teacher Report Form (ASEBA: TRF; Achenbach & Rescorla, 2001). One study focused on leisure participation. Hochhauser and Engel-Yeger (2010) used the Children's Assessment of Participation and Enjoyment (CAPE; King et al., 2004) in which children rated their participation in a number everyday activities outside the school. Watson et al. (2011) measured social participation using the Vinland Adaptive Behavior Scales-Survey Edition (VABS; Sparrow, Balla & Cicchetti, 1984); whereas, Zobel-Lachiusa, et al. (2015) measured meal-time participation using the Brief Autism Mealtime Behavior Inventory (BAMBI; Lukens & Linscheid, 2008).

The remaining studies measured multiple participation areas. Brown and Dunn (2010) correlated the Sensory Profiles from home (SP Caregiver Questionnaire; Dunn, 1999) and from school (SP School Companion; Dunn, 2006) to measure how sensory processing impact participation in the two contexts. Reynolds et al., (2011) implemented the Child Behavior Checklist (CBCL; part of ASEBA: TRF; Achenbach & Rescorla, 2001), which is a parent report questionnaire about children's participation in different areas including home, school and social activities. Similarly, Reynolds, et al., (2012) implemented the CBCL questionnaire, but focused on outcomes related to sleep quality, duration and behavior.

The impact of sensory processing on participation in ASD. Evidence from seven studies showed that sensory processing significantly impacted children with ASD's participation in daily life. Table three summarizes the seven studies; whereas, the following sections highlight studies' results according to different participation areas.

Education. One study (Ashburner et al., 2008) focused on educational outcomes in the classroom and found that under-responsive/seek sensation, auditory filtering, and tactile sensitivity sections of the SSP were significantly negatively associated with academic performance and attention to cognitive tasks as measured by CTRS-R;L. The study suggested that children with ASD who have difficulty tuning in to verbal instructions in the presence of background noise and who often focus on sensory seeking behaviors appear to underachieve academically. The study reported that the choice of assessment tools was limited to budget constraints, and that future research should implement more valid and reliable measures of classroom outcomes.

Leisure. One study (Hochhauser & Engel-Yeger, 2010) found that children with higher sensation seeking performed more self-improvement activities in their home. Also, they found that the higher the tactile sensitivity, the higher the intensity of participation in physical activities, and the higher taste/smell sensitivity, the lower participation intensity. In addition, children with higher movement sensitivity performed more recreational and informal activities in their home, while, children with higher visual or auditory sensitivity performed self-improvement activities with others. The study was limited to a small convenience sample with little ethnic or socioeconomic backgrounds.

Social participation. One study (Watson, et al., 2011) focused on social participation and found that hyposensitivity and sensory seeking were significantly negatively associated with social adaptive skills as measured by VABS. The study reported limitations in terms of sample heterogeneity, possibility of multiple interpretation of results, and threats of validity of some implemented measures.

Meal time. One study (Zobel-Lachiusa, et al., 2015) focused on meal-time participation and found significant correlations between children's sensory processing patterns and their eating behaviors. Children with ASD showed higher scores on both the SSP and the BAMBI, suggesting more extreme sensory patterns and more challenging meal-time behaviors. The study implemented a convenience sample, from the same geographical area, that allowed participants to volunteer if they had an innate interest or concern about their child's sensory responses and eating behaviors.

Sleep. Reynolds, et al., (2012) showed that children with ASD have high prevalence of sleep disturbances as compared to typically developing children. Results also showed there was a relationship between sensory avoiding and sleep problems in children with ASD. The study considered the use of a parent report measures to identify sleep disturbances as one study limitation.

Other areas of participation. Two studies addressed multiple or other areas of occupation. Brown and Dunn (2010) compared SP from home and school, and showed that the avoiding and seeking quadrants in both SPs were significantly correlated. That means children's reactions of being overwhelmed by sensory experiences might be similar at home and at school. Reynolds, et al., (2011) showed that children who have more sensory sensitivity and avoiding behaviors demonstrated lower levels of competence in CBCL categories. The study was limited to a small sample size, and disproportionate number of female subjects in the typical group which may affect children's activity choices. Also, the study used the caregiver questionnaire for children above ten years.

Discussion

Results of this literature review suggested that sensory processing influences participation in everyday life activities across a variety of areas of occupation and contexts. It appears that children's patterns of sensory processing can both support or hinder participation. For example, children reported their interests in leisure activities that match their sensory needs (Hochhauser & Engel-Yeger, 2010). While the nature of leisure activities allows children with ASD to freely choose what matches their sensory preferences, other obligatory occupations like education, self-care or sleep may be challenging when considering extreme sensory patterns. For example, children with ASD who have increased sensation seeking appeared to have difficulties with academic performance and attention in the classroom (Ashburner, et al., 2008), and difficulties with social participation (Watson, et al., 2011). The reason might be that children who are sensation seeking may seek movement or sound inputs, and therefore, may miss teacher's instructions to classroom tasks or cues from their peers to engage in social interactions.

Results also showed that children with ASD who have sensation avoiding have difficulties with meal-time, sleep and school activities (Reynolds, et al., 2011; Reynolds, et al., 2012; Zobel-Lachiusa, et al., 2015). Children with sensation avoiding are overwhelmed with sensory inputs (Brown & Dunn, 2010) which makes dynamic activities that involve rich sensory inputs like meal-time, or activities that require quiet environments like sleep and study to be challenging. Brown and Dunn (2010) concluded that knowing children's sensory processing patterns without considering contextual factors is not sufficient to plan interventions that aim to increase children with ASD's participation.

The level of evidence about the relationship between children with ASD's sensory processing patterns and their participation is limited, as there are few studies that address participation in ASD with medium and low levels of evidence. As presented in this systematic

review, current evidence addressed certain participation areas like leisure and education; while other areas of occupations like activities of daily living and instrumental activities of daily living remain uninvestigated. While parents identify participation in ADL as their top goal area for their children with ASD (Schaaf, et al., 2015), services for children ages three and older focus on meeting the educational needs of children (Individuals with Disabilities Education Act, 2004). Therefore, individualized education plans for school-aged children mostly address classroom educational and behavioral outcomes. Intervention should support children with ASD's participation in different daily life occupations.

Strengths, Limitation and Future Research

The strengths of this systematic review include following the PRISMA guidelines in conducting the search and refining the results, consulting a health professions librarian with experience in conducting systematic reviews, using well-defined definitions of sensory processing and participation, and including studies of the same measure of sensory processing. This systematic review was limited to only full-text articles published in English. The low level of evidence of the included studies limited following PRISMA guidelines in reporting results. Future research should investigate the impact of sensory processing on different areas of participation in ASD with more rigorous methods. Also, future research should investigate the impact of occupation-based interventions on children with ASD's participation.

Implication for Occupational Therapy Practice

The impact of sensory processing on children with ASD's participation in different areas of occupation requires further exploration in terms of more rigorous methods and variety of participation areas. Research in this area will:

- Highlight the importance of participation as an outcome of occupational therapy interventions
- Guide occupational therapy evaluations toward assessing context as a crucial factor in supporting or hindering participation
- Guide occupational therapy interventions that support participation in desired occupations and in natural contexts

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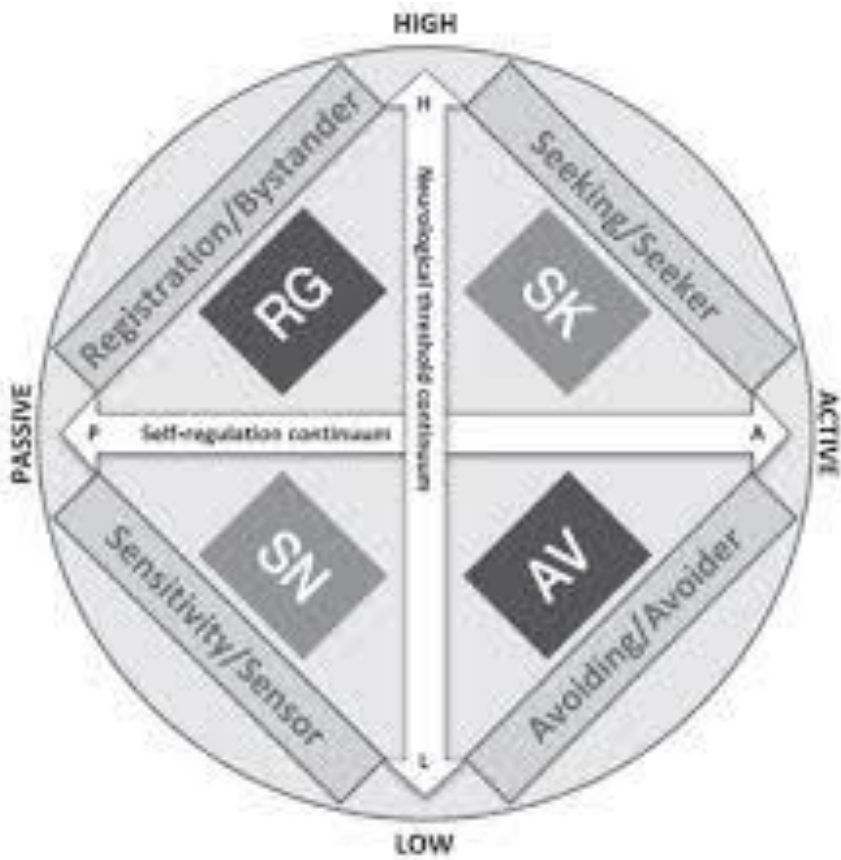
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Figure 1

Dunn's Sensory Processing Framework



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Figure 2

PRISMA Flow Diagram

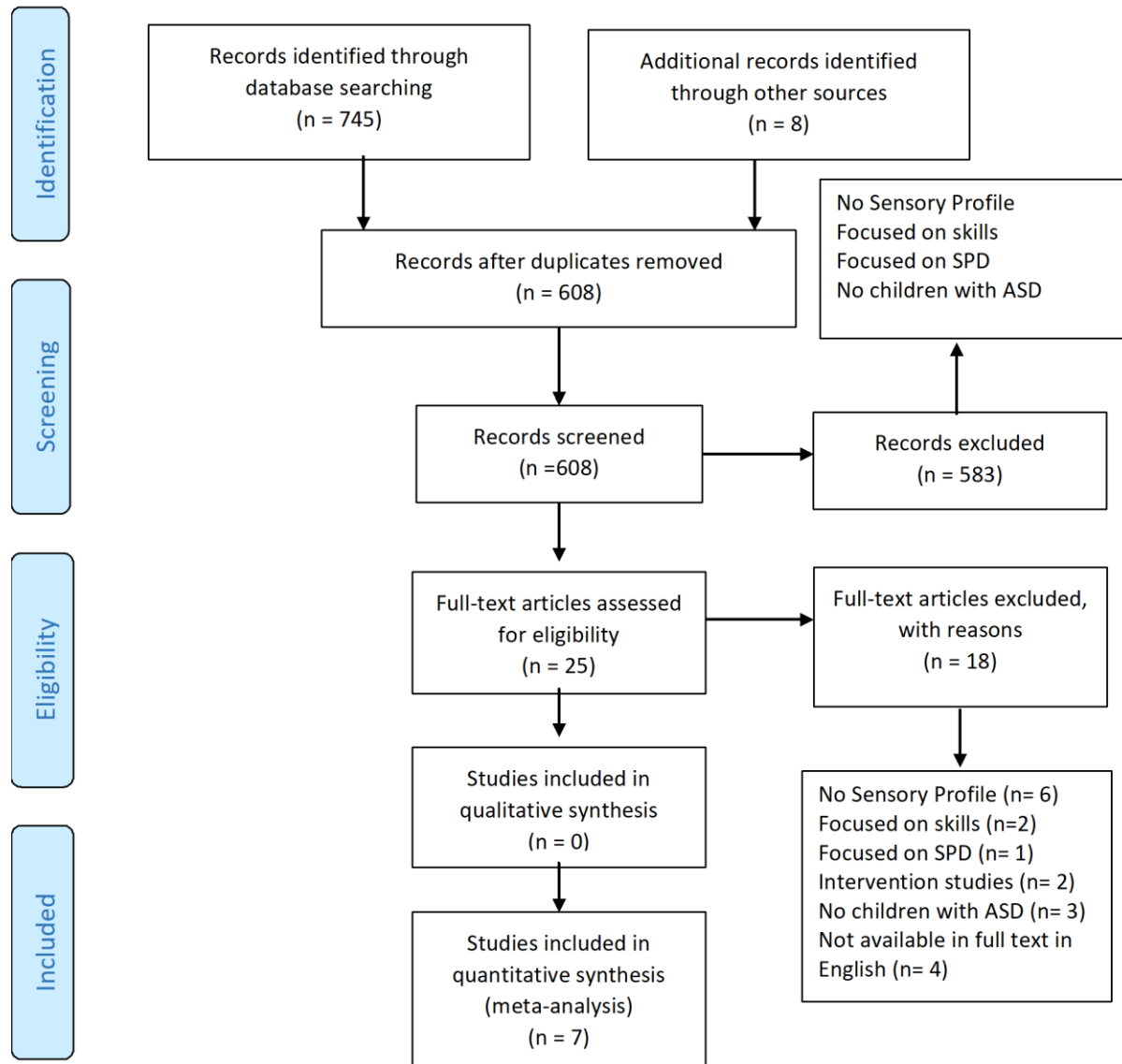


Table 1

Examples of Search Terms

Sensory processing	Population	Participation
“Seek”, “Registration”, “Sensitivity”, “Avoid”, “Modulation”, “Hyper”, “Hypo”, “Visual”, “Olfactory”, “Taste”, “Touch”, “Tactile”, “Defensiveness”, “Vestibular”, “Proprioception”, “Pressure”, “Pattern”, “Experience”, “Profile”, “Perception”, “Preference”, “Praxis”, “Temperament”, “Threshold”, “Sensorimotor”. “Sensory processing”, “Dunn”, “Sensory processing”, “disorder”, “Dunn's model of sensory processing”, “Dunn’s Sensory Processing Framework”, “Sensation Disorders”, “Sensory Responsiveness”, “Sensory Profile”, “Sensory Modulation”, “Sensation”, “Sensory Threshold”.	“Autism”, “Autistic Disorder”, “Autism Spectrum Disorder”, “Pervasive Developmental Disorder”, “Asperger’s”, “Child”, “Children”, “School”, “Adolescent”.	“Activities of Daily Living”, “Routine”, “Daily Living Skills”, “Self-Care”, “Occupation”, “Task”, “Participate”, “Activity”, “Adapt”, “Competence”, “Occupational therapy”, “Social Participation”, “Social Skills”, “Environment”, “Context”, “Family”, “Communication”, “Socialization”, “Toilet”, “Dress”, “Eat”, “Hygiene”, “Groom”, “Bath”, “Sleep”, “Education”, “Learning”, “Classroom”, “Handwriting”, “Reading”, “Work”, “Job”, “Play”, “Leisure”, “Social”, “Shower”, “School”, “Exercise”, “Physical Activity”, “Recess”, “Canadian Occupational Performance Measure”, “COPM”, “Goal Attainment Scaling”, “Playground”, “CAPE”, “PAC”, “Vineland”.

Table 2

Pediatric Sensory Profiles

The Sensory Profile: Caregiver Questionnaire	Sensory Profile School Companion	Adolescent/Adult Sensory Profile user's manual
<p>A Caregiver-report Questionnaire for children aged 3-10 years. It consists of 125 items that reflect sensory processing, modulation, and behavioral and emotional responses</p> <p>Cronbach's α for each of the various sections ranged from .47 to .91</p>	<p>A Teacher-report Questionnaire for children aged 3-11 years. It consists of 62 items that reflect a child's responses to daily sensory experiences in the classroom. The School Companion is designed to be used in conjunction with the Sensory Profile (Dunn, 1999).</p> <p>Cronbach's α coefficient ranged from .83 to .95</p>	<p>A Self-report Questionnaire for children aged 11 years and older. It consists of 60 items that reflect taste/smell processing, movement processing, visual processing, touch processing, activity level, and auditory processing.</p> <p>Coefficient α ranged from .64 to .78</p>

Table 3

Summary Table of Included Studies

Citation	Aim/Design/Level of Evidence	Participants characteristics	Focused Area of Participation	Results
Ashburner, Ziviani & Rodger (2008)	Explored the association between sensory processing and classroom emotional, behavioral, and educational outcomes of children with ASD Case-control research design Level 3b	28 (24 boys and 4 girls) children with ASD diagnosed by a pediatrician, ages 6-10 years, and included in regular education classes. 51 (43 boys and 8 girls) typically developing children matched controls from the same classrooms.	Impact of sensory processing on educational outcomes in regular classrooms	In the ASD group, results showed that under-responsive/ seek sensation, auditory filtering, and tactile sensitivity were significantly negatively associated with academic performance and attention to cognitive tasks (CTRS-R;L cognitive/inattention).
Brown & Dunn (2010)	Explored the relationship between sensory processing and context for children with ASD Descriptive, correlational research design Level 4	56 (49 boys and 7 girls) children with ASD as designated by the educational system, ages 3-11 years, and included in US public schools. Analysis included 49 pairs of children with ASD and their public school teachers.	Impact of sensory processing on participation in home and school	Results showed that the avoiding and seeking quadrants in both SPs were significantly correlated. That means children's reactions of being overwhelmed by sensory experiences might be similar at home and at school. Need to summarize the results

Hochhauser & Engel-Yeger (2010)	Examined the relationship between sensory processing and participation in leisure activities. Case-control research design Level 3b	25 (17 boys and 8 girls) children with high functioning ASD based on DSM-IV criteria and a neurologist report), ages 6-11 years, and attended regular education classes). 25 (18 boys and 7 girls) typically developing children within the same age group.	Impact of sensory processing on leisure participation	Results showed that children with higher sensation seeking performed more self-improvement activities in their home. Also, they found that the higher the tactile sensitivity, the higher the intensity of participation in physical activities, and the higher taste/smell sensitivity, the lower participation intensity. In addition, children with higher movement sensitivity performed more recreational and informal activities in their home, while, children with higher visual or auditory sensitivity performed self-improvement activities with others.
Reynolds, Bendixen, Lawrence & Lane (2011)	Pilot study Explored activity patterns in children with and without ASD/ examined the role of sensory responsiveness in determining children's level of competence in activity performance. Descriptive, Cross-sectional research design Level 4	26 (23 boys and 3 girls) children with ASD diagnosed by a psychologist or psychiatric, ages 6-12 years. 26 (12 boys and 14 girls) typically developing children 6-12 years. Children were recruited via flyers.	Impact of sensory processing on participation in home, school and social activities	Results showed that children who have more sensory sensitivity and avoiding behaviors (more than) or (much more than) demonstrated lower levels of competence in CBCL categories.

Reynolds, Lane & Thacker (2012)	Examined the relationship between physiologic responses to sensation and sleep in children with and without ASD Descriptive, Cross-sectional research design Level 4	27 (23 boys and 4 girls) children with ASD diagnosed by a psychologist or psychiatric, ages 6-12 years. 28 (14 boys and 14 girls) typically developing children 6-12 years.	Impact of sensory processing on sleep	Results showed that children with ASD have high prevalence of sleep disturbances as compared to typically developing children. Results also showed there was a relationship between sensory avoiding and sleep problems in children with ASD.
Watson, Patten, Baranek, Poe, Boyd, Freuler & Lorenzi (2011)	Examined patterns of sensory responsiveness as factors accounted for variability in language, social, and communication skill development in children with ASD Descriptive, correlation research study Level 4	72 (61 boys and 11 girls) children with autistic disorder (diagnosed by a psychologist or physician) and 44 children with other developmental disorders.	Impact of sensory processing on social participation	Results showed that hyposensitivity and sensory seeking were significantly negatively associated with social adaptive skills as measured by VABS.
Zobel-Lachiusa, Andrianopoulos, Mailloux & Cermak (2015)	Examined sensory processing and mealtime behaviors in children with ASD as compared to typically developing children Case-control research design Level 3b	34 (33 boys and 1 girl) children with ASD diagnosed by a physician and medical behavioral specialist, ages 5-12 years. 34 (27 boys and 7 girls) typically developing	Impact of sensory processing on meal-time participation	Results showed significant correlations between children's sensory processing patterns and their eating behaviors. Children with ASD showed higher scores on both the SSP and the BAMBI, suggesting more extreme sensory patterns and more challenging meal-time behaviors.

children
matched on
ages.

* Note: Modified for dissertation formatting. The full table will be published in (Ismael, N., Mische Lawson, L., & Hartwell, J. (2016). The relationship between sensory processing and participation in daily occupations for children with ASD: A systematic review of studies that used Dunn's sensory processing framework. American Journal for Occupational Therapy. Manuscript in press.)

Chapter 2

THE RELATIONSHIP BETWEEN CHILDREN WITH ASD'S SENSORY PROCESSING PATTERNS AND THEIR ACTIVITY PARTICIPATION PATTERNS

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Summer 2016

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Abstract

Current evidence about the impact of sensory processing on participation in ASD addressed certain participation areas like leisure and education; while other areas of occupations like activities of daily living (ADLs) and instrumental activities of daily living (IADLs) remain uninvestigated. The purpose of this study was to investigate the relationship between children with ASD's sensory processing patterns and their activity participation in a number of home and community activities. A secondary purpose was to investigate the number and variety of activities that children with ASD participate in during the year. The current study utilized a correlational survey and included children with ASD aged 4-13 years who have participated in a community sensory enhanced swim program designed for children with ASD. The study use the Sensory Profile Caregiver Questionnaire, and the Home and Community Activity Scale as measures. Results showed that sensory processing was significantly related to children with ASD's participation in home and community activities. The study also showed that children with ASD participated more in parent-child household activities and routine errands as compared to other types of activities. Additional research about the impact of sensory processing on participation in ASD is needed using more robust scientific methods.

Keywords: sensory processing, participation, Autism Spectrum Disorder,

The Relationship between Children with ASD's Sensory Processing Patterns and their Activity Participation Patterns

Introduction

Participation in everyday activities provides children with different learning opportunities, and supports children in developing competencies to become successful in their homes, schools, and communities (King, Law, King, Rosenbaum, Kertoy, & Young, 2003; Law et al., 2006). Children with Autism Spectrum Disorder (ASD) participate less frequently in self-care, educational and leisure activities, with less variety (LaVesser & Berg, 2011; Dickie, Baranek, Schultz, Watson, & McComish, 2009), and with a narrower group of other children (Potvin, Snider, Prelock, Kehayia, & Wood-Dauphinee, 2013) than typically developing children. A number of factors affect children with ASD's participation in different activities, including their sensory processing preferences (Tomchek, Little & Dunn, 2015; Reynolds, Bendixen, Lawrence, & Lane, 2011). When care providers understand how sensory processing impacts participation, it will be easier to design activities and interventions that match children with ASD's sensory preferences, which can then increase participation.

Literature Review

Sensory processing influences participation in everyday life (Dunn, 2001; Tomchek, Little & Dunn, 2015). Dunn's sensory processing framework (Dunn, 2014) describes sensory processing in the context of participation in everyday occupations and in natural settings. The framework considers individuals' neurological thresholds, self-regulation strategies, and the interaction between thresholds and self-regulation strategies. Dunn's framework outlines four patterns of sensory processing: Registration, Sensation Seeking, Sensory Sensitivity, and Sensation Avoiding. The Sensory Profile series (Brown & Dunn, 2002; Dunn, 1999, 2006, 2014)

have been widely used to measure sensory processing in ASD based on Dunn's sensory processing framework. The Sensory Profile allows caregivers, teachers and/or professionals to understand sensory processing patterns of children with ASD and how these patterns affect children's participation at home and school (Dunn, 2014). In the current study we used Dunn's sensory processing framework to characterize children with ASD's sensory processing patterns.

A number of studies investigated the impact of sensory processing on participation in ASD using different activity participation measures (Hochhauser & Engel-Yeger, 2010; Little, Ausderau, Sideris & Baranek, 2015; Reynolds, et al., 2011). Hochhauser and Engel-Yeger (2010) used the Children's Assessment for Participation and Enjoyment (CAPE) in which children rated their participation in a number leisure activities outside the school. The study found that children with higher sensation seeking performed more self-improvement activities (e.g. writing letters and reading) in their home. Also, the study found that children with higher tactile sensitivity participated more intensely in physical activities. In addition, children with higher movement sensitivity performed more recreational activities in their home, while, children with higher visual or auditory sensitivity performed self-improvement activities with others. Similarly, Ismael, Mische Lawson and Cox (2015) used CAPE and the Preferences for Activities of Children (PAC; King et al., 2004) PAC to investigate how sensory processing is related to leisure participation in a sample including children with Individualized Education Plan (IEP). Results showed that children with higher registration participated in fewer activities, children with higher sensory sensitivity participated less in social and skill-based activities (e.g. swimming and dancing), and children with higher sensory avoiding participated less in social activities.

Besides leisure participation, some studies investigated the impact of sensory processing on other areas of participation including home and school. Reynolds et al. (2011) investigated how sensory processing impacted children with ASD's participation in different areas using the Child Behavior Checklist (CBCL; part of ASEBA: TRF; Achenbach & Rescorla, 2001) and showed that children who have more sensory sensitivity and avoiding sensory patterns demonstrated lower levels of competence in home, school and social activities. Ashburner, Ziviani, & Rodger (2008) focused on participation in the classroom and found that sensation seeking and sensory avoiding were significantly negatively associated with academic performance and attention to cognitive tasks. The study suggested that children with ASD who have difficulty tuning in to verbal instructions in the presence of background noise and who often focus on sensory seeking behaviors appear to underachieve academically. Results from Ashburner et al. (2008) and Reynolds et al. (2011) suggested that certain extreme sensory patterns in children with ASD contributed to challenges to successful participation in home and school activities.

As presented earlier, current evidence addressed certain participation areas like leisure; while other areas of occupations like activities of daily living (ADLs) and instrumental activities of daily living (IADLs) remain under investigated. To contribute to the body of knowledge about participation in ASD, the purpose of this study was to investigate the relationship between children with ASD's sensory processing patterns and their participation patterns in a variety of activities at home and in the community. A secondary purpose of this study was to investigate the number and variety of activities in which children with ASD participate in during the year. This study is unique in addressing participation of children with ASD who are involved in a community physical activity program. We intended to answer two questions:

1. Among children with ASD, what are the relationships between sensory processing patterns and activity participation patterns?
2. What activities do children with ASD participate in most?

Methods

Research Design

The current study utilized a correlational survey design to investigate the relationships between children's sensory processing patterns and caregiver reported activity participation patterns.

Participants

The current study included children with ASD aged 4-13 years who have participated previously or were participating at the time of this study in a community sensory enhanced swim program designed for children with ASD. All children were within the age range at the time their parents completed the Sensory Profile. Parents of children with ASD served as informants in this study and provided information about their children's patterns of participation in different activities.

Measures

The current study used data from children with ASD's Sensory Profiles that were collected previously as part of enrolling in the swim program. The current study collected data about children with ASD's patterns of participation in a number of home and community activities, and demographic information about children with ASD and their families.

The Sensory Profile (SP; Dunn, 1999). This caregiver questionnaire is a pediatric assessment tool that helps professionals measure the possible contributions of sensory processing to children's daily performance patterns. The Sensory Profile measures sensory processing in

children ages three to ten years. It consists of 125 items that reflect sensory processing, modulation, and behavioral and emotional responses. Caregivers rate how frequently children engage in selected behaviors on an inverted 5 point Likert scale from never to always (5=never, 1=always). When using the SP, professionals refer to sensory patterns' quadrant summary scores to understand children's sensory preferences. A number of psychometric studies (Dunn & Westman, 1997; Ermer & Dunn, 1998; Kientz & Dunn, 1997) established the Sensory Profile's validity, internal consistency, and test-retest reliability.

Home and Community Activities Scale (HCAS; Adapted from Dunst, Hamby, Trivette, Raab & Bruder, 2000). The HCAS is based on the research in Dunst et al. (2000), in which researchers attempted to investigate the settings of naturally occurring learning opportunities. Little, Sideris, Ausderau & Baranek (2014) utilized a confirmatory factor analysis of HCAS among a sample of school-age children with ASD. The study showed that the HCAS measured six factors of activity participation: (1) Parent-Child Household Activities (e.g. household chores and bedtime stories); (2) Community Activities (e.g. community celebrations out and parades); (3) Routine Errands (e.g. food shopping and eating out); (4) Neighborhood-Social Activities (e.g. visiting neighbors and sleepovers); (5) Outdoor Activities (e.g. hiking and camping); and (6) Faith-based Activities (e.g. religious activities and going to church). In Little et al, (2014), caregivers rated the frequency of the child's participation in each activity (0=never, 1=monthly, 2=weekly, or 3=daily). Using the Sensory Experience Questionnaire (SEQ 3.0; Baranek, 2009) and HCAS, Little, Ausderau, Sideris & Baranek (2015) showed that sensory response patterns impacted dimensions of activity participation. The current study referred to the same HCAS six activity groups presented in Little et al. (2014). The current study adapted how

HCAS measures frequency of participation in each activity (1=never, 2=seasonally, 3=monthly, 4=weekly, or 5=daily).

Demographic Information Form. The form collected information about characteristics of children with ASD and their families (e.g. age, gender, and educational level). It also collected information about certain contextual factors (e.g. number of siblings, income, and living arrangement) that might affect child and family participation. The demographic form was part of the survey that included the HCAS.

Procedure

After obtaining approval through the institution's Internal Review Boards, we collected data about children with ASD's patterns of participation in different activities through a web-based survey of HCAS developed in Research Electronic Data Capture (REDCap), as well as, through paper forms of the same scale. We initiated communication with seven-four caregivers of children with ASD via e-mail, and sent out information about the study and an online survey that included the HCAS and the demographic information form. We sent parents directions on completing the survey and provided contact information to answer any questions. Directions made clear that participants are being invited to complete the survey because their children have participated or were currently participating in the swimming program and parents had previously completed the SP for their children. The survey was open for three weeks before analysis. We also visited the swim program, and provided paper forms of the survey to caregivers while their children were taking the swim lessons.

Data Analysis

To determine what relationships were present between children with ASD's sensory processing patterns and their activity participation patterns, we performed two-tailed Spearman's

rank correlations using the SP quadrants' summary scores and HCAS activity groups' mean scores for all participants who completed the survey. The mean score of each activity group represents the intensity of participation in that activity group. We calculated mean scores for each activity group to account for the difference in the number of activities in each group (Parent-Child Household Activities $n= 14$; Community Activities $n= 20$; Routine Errands $n= 4$; Neighborhood-Social Activities $n= 6$; Outdoor Activities $n= 5$; and Faith-based Activities $n= 4$). We used Statistical Package for the Social Sciences (SPSS) 22.0 to analyze data, and we set the p-value at the standard level of .05. We used Spearman's rank correlations because we used non-parametric data from Likert scales (Portney & Watkins, 2015).

To determine the variety of activities that each child had participated in, we calculated the total number of activities that caregivers reported their children with ASD had participated in regardless of the frequency of their participation. We recoded the HCAS Likert scale values to read 0=never and 1= other frequencies of participation (seasonally, monthly, weekly, and daily). We also used activity groups' mean scores to know which activity groups did children with ASD in our sample participated in more frequently.

Results

Seventeen caregivers filled out online or paper surveys for their children with ASD (response rate= 23%). Children with ASD in this study were sixteen males (94.1%) and one female (5.9%), ages 5-13, and a majority being Caucasian (70.6%). Table 1 summarizes children and families' demographics.

Results showed strong positive correlations between seeking quadrant summary scores and mean participation in neighborhood and social activities ($r_s= .70, p= .002$). That means children with more seeking traits participate less frequently in neighborhood and social activities.

In addition, results showed moderate positive correlations between registration quadrant summary scores and mean participation in routine errands ($r_s = .5$, $p = .04$). That means children with more registration traits participate less frequently in routine errands activities.

The total number activities calculated for each child ranged from 25-60 activities with a mean of 49 out of 80 various activities. HCAS activity groups' frequency mean scores showed that children with ASD in our sample participated more in parent child household activities (mean= 3.51) and routine errands (mean= 2.96) as compared to other HCAS activity groups' mean scores [community activities (mean= 2.05), neighborhood social activities (mean= 1.90), outdoor (mean= 1.61) and faith-based (mean=2.03)].

Discussion

This study investigated the relationships between children with ASD's sensory processing patterns and their activity participation patterns. We used HCAS and SP to characterize children's activity and sensory patterns. We found that children with more sensory seeking traits participate less frequently in neighborhood and social activities, like visiting friends and neighbors or attending a family member's birthday party. Children with a seeking sensory pattern have a high threshold for sensory input and an active regulation style (Dunn, 2010). These children may like to explore their environments with their hands or create other sensory experiences for themselves (Dunn, 2007). Their preference for more sensory input may cause them to get distracted in a social activity with peers by the higher intensity stimuli (e.g. flashy/colorful objects, noisy toys, etc.) around them instead of focusing on the activity with their friends and families.

We also found that children with more registration traits participate less frequently in routine errands activities. Children with a registration sensory pattern have a high threshold for

sensory input and a passive self-regulation style meaning that means they usually do not notice what others notice readily (Dunn, 2010). Children with registration profiles are passive and do not seek out different opportunities or ask their parents to provide them with different opportunities. They do not have the need get away as avoiders do or find more sensations like seekers do. The nature of routine errands (e.g. food shopping or doing errands) are predictable, in which they are the same each time. Perhaps children with more registration traits participate less in routine errands due to their need for spontaneous sensory stimuli to encourage participation (Little, Ausderau, Sideris, & Baranek, 2015). Those children are often described by parents and teachers as easy-going and aloof.

The present study found that children with ASD participate in a small variety of activities. In our sample, the number of activities that each child has participated in during the year ranges from 20-60 out of 80 activities. Also, children participated more in parent-child household activities and routine errands as compared to other HCAS activity groups [community activities, neighborhood social activities, outdoor and faith-based]. These findings are similar to Hilton, Crouch, and Israel (2008), which, through the use of CAPE score comparisons, found that children with ASD participated in a less variety of activity types than typically developing peers. Little, Ausderau, Sideris, and Baranek (2015) also found a negative correlation between the presence of ASD and the variety of activity participation when using the HCAS assessment tool. Children with ASD find it difficult to be flexible and transition between activities (Hochhauser & Engel-Yeger, 2010), and this may explain why children with ASD participate in fewer and a less variety of activities than their typically developing peers. In terms of activity preference, typically developing children tend to participate in outdoor and social activities more

than children with ASD who prefer indoor and home-based activities more than outdoor and social recreations (Solish, Perry & Minnes, 2010).

Limitations

This study has some limitations. The sample size was small (n=17) due to time restraints and a limited response rate from participants. Our sample was primarily Caucasian participants, which limits the potential to generalize the results. Lastly, the HCAS survey may be considered long and consisted of answering 80 activity participation questions, as well as, completing a demographic survey. This may have contributed to participants' fatigue, and may have potentially affected the results.

Implications for Occupational Therapy Practice

Occupational therapists play an important role in supporting children and families to participate successfully in everyday activities. Parents need our support to identify ways their children can be successful in neighborhood and social activities. This study clarifies areas of strength for community participation, so families can work towards increased participation as their children grow to adulthood. Care providers may use this information in practice by considering the child's individual sensory processing/activity preferences when planning interventions in children and families' authentic contexts. For example, school teachers may adapt classroom environments to support children's sensory needs. Care providers may also create community programs that supports children with autism and their families (e.g. dance, swimming or soccer programs). Such programs may provide certain adaptations while considering children's sensory preferences.

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Table 1

Families and Children's Demographics

Variable	n(%)
Child gender	
Male	16 (94.1)
Female	1 (5.9%)
Age groups	
5-7 yrs	5 (29.5%)
8-10 yrs	9 (52.8%)
11-13 yrs	3 (17.7%)
Grade	
Preschool/ Kindergarten	3 (17.7%)
1-6	14 (82.3%)
Child race–ethnicity	
Caucasian	12 (70.6%)
African-American	2 (11.8%)
Hispanic	2 (11.8%)
Asian	2 (11.8%)
More than one	1 (5.9%)
Other	1 (5.9%)
Diagnostic category	
Autism	13 (76.5%)
Autistic Disorder	4 (23.5%)
Asperger's Syndrome	2 (11.8%)
PDD-NOS	3 (17.6%)
Multiple ASD Diagnosis	0 (0%)
Other Health Condition	2 (11.8%)
Medications	
Yes	7 (41.2%)
No	8 (47.1%)
Current services	
Occupational Therapy	12 (70.6%)
Speech Therapy	15 (88.2%)
Physical Therapy	3 (17.6%)
Special Education	9 (59.9%)
Adapted Physical Education	3 (17.6%)
Other	1 (5.9%)
Respondent	
Mother	14 (82.4%)
Father	2 (11.8%)
Grandmother	1 (5.9%)
Grandfather	0 (0%)
Other primary	0 (0%)

Respondent years of
education

Completed high school	3 (17.6%)
Some college	2 (11.8%)
Associates degree	1 (5.9%)
Bachelor's degree	8 (47.1%)
Graduate degree	3 (17.6%)

Chapter 3

COPING STRATEGIES AMONG CAREGIVERS OF CHILDREN WITH AUTISM
SPECTRUM DISORDERS: A CLUSTER ANALYSIS

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Abstract

Research suggests that there is variability in the coping strategies used among caregivers. Therefore, drawing from a large sample of 273 caregivers of children with ASD, this study aimed to identify subgroups of caregivers based on coping mechanisms as well as to investigate whether there are differences among these subgroups in terms of the strain level. Findings showed that there were four distinct subgroups of caregivers of children with ASD with different coping styles: Social-Supported/Planning, Spontaneous/Reactive, Self-Supporting/Reappraisal, and Religious/Expressive coping styles. Caregivers' subgroups didn't differ on strain level. This study showed that caregivers of children with ASD may utilize differential combinations of coping strategies, and revealed the power of these combinations for managing the strain of caregiving.

Keywords: cluster analysis, coping strategies, caregivers, ASD

Coping Strategies among Caregivers of Children with Autism Spectrum Disorders: A Cluster Analysis

Introduction

Caregivers of children with Autism Spectrum Disorder (ASD) must develop strengths to overcome daily caregiving challenges, and to manage stressful situations. Caregivers celebrate their children's successes every day, but their lives may involve additional caring demands due to therapies, changes in routines, and other child and family related needs (Zablotsky, Bradshaw, & Stuart, 2013). As a result, caregivers of children with ASD develop coping mechanisms to overcome the stress and challenges in order to successfully parent their child. Given the demands of caring for a child with ASD, there has been an increase in targeted intervention approaches to promote caregiver well-being (Karst & Van Hecke, 2012). However, research suggests that there is variability in the coping strategies used among caregivers (Phelps, McCammon, Wuensch and Golden, 2009; Zablotsky, et al., 2013); capturing homogeneity among such variable groups may help elucidate targeted intervention approaches for caregivers of children with ASD. Therefore, drawing from a large sample of caregivers of children with ASD, we identified groups of caregivers based on coping strategies, as well as, investigated differences in strain among these groups.

Literature suggests that caregivers of children with ASD experience higher levels of stress than caregivers of typical children (Khanna, Madhavan, Smith, Patrick, Tworek, & Becker-Cottrill, 2011) or children with other developmental conditions (Abbeduto et al., 2004). Research showed that the characteristics of children with ASD, including autism severity (Abbeduto et al., 2004; Khanna et al., 2011; Zablotsky et al., 2013), challenges in social interactions and communication (Ludlow, Skelly, & Rohleder, 2011), and challenging behaviors

that are hard to manage (Abbeduto et al., 2004; Ben-Sasson, Soto, Martínez-Pedraza, & Carter, 2013; Ludlow, Skelly, & Rohleder, 2012), can create stress throughout the household and the family. However, many caregivers adapt successfully to the demands of raising a child with ASD through the development of different coping mechanisms. Keeping in mind the additional demands, it is important to understand the different coping mechanisms that caregivers of children with ASD utilize to overcome daily stress.

Researchers interested in understanding people's coping mechanisms acknowledged the importance of understanding the stress that derives coping. Stress results from interactions between persons and their environment that are perceived as exceeding persons' adaptive capacities (Folkman, 2010). Strain is the change in a person's daily life in a way that care is needed (Stadnyk, Duxbury, Higgins, & Smart, 2011). In the caregiver coping literature, caregiver strain refers to the demands, responsibilities, difficulties, and negative psychological consequences of caring for relatives with special needs (Arai, 2004; Brannan & Heflinger, 1997). Evidence shows that caregiver strain is a predictor of several negative outcomes on caregivers' health and wellbeing (Davis & Carter, 2008; Magaña & Smith, 2006). For example, Montes and Halterman, (2007) found that mothers of children with ASD had high levels of parenting stress, and were more likely to report poor mental and emotional health than mothers in the general population. Similarly, Lee et al. (2009) showed that parents of children with ASD reported significantly higher levels of stress as compared to parents of typically developing children. In addition, parents of children with ASD reported a number of negative experiences and substantially reduced quality of life that were not reported by parents of typically developing children. Inconsistent with several studies that showed caregivers with ASD are under severe stress, Tehee, Honan and Hevey (2009) found that caregivers of children with ASD

demonstrated relatively low levels of general perceived stress, as well as, stress and coping related to caregiving, suggesting coping is an important factor affecting caregivers' psychological well-being.

An early study on stress and coping (Folkman & Lazarus, 1980) identified how people are similar or different in coping with the stressful events of daily living. By analyzing the ways that individuals cope with the stressful events of daily living over the course of one year, Folkman and Lazarus (1980) found two types of highly used coping strategies: 1) problem-focused coping, which is aimed at problem solving or doing something to alter the source of the stress; and 2) emotion-focused coping, which is aimed at reducing or managing the emotional distress that is associated with the situation. This study further analyzed contextual factors and showed that work contexts favor problem-focused coping, while health contexts favor emotion-focused coping. Subsequent research continued to show that coping is context-dependent (Carver, Scheier, & Weintraub, 1989), and that both the nature of the stress and the interaction between stressors and the environment affect the development of coping mechanisms.

Carver et al. (1989) investigated distinct activities within problem-focused and emotion focused coping in order to find ways to separately measure the two coping strategies. In this study, researchers developed an instrument to assess people's coping styles and to distinguish between different coping strategies. The COPE inventory (Carver et al., 1989) included five scales that measured conceptually distinct aspects of problem-focused coping (active coping, planning, suppression of competing activities, restraint coping, seeking of instrumental social support); and five scales that measured distinct aspects of emotion-focused coping (seeking of emotional social support, positive reinterpretation, acceptance, denial, turning to religion). The measure also included three additional scales of coping responses that were not related to the

above categories (focus on and venting of emotions, behavioral disengagement, and mental disengagement) (see Table 1).

Several studies on caregiver coping highlighted a number of coping strategies as effective ways to overcome stress, and to improve health outcomes. For example, Zablotsky et al. (2013) found that mothers of children with disabilities who utilized effective coping mechanisms were at a reduced risk for stress and mental health problems as compared to mothers with limited coping. Researchers also identified the strong social supports in the neighborhood as an important factor in protecting a mother's mental health. Similarly, Tway, Connolly and Novak (2007) found that caregivers of children with ASD used social support systems within the family's social network as effective coping strategies. In this study, caregivers of children with ASD identified stress as significant and chronic in which seeking social support is very essential.

Besides social coping, positive coping is another coping strategy that evidence identified as effective. Studies showed that positive reframing of potentially stressful events is an effective coping strategy under conditions where it is difficult to act directly to reduce the impact of the stressor (Hastings, Kovshoff, Brown, Ward, Degli Espinosa, & Remington, 2005; Hastings & Taunt, 2002). In Hasting et al. (2005), positive coping was associated with lower levels of depression in mothers and fathers of children with ASD.

While some studies highlighted many coping strategies as effective, other studies identified some coping strategies as not helpful. For example, Phelps, McCammon, Wuensch and Golden (2009) found that many caregivers used passive appraisals as an ineffective coping strategy for managing their child's ASD symptoms. In this study, caregivers reported the use of passive behaviors because they believed they did not have the ability to alter the outcomes of their children. Additionally, evidence has shown mixed effects of religious coping in caregiver of

children with ASD. While Tarakeshwar and Pargament (2001) found that religious coping may reduce stress and depression in parents of children with ASD, results in Hastings et al. (2005) did not support this finding. Not surprising, Hastings et al. (2005) found that active avoidance coping for caregivers of children with ASD was associated with more stress, anxiety and depression.

Based on the notion that caregivers of children with ASD experiences higher levels of stress, the existing body of evidence attempted to highlight the differences between coping in caregivers of children with ASD and caregivers in the general population. Inconsistent with the existing evidence, one study (Montes & Halterman, 2007) showed that mothers of children with ASD were similar to mothers in the general population in aspects of having a close relationship with their children and coping with parenting tasks. Also, there is some support that diverse contextual variables impact the coping strategies caregivers of children with ASD adopt to overcome the caregiving stress (Hastings et al., 2005).

Our exploratory cluster analysis on the COPE (Carver et al., 1989) expands upon existing studies of coping in caregivers of children with ASD. Specifically, we addressed the following research questions:

1. Based on the COPE Inventory, are there distinct coping subgroups (clusters) of caregivers of children with ASD?
2. How do these subgroups (clusters) of caregivers differ on the sense of strain as measured by the CGSQ?

Methods

Research Design

The current study utilized a retrospective data analysis to identify groups (clusters) of caregivers of children with ASD based on their coping strategies. The original survey (Social

Networking Sites and Caregivers of Children with ASD) aimed to investigate the role of Social Networking Site use by caregivers of children with ASD as a tool for coping with stress. This study used secondary data from the larger study to further examine caregivers' coping and strain.

Participants

The original dataset consisted of 392 survey responses. Researchers included respondents if they reported that they had a child with an ASD and could read English. Researchers excluded caregivers of children with ASD if they reported that they were not the child's primary caregiver (e.g., teacher, therapist) or did not live in the same household as the child. Recruitment methods included using the Healthcare Enterprise Repository for Ontological Narration (HERON) and Frontiers Registry of a local medical hospital, by sending letters to the addresses of caregivers of children with ASD who have visited the hospital in the past and agreed to be contacted for research purposes. By using the hospital registry, we were assured that we were targeting caregivers of children with a diagnosis of ASD. Recruitment also included posting a survey link on social media platforms such as Facebook. An online research registry for caregivers of children with ASD authenticated the parent-report ASD diagnosis for a subset of individuals in their registry, and showed a high level of corroboration (98 %) between parent reported and professional documentation of a diagnosis (Daniels, Rosenberg, Anderson, Law, Marvin, & Law, 2012). After handling missing data, the current study included 273 survey responses. Characteristics of the sample are presented in Table 2.

Measures

The COPE Inventory (Carver et al., 1989). The COPE is comprised of fifteen four-item scales designed to assess a variety of coping strategies (see Table 1). Scales' scores from a total of sixty items are generated by summing across items for each subscale. Higher scores on

the scales indicate a respondents' tendency to engage in a particular strategy (Greer, 2007).

Carver et al. (1989) reported adequate internal consistency for the COPE for each of the subscales, with Cronbach's α reliabilities ranging from .45 to .92.

Data for the current study consisted of items with the highest item loadings (Carver et al., 1989) on each of the following categories on the COPE: planning, suppression of competing activities, restraint, use of instrumental social support, use of emotional social support positive reinterpretation of growth, acceptance, religious coping, focus on and venting of emotions, denial, and substance use. The original survey excluded the following COPE categories: active coping, behavioral disengagement, mental disengagement, and humor because these categories have poor loading of items (Carver et al., 1989).

The Caregiver Strain Questionnaire CGSQ (Brannan & Heflinger, 1997). The CGSQ contains twenty one items rated on a five-point scale ranging from one (not at all a problem) to five (very much a problem) to assess the degree to which caregivers experience difficulties, strains, and other negative effects as the result of caring for a child with emotional or behavioral problems. Using the CGSQ, Brannan and Heflinger (1997) suggested three factor model of caregiver strain: Objective Caregiver Strain, Subjective Externalized Caregiver Strain, and Subjective Internalized Caregiver Strain. The objective strain dimension describes how challenging events related to the child's condition have been a problem for the family, such as, trouble with neighbors, disrupted family relationships, interrupted routines, curtailed social activities, and loss of personal time. The subjective externalized strain dimension describes feelings about the child's problems such as anger, resentment, or embarrassment. Subjective internalized strain describes negative feelings that are directed inwardly, such as worry, guilt,

sadness, and fatigue. The total CGSQ and its subscales demonstrated good internal consistency with Cronbach alpha coefficient for the entire scale .93 (Brannan & Heflinger, 1997).

Khanna, Madhavan, Smith, Tworek, Patrick and Becker-Cottrill (2012) aimed to test the psychometric properties of the CGSQ among caregivers of children with ASD, and validated this measure with the ASD population. Researchers used confirmatory factor analysis, and compared the one-factor (global caregiver strain), two-factor (objective and subjective strain), and three-factor (objective, subjective internalized, and subjective externalized strain) models. Khanna et al. (2012) found that the three-factor strain structure of CGSQ fitted better for caregivers' of children with ASD. The current study utilized only the eight items of the objective strain domain of the CGSQ with the highest means (Khanna et al., 2012). Because the subjective domains measures negative feelings internal the caregiver or toward the child, caregivers may not be willingly admit to on a self-report measure. For example, parents of children with ASD would rather display patience, compassion, and acceptance toward their child (Altiere & von Kluge, 2009) while feelings like anger, resentment, or embarrassment are not common among caregivers of children with ASD (Kirby, White, & Baranek, 2015).

Demographic Information Form. The original survey included information about the following caregiver and child characteristics: primary caregiver, child's age, child's sex, child's age when diagnosed, caregiver's relationship to child, caregiver's age, caregiver's sex, caregiver's level of education, and caregiver's marital status, and race/ethnicity. Demographic data analysis for the current study included child's sex, caregiver's relationship to child, caregiver's sex, caregiver's level of education, caregiver's marital status, and caregiver's race/ethnicity.

Data Analysis

Missing data analysis. We did not include respondent data with incomplete data, or with 20% or more missing data in important survey fields for the current study (survey questions from the CGSQ and the COPE Inventory). For surveys with less than 20% of missing data in important survey fields, we used item means to replace missing data across the CGSQ and the COPE. Using item means for handling missing data provides very good representations of the original data if both the number of respondents with missing items and the number of items missing for each scale were 20% or less (Downey & King, 1998).

Research question one (exploratory cluster analysis). We used SPSS version 22 to run the analyses. To determine if there were subgroups (clusters) of caregivers of children with ASD with similar coping strategies, we performed cluster analysis to identify classifications of caregivers' coping strategies as measured by the COPE Inventory. Cluster analysis identifies groupings of people that demonstrate similar characteristics in an analogous process (Portney & Watkins, 2015). First, we used mean scores from each COPE subscale (planning, suppression of competing activities, restraint, use of instrumental social support, use of emotional social support positive reinterpretation of growth, acceptance, religious coping, focus on and venting of emotions, denial, and substance use) to create coping strategies categories. Then, we used k-means cluster analysis of coping strategies categories to group caregivers based on their coping strategies. The k-means algorithm partitions the data field into nonempty, no overlapping regions so that points in different clusters are as widely separated as possible, whereas those in the same cluster are close together (Pelleg & Moore, 2000). To determine the number of clusters that best fit our data, we compared the results from two, three, four and five-cluster solutions on the number of participants in each cluster, the differences between COPE items in different clusters, and on the potential interpretation of caregivers' coping characteristics between clusters. We

used Bonferroni post hoc tests for multiple comparisons to evaluate differences between COPE items in the four clusters for cluster profile analysis, and to compare the four clusters on caregiver and child demographics.

Research question two (clusters differences on sense of strain). We first created a total objective strain subscale score for each caregiver. To determine if the clusters differed in objective strain, we performed ANOVA between the four-group cluster membership and the objective strain subscale total score. We used Bonferroni post hoc tests to evaluate differences between the four caregiver clusters on the total objective strain subscale score.

Results

Cluster Profile Analysis

We investigated results from two-five cluster analyses and ultimately selected the four-group cluster solution. The four-group cluster presented a reasonable distribution of participants across clusters (cluster n1= 89, n2= 79, n3= 54, n4= 51), comparisons between the four clusters showed significant differences in all COPE items, and the results of the cluster loadings demonstrated interpretable caregivers' characteristics between clusters (see Figure 1). Exploratory cluster analysis revealed four distinct caregivers' clusters (groups) with different combinations of coping strategies: Group one (Social-Supported/Planning), group two (Spontaneous/Reactive), group three (Self-Supporting/Reappraisal), and group four (Religious/Expressive). The cluster profile analysis showed that the caregivers in group one (Social-Supported/Planning) demonstrated significantly higher levels than the remaining three groups in the use of the following coping strategies: planning, use of instrumental social support, and use of emotional social support, relative to the other three groups (all $p < .05$). In contrast, caregivers in group three (Self-Supporting/Reappraisal) demonstrated significantly lower levels

of the use of instrumental social support and the use of emotional social support relative to the other three groups (all $p < .05$), while engaging more in acceptance (more than groups two and four, $p < .05$), and positive reinterpretation and growth (more than groups two and four, $p < .05$) coping strategies. Caregivers in group four (Religious/Expressive) demonstrated significantly higher levels of religious coping relative to the other three groups (all $p < .05$), and focus on and venting of emotions strategies (more than groups two and three, $p < .05$). Caregivers in group two (Spontaneous/Reactive) used less restraint relative to the other three groups (all $p < .05$), and less suppression of competing activities relative to the other three groups (all $p < .05$) as coping strategies. Also, group two showed significantly lower levels of religious coping as compared to the other three groups (all $p < .05$).

Clusters' Differences on Sense of Strain

ANOVA results showed no significant differences ($F = .01$, $p = .999$) between the four groups on the objective subscale strain scores.

Discussion

This study identified groups of caregivers of children with ASD that have distinct coping styles and compared these groups of caregivers on their sense of objective strain. Our findings showed that there were four distinct groups of caregivers of children with ASD with different coping styles: Social-Supported/Planning, Spontaneous/Reactive, Self-Supporting/Reappraisal, and Religious/Expressive coping styles. Each caregiver group engaged in a combination of coping strategies to overcome the strain of caregiving. Although we hypothesized that the four caregivers' groups would differ on their sense of strain, our findings showed no significant differences. It may be surprising that the groups with different combinations of coping strategies did not differ on objective strain as previous studies suggest that engagement in certain coping

strategies (i.e. social supports) reduces stress (Tway, et al., 2007) in comparisons to other coping strategies (i.e. passive re-appraisal) (McCammon, et al., 2009).

Caregivers with a Social-Supported/Planning coping style utilized planning, use of instrumental social support, and use of emotional social support as coping strategies more than the remaining three groups. Caregivers in this group also used positive reinterpretation and growth and acceptance coping strategies more frequently. It is possible that the social support received by caregivers in this group allowed for guidance and assistance in planning daily life. Or perhaps caregivers of children with ASD may benefit from extra time to plan therapy or family activities while other family members or friends care for their children with ASD. Social support is essential as caring for a child with an ASD can present intense and stressful challenges that tend to stretch the resources of the caregiver (Stuart & McGrew, 2009). In fact, evidence shows that higher utilization of social support is associated with significant decrease in individual and family stress (Khanna et al., 2011; Stuart & McGrew, 2009). Perhaps the high utilization of social supports by caregivers in this group helped them to effectively manage their stressors.

In contrast, caregivers with a Spontaneous/Reactive coping style engaged less in the use of instrumental social support and emotional social support as coping strategies. Further, caregivers in this group minimally utilized suppression of competing activities and restraint as coping strategies. Perhaps caregivers in this group have limited social systems of families and friends preventing their use of social coping strategies. Just as group one's strong social network may make it possible for them to plan, it could be that group two's limited social network makes it challenging to engage in a planning coping strategy. Suppression of competing activities and

using restraint coping strategies requires planning, so it is likely the low use of all three of these strategies is a fundamental feature of group two.

Caregivers in group two have developed skills to quickly respond to daily situations, with management skills to respond to situations without previous planning. Though caregivers in this study appear to have effective coping strategies to manage strain, literature suggests the long-term use of passive avoidant coping strategies increase stress, and mental and physical health (Stuart & McGrew, 2009). The spontaneous/reactive strategies utilized by group two may be considered passive and could have longer term implications, particularly for caregivers with younger children or a new diagnosis of ASD.

Caregivers of children with ASD in group three (Self-Supporting/Reappraisal) used less instrumental and emotional social coping strategies. While caregivers in this group limited their use of instrumental social support and their use of emotional social support, they focused on positive reinterpretation and growth and acceptance as coping strategies. Research shows that higher levels of problem-focused coping and lower levels of emotion-focused coping were associated with better caregiver wellbeing (Hastings et al., 2005; Smith, Seltzer, Tager-Flusberg, Greenberg, & Carter, 2008). Similar to group one (Social-Supported/Planning), caregivers in group three used a high level of planning coping strategies. The limited interaction with families and friends may have allowed caregivers in group three to have more time to reinterpret situations and learn from different experiences. Or, it might be that caregivers in this group are further along the journey of caring for a child with ASD, and therefore, they minimally seek advice from other family members or friends. Some children may receive their diagnosis earlier than others, so parents of children with the same age can be at different places on the “ASD journey”. This group may not use socialization opportunities to discuss coping with their child’s

condition; this group may not seek others' help as they become more familiar with their children's condition. Also, caregivers may fear negative responses from others as they seek social support (Pottie & Ingram, 2008).

Another coping style that emerged in this study was the Religious/Expressive coping style of group four. Caregivers in this group utilized religious coping much more than the remaining three groups, and combined this strategy with venting of emotions and suppression of competing activities as coping strategies. Although the use of denial as a coping strategy was relatively low among all groups, caregivers with Religious/Expressive coping style adopt denial at a significantly higher rate than other groups. It might be that this group's strong religious beliefs as a powerful coping strategy led them to be hopeful of improvement of their child's condition. Research suggests that religious coping may not result in better long-term outcomes for individuals with ASD (Khanna et al., 2011) when compared to task-oriented, or distraction coping (Lyons, Leon, Phelps, & Dunleavy, 2010), though caregivers in this group did not differ in caregiver strain from other groups in our analysis.

This study showed that caregivers of children with ASD may utilize differential combinations of coping strategies, and revealed the power of these combinations for managing the strain of caregiving. Findings may be particularly important for health care professionals to provide appropriate professional support and resources to caregivers of children with ASD. Results are also important to develop appropriate future caregiver interventions as this study captured homogeneity in utilizing certain coping strategies among the caregiver of children with ASD population. Future research is needed to investigate personal and contextual factors that predict the caregivers' adoption of different coping styles.

Limitations

While this study had a large sample size, the sample had limited diversity. Most caregivers reported their race/ethnicity as white, and that they were married. The limited diversity in these contextual factors may affect the generalizability of study results. Another limitation is using sections of the assessment tools, rather than the entire measures. While the study included items of the CGSQ and COPE that have good factor loading, the tools might be designed to for use as a whole. As we mentioned in our methods section, we included only the objective strain domain of the CGSQ as caregivers of children with ASD are less likely to report their bad personal feelings toward their child with ASD. While cluster analysis can reveal unique coping styles, it does not illustrate if caregivers have unique personal skills or contextual supports influencing their coping. Further investigation is warranted to determine what spontaneous techniques caregivers in group two utilize to manage strain.

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Table 1

Demographic Characteristics of the Sample

Child and Caregiver Demographic Characteristics		Participants N= 273
Primary Caregiver	Yes	271 (99.6%)
	No	1 (0.4%)
	Missing	1 (0.4%)
Child Gender	Male	209 (76.6%)
	Female	59 (21.6%)
	Missing	5 (1.8%)
Race	American Indian or Alaska Native	6 (2.2%)
	Asian	10 (3.7%)
	Black or African American	13 (4.8%)
	Hispanic or Latino	23 (8.4%)
	Native Hawaiian or Pacific Islander	2 (0.7%)
	White	238 (87.2%)
Caregiver Gender	Male	16 (5.9%)
	Female	249 (91.2%)
	Missing	8 (2.9%)
Caregiver Marital Status	Yes	225 (82.4%)
	No	46 (16.8%)
	Missing	2 (0.7%)
Caregiver Educational Level	Less than high school	5 (1.8%)
	High school	67 (24.5%)
	Associate degree	47 (17.2%)
	Bachelor degree	79 (28.9%)
	Master's degree	63 (23.1%)
	Doctoral degree	10 (3.7%)

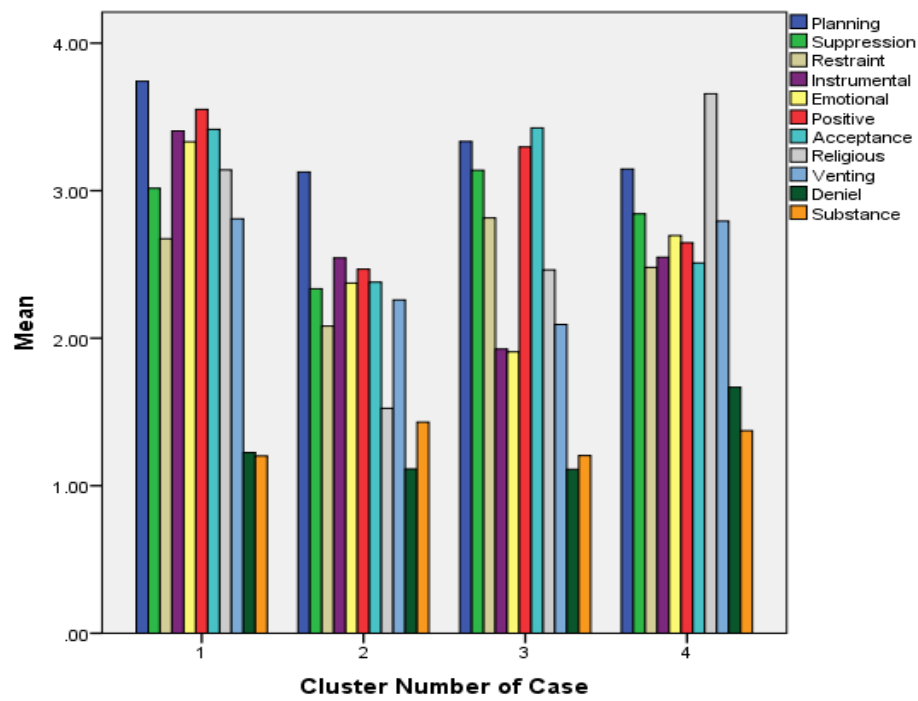
Table 2

One Way ANOVA with Post Hoc Tests:

Coping Strategy	Social-Supported / Planning	Spontaneous/ Reactive	Self-Supporting/ Reappraisal	Religious/ Expressive	F	p	Tukey's HSD
Planning	3.74	3.13	3.33	3.15	14.05	.000	1>2,3,4
Suppression of competing activities	3.02	2.34	3.14	2.84	22.41	.000	2<1,3,4
Restraint	2.67	2.08	2.81	2.48	13.16	.000	2<1,3,4
Instrumental use of social support	3.40	2.54	1.93	2.55	47.79	.000	1>2,3,4
Emotional use of social support	3.33	2.37	1.91	2.70	55.96	.000	1>2,3,4
Positive reinterpretation and growth	3.55	2.47	3.30	2.65	42.72	.000	3>2,4
Acceptance	3.42	2.38	3.43	2.51	39.93	.000	3>2,4
Religious coping	3.14	1.53	2.46	3.66	79.17	.000	4>1,2,3
Focus on and venting of emotions	2.81	2.26	2.09	2.79	19.38	.000	4>2,3
Denial	1.22	1.11	1.11	1.67	15.02	.000	4>1,2,3
Substance use	1.20	1.43	1.20	1.37	2.81	.04	

Figure 1

Comparison between Clusters on Mean COPE Categories



Chapter 4

EFFECTS OF SENSORY PROCESSING ON SOCIAL SKILLS AND PROBLEM
BEHAVIORS

By

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Summer 2017

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Effects of Sensory Processing Patterns on Social Skills and Problem Behaviors

Introduction

Social participation is an important daily life activity (Occupational Therapy Practice Framework: Domain and Process (3rd Edition), 2014). Children's participation in social opportunities with adults and peers affects their successful engagement in many other activities including learning and play (Harper, Symon, & Frea, 2008). In addition, social participation affects development of many skills including social and communication skills (Durlak, Weissberg, & Pachan, 2010). It is well documented in the literature that sensory processing affects daily life activities including social participation (Dunn, Little, Dean, Robertson, & Evans, 2016). Sensory processing patterns influence the acquisition and development of certain skills that are necessary for their successful participation. This study focused on how sensory processing patterns impacts children's social skills and problem behaviors related to overall social functioning.

Literature Review

Quality of social functioning refers to the child's ability to appropriately interact in social situations and may include children's levels of social skills and problem behaviors (Eisenberg, Pidada, & Liew, 2001). Social skills are the specific verbal and non-verbal behaviors that result in positive social interactions (Elliott & Gresham, 2008), like communication, empathy and self-control (Crosby, 2011). Research linked social skills in childhood to many outcomes including learning (Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008), peer relationships (Fox & Boulton, 2006), and play participation (Ingersoll & Schreibman, 2006). Problem behaviors (e.g., bullying and hyperactivity/ inattention) interfere with the acquisition or performance of socially appropriate behaviors (Crosby, 2011). There are many personal and contextual factors that

contribute to children's levels of social functioning; children's sensory processing ability is one important factor (Lane, Young, Baker, & Angley, 2010; Tomchek, Little, & Dunn, 2015).

Sensory processing refers to the way that the nervous system manages sensory stimuli to enable necessary adaptive responses for successful engagement in daily life activities (Miller & Lane, 2000). Dunn's sensory processing framework (Dunn, 2014) considers individuals' neurological thresholds, self-regulation strategies, and the interaction between thresholds and self-regulation strategies. Dunn's framework outlines four patterns of sensory processing: Registration, sensation seeking, sensory sensitivity, and sensation avoiding. *Registration* is a combination of low threshold and passive regulation strategies. People with registration sensory pattern –also called bystanders- miss sensory stimuli more than others. *Sensation seeking* is a combination of high threshold and active regulation strategies. People with seeking sensory pattern, or seekers, search for ways to get more sensory input. *Sensory sensitivity* is a combination of high threshold and passive regulation strategies. People with sensitivity sensory pattern, or sensors, detect sensory stimuli more than others. Lastly, *Sensation avoiding* is a combination of low threshold and active regulation strategies. People with avoiding sensory pattern or avoiders search for ways to reduce sensory input. The Sensory Profile (SP; Dunn, 1999, 2014) measures sensory processing based on Dunn's sensory processing framework. The SP allows care providers to understand children's sensory processing and how it affects children's participation at home and school (Dunn, 2014).

Sensory Processing and Socialization

Evidence has linked sensory processing to several social outcomes (Baker, Lane, Angley, & Young, 2008; Carr, Agnihotri, & Keightley, 2010; Dean, Tomchek, Dunn, & Little, 2016; Hilton, Graver, & LaVesser, 2007; Lane et al., 2010; Liss, Saulnier, Fein, & Kinsbourne, 2006;

Tomchek et al., 2015; Watson et al., 2011). However, studies in this area have utilized a variety of sensory and social measures leading to variable results. Some investigators used the short version of the SP (McIntosh, Miller, Shyu, & Dunn, 1999) and the Vineland Adaptive Behavior Scales (Sparrow, Balla, Cicchetti, Harrison, & Doll, 1984) to uncover associations between certain sensory and social functions. For example, Baker et al. (2008) reported that less overall sensory processing function (i.e., lower SSP total score) was associated with low social relating and increased maladaptive behavior. Further, specific sensory functions (i.e., movement sensitivity, auditory filtering, under-responsive/ seeks sensation, and low energy/weak), were associated with maladaptive behavior (Baker et al., 2008). Similarly, Lane et al. (2010) found that movement sensitivity and auditory filtering were associated with the maladaptive behavior, while Carr et al. (2010) found associations between low energy/weak sensory function and the adaptive behavior composite.

While the SP is the most widely used tool to measure sensory processing (Ben-Sasson, Hen, Fluss, Cermak, Engel-Yeger, & Gal, 2009), some studies used other sensory measures to investigate the influence of sensory processing on social outcomes. For example, Liss et al. (2006) used the Sensory Questionnaire, and found that over-reactivity (avoiding) was associated with lower levels of the socialization domain of the Vineland Adaptive Behavior Scales, while under-reactivity (registration) and seeking was associated with maladaptive behavior. In contrast, Watson et al. (2011) reported that hypo-responsiveness (under-reactivity) was associated with lower levels of socialization. In Watson et al. (2011), researchers utilized four different sensory measures –including SP- to characterize children’s sensory responses, which may have contributed to the contradictory results.

Though many investigators have utilized the Vineland Adaptive Behavior Scales as a primary measure of social functioning, other social outcome measures have explored relationships with sensory processing. For example, lower levels of social competence (i.e., social awareness, social cognition, social communication, social motivation, and autism mannerisms), as measured by the Social Responsiveness Scale (Constantino & Gruber, 2007), were associated with all SP patterns (seeking, avoiding, sensitivity and registration) (Hilton et al., 2007). In addition lower levels of social behavior, as measured by retrospective chart review, was associated with seeking/ distractibility sensory function (Tomchek et al., 2015).

To further understand how sensory processing influences social functioning, investigators provided predictive models which uncovered the effect of sensory processing on maladaptive behavior in children (Dean et al., 2016; Lane et al., 2010, and Tomchek et al., 2015). While some research measured maladaptive behavior within an overall outcome measure of social functioning (e.g., both Lane et al., 2010, and Tomchek et al., 2015), Dean et al. (2016) specifically looked at challenging behaviors using the Behavior Assessment System for Children (Reynolds, 2004). Dean et al. (2016) included two dimensions of challenging behavior: Externalizing (i.e., responding outwardly) and internalizing (i.e., responding inwardly). In this study, both avoiding and sensitivity predicted externalizing behaviors (e.g., hyperactivity, aggression, and conduct problems).

Most evidence about the influence of sensory processing on social functioning is limited to children with conditions including ASD or other developmental disorders (Carr, et al., 2010; Hilton et al., 2007; Lane et al., 2010; Liss, et al., 2006; Tomchek et al., 2015; Watson et al., 2011). Though children with specific conditions may have similarities in sensory processing, they may also have differences (Ben Sasson et al., 2009). Only one study sampled the general

population which included typical children and children with conditions (Dean et al., 2016), focusing on shared sensory patterns rather than sensory patterns specific to those with conditions. Also, most evidence in this area measured social functioning using an adaptive behavior measure, with only one study focused on social competence (Hilton et al., 2007). To our knowledge, no evidence has specifically investigated the associations between the social skills aspect of social functioning and sensory processing. It is noteworthy to differentiate between social skills and social competence. While social skills are behaviors that an individual exhibits, social competence is an evaluative term based on judgments that an individual has performed a social task adequately (Gresham, Elliott, Cook, Vance, & Kettler, 2010).

This study built on the emerging evidence regarding the effects of sensory processing on children's social functioning. This study is novel in focusing on the social skills aspect of social functioning and how sensory processing affects social skills in children with and without conditions. This study built on Dean et al. (2016) research by examining additional dimensions of problem behaviors (bullying and hyperactivity/inattention). We aimed to answer the following research question: How do sensory processing patterns predict children's social skills and problem behaviors?

Methods

Design

This study utilized a retrospective cross-sectional survey design to examine the extent to which sensory processing patterns predict children's social skills and problem behaviors.

Procedures

Caregivers who agreed to participate in the Sensory Profile 2nd Edition (SP2; Dunn, 2014) standardization study completed the Child Sensory Profile 2 (CSP2; Dunn, 2014) and the

Social Skills Improvement Systems-Rating Scales/Parent Form (SSIS-RS/PF; Elliott & Gresham, 2008). The SP2 standardization study was approved by the institution's Internal Review Board. Caregivers provided child and family demographic information through both study measures, and through a demographic information form.

Participants

The sample for this study consisted of 53 children with age range 3-14 years. Researchers in the SP2 standardization study sampled children from the general population including children with typical development and children with conditions. In this study, the sample included 45 children with typical development, and eight children with medical or learning conditions. Eighty one percent of caregivers reported not receiving any educational or medical services to support the child or family, and 93% reported not taking any medication. Table one shows additional demographic characteristics of the sample.

Materials/Instrumentation

The Child Sensory Profile 2 (CSP2; Dunn, 2014) is an 86-item caregiver report questionnaire designed to measure sensory processing in children aged 3-14 years. This measure provides scores for four sensory processing quadrants (Registration, Seeking, Sensitivity, and Avoiding), six sensory sections (auditory, visual, touch, movement, body position, and oral), and three behavioral sections (conduct, social-emotional, and attentional). The CSP2 includes a six-point Likert scale to identify how often children engaged in certain behaviors related to their sensory preferences (5= almost always, 4= frequently, 3= half the time, 2= occasionally, 1= almost never, and 0= does not apply). Higher quadrants' or sections' scores indicate more frequent behaviors related to these quadrants or sections, whereas lower scores indicate less

frequent behaviors. The SP2 shows strong internal consistency (Cronbach's $\alpha = 0.88\text{--}0.92$) and test-retest reliability ($r = 0.96\text{--}0.97$). The CSP2 can be administered in fifteen to twenty minutes.

The Social Skills Improvement System-Rating Scales/ Parent Form (SSIS-RS/PF; Elliott & Gresham, 2008) is a 79-item caregiver report questionnaire designed to measure social skills and problem behaviors in children aged 3-18 years. This measure provides scores for seven Social Skills domains (Communication, Cooperation, Assertion, Responsibility, Empathy, Engagement, and Self-Control), and four Problem Behaviors domains (Externalizing, Bullying, Hyperactivity/ Inattention, and Internalizing (see Appendix A). The measure includes a four-point Likert scale to identify how often children engaged in certain behaviors related to socialization (0= never, 1= seldom, 2= often, and 3= almost always), and a three-point Likert scale to identify the degree to which certain behaviors are important (n= not important, i= important, and c= critical). Internal consistency of social skills and problem behavior domains ranged between .70 and upper .90s (Elliott & Gresham, 2008). The SSIS can be administered in fifteen to twenty five minutes.

In the current study, we utilized standard scores for the social skills and problem behaviors scales. The Standard score indicates the position of a child's raw score in relation to the distribution of raw scores in the normative group (Elliott & Gresham, 2008). We also utilized behavior levels (1= below average, 2= average, and 3= above average) for the social skills and problem behaviors domains or sub-scales.

Demographic information forms. Both the CSP2 and the SSIS-RS/PF gathered demographic information (age, gender, school grade, caregiver relationship to child) as part of completing these measures. Researchers in the SP2 study collected additional caregiver reported

demographic information regarding caregiver's educational level, child race/ethnicity, caregiver and child services, child diagnosis or condition, and medication.

Data Analysis

Descriptive statistics. This study utilized the Statistical Package for Social Sciences (SPSS) version 22.0 to perform all data analyses. To understand our sample's levels of sensory processing, we created ranks among the CSP2 quadrant summary scores (1= much less than others, 2= less than others, 3= just like the majority of others, 4= more than others, and 5= much more than others). We also created ranks among social skills and problem behaviors scales' standard scores (1= below average, 2= average, and 3= above average). We referred to the CSP2 and the SSIS-RS/PF manuals to calculate the rankings. We ran analysis of frequencies using the CSP2 quadrant ranks, and the SSIS scales' ranks. We also ran frequencies for sample demographics.

Spearman rank-order correlations. For detailed interpretations about the associations between the four sensory processing quadrants and the specific social skills and problem behaviors domains, we ran Spearman rank-order correlations between the CSP2 quadrant summary scores, and the SSIS-RS/PF standard scale scores, and sub-scales behavior levels for social skills and problem behaviors.

Multiple linear regression. We aimed to investigate how sensory processing patterns predict social skills and problem behaviors aspects of social functioning. To best understand our outcomes or dependent variables (social skills and problem behaviors) separately, we ran two multiple linear regression models using the four sensory processing quadrants as our predictors or independent variables.

Canonical correlations. Our sample size allowed us to include the social skills and problem behaviors standard scale scores in the regression analyses. To investigate the influence of sensory processing patterns on specific social skills (e.g., Communication, Empathy) and problem behaviors (e.g., Externalizing, Bullying) domains, we ran two canonical correlation models between (a) the set of sensory processing and the set of social skills variables, and (b) the set of sensory processing and the set of problem behaviors variables, respectively. While multiple regression is capable of handling only a single dependent variable, canonical correlation creates a composite measure (canonical variate) of our dependent variable (social skills) that consists of multiple dependent variables (social skills domains). It also creates a canonical variate of the set of independent variables (the four sensory processing quadrants). These two canonical variates represent the optimal linear combinations of the dependent and independent variables (Hair, Black, Babin & Anderson, 2010). In both models, we used sensory processing quadrant summary scores, and social skills and problem behaviors sub-scales' behavior levels.

Results

Appendix B presents results of the descriptive statistics and Spearman rank-order correlation analyses. We utilized multiple linear regression and canonical correlation to investigate how sensory processing patterns predicted social skills and problem behaviors.

Multiple Linear Regression

The first model (social skills outcome and sensory processing patterns predictors) accounted for 25% of variance in social skills ($F [4, 49] = 5.418, p < .001$), with Avoiding having significant negative partial effects ($\beta = -.723, p = .006$). The second model (problem behavior outcome and sensory processing patterns predictors) accounted for 42% of variance in problem

behaviors ($F[4, 49] = 10.532, p < .000$). While the second model was highly significant in overall, none of the sensory processing patterns had significant partial effect (see Table 2 and 3).

Canonical Correlation

Our regression results added evidence for conducting the canonical correlation analyses. Both models do not predict which social skills or problem behaviors domains accounted for overall significance in these models. Therefore, we performed canonical correlation analysis to determine the relationships between the set of sensory processing variables and the set of social skills variables. We performed another canonical correlation analysis for the set of problem behaviors with the set of sensory processing variables. The first canonical correlation model (sensory processing and social skills) yielded four functions with squared canonical correlations (Eigenvalues) of .525, .400, .165, and .054 for each successive function. Overall, the full model across all functions was statistically significant using the Wilk's Test (Wilks's $\lambda = .382, F(28, 156.46) = 1.712, p = .021$). The full model, with sensory processing quadrants' set as factors, explained about 62% of the variance in social skills.

Only the first function was significant with canonical correlation coefficient .725 suggesting a strong canonical relationship (Hair, et al., 2010). The canonical variate for the set of sensory processing patterns extracted 50% of the variance from the sensory processing patterns variables and 17% of the variance from the social skills variables. The canonical variate for the set of social skills extracted 29% of the variance from social skills variables and 10% of the variance from the sensory processing patterns variables. Canonical weights and loadings indicated the important variables in both canonical models (see Table 4 and Figure 1). Because there are limitations in interpreting canonical weights (Hair, et al., 2010), we focused our interpretations on canonical loadings. Given the negative correlations between sensory

processing variables and their variate, and the positive correlations between social skills variables and their variate, the canonical function indicated a general negative association between sensory processing and social skills. We considered loadings more than or equal to .7 as strong correlations. In summary, sensory processing patterns (strong correlations with seeking and avoiding, and moderate correlations with registration) were negatively associated with social skills (strong correlations with cooperation and responsibility, and moderate correlations with communication and engagement).

The second canonical correlation model (sensory processing and problem behaviors) yielded four functions with Eigenvalues of .749, .141, .077, and .003 successively. The full model was statistically significant (Wilks's $\lambda = .464$, $F[16, 141.17] = 2.525$, $p = .002$). The full model, with sensory processing quadrants' set as factors, explained about 54% of the variance in problem behaviors. Only the first function was significant with canonical correlation coefficient .866 suggesting a strong canonical relationship. The canonical variate for the set of sensory processing patterns extracted 71% of the variance from the sensory processing patterns variables and 30% of the variance from the social skills variables. The canonical variate for the set of problem behaviors extracted 52% of the variance from problem behaviors variables and 22% of the variance from the sensory processing patterns variables. Table five and Figure two presented canonical weights and loadings of the sensory processing and problem behaviors canonical model. In summary, all sensory processing patterns were positively associated with problem behaviors (strong correlations with hyperactivity/inattention and internalizing, and moderate correlations with externalizing).

Discussion

Our study investigated how sensory processing patterns predicted social skills and problem behaviors in children from the general population including typical children and those with conditions. Previous studies in this area sampled children with ASD and other developmental conditions. Given that most resources and interventions are targeted toward children with conditions and their families (Individuals with Disabilities Education Act, 2004) and knowing that typical children may also demonstrate sensory patterns similar to children with conditions (Little, Dean, Tomchek, & Dunn, 2017), typical children may not receive adequate support during daily activities that match their sensory preferences. This study provided novel findings in relation to how sensory processing affected socialization in the general population of children.

In the current study, we utilized multiple linear regression models to investigate how different sensory processing patterns predicted social skills and problem behaviors. Results from the social skills model showed that sensory avoiding predicted lower social skills levels. The problem behaviors model showed that the four sensory processing patterns collectively predicted problem behaviors' levels (indicated by the highly significant overall model) but none of these patterns was a significant contributor. In light of the social skills model, our results suggested that being sensory avoiding may limit the development of social skills. In looking for ways to reduce sensory input, children who are sensory avoiding may withdraw from social situations impeding their opportunities to learn and practice positive social behaviors. Our findings differ from previous research that suggested sensory seeking children demonstrated lower social skills (i.e., receptive language) (Tomcheck et al.). Researchers proposed children with sensory seeking may miss language input from caregivers and peers due to their interest in sensory elements in their environment. Both sensory seeking and avoiding are active responding strategies, so our

results contribute to findings by Tomchek et al. (2015). Results suggest by engaging in sensory patterns that involve actively looking for ways to intensify (seeking) or limit (avoiding) sensory experiences, children may have fewer opportunities to engage in social situations. Social participation promotes the development of many social and communication skills (Durlak, et al., 2010), and missing these opportunities may negatively impact social functioning.

Consistent with previous reports (Dean et al., 2016; Lane et al., 2010), our study showed that increases in sensory processing patterns predicted higher levels of problem behaviors. While these reports suggested that sensitivity (Dean et al., 2016; Lane et al., 2010) and avoiding (Dean et al., 2016) contributed to problem behaviors, our results did not show which sensory patterns contributed to the significant problem behaviors model. Conceptually, sensory processing patterns are distinct from each other, and identify different combinations of sensory threshold levels and behaviors as reactions to these thresholds (Dunn, 2014). In our study, we utilized multiple linear regressions which allowed us to include all four sensory processing patterns as our predictors based on the conceptual understanding of sensory processing patterns. One possible explanation that none of the predictors were significant while the overall model was highly significant is including predictors from one measure (Zilvinskis, Masseria, & Pike, 2015). We included the four sensory processing quadrants, measured by the SP2, and these quadrants were themselves correlated. Because there was overall significance in the problem behaviors model, but none of the four patterns were significant, we considered canonical correlations to determine which specific social skills or problem behavior domains contributed to the overall significance. Canonical correlations provide greater detail about the influence of specific sensory patterns for the social skills model. It is an appropriate analysis when examining the relationships

between two sets of measures, and the measures within sets are themselves correlated (Zilvinskis, et al., 2015).

In our two canonical correlations models, results showed strong relationships between sensory processing patterns, and social skills and problem behaviors domains respectively. Important findings from the social skills model suggested that mostly seeking and avoiding from the sensory processing set, and mostly cooperation and responsibility from the social skills set contributed to the strong negative relationship between sensory processing and social skills. Our results were consistent with previous research that found negative relationships between sensory processing and social outcomes (e.g., Hilton et al., 2006; Liss et al., 2006; Watson, et al., 2011). While Liss et al. (2006) and Watson et al. (2011) showed that hypo-responsivity (registration) and seeking were associated with lower social outcomes, we also showed that avoiding was related to lower social skills. As we suggested in our social skills regression model, avoiding social situations may limit the development of social skills.

As for why sensitivity had moderate to low negative correlation in our model, we assume that this is because children who are sensory sensitive have passive self-regulation strategies (Dunn, 2014). While those children notice more sensory input than others, they are passive, and thus care-providers may not notice if they dislike being in certain social activities. Instead of withdrawing from sensory stimuli, like children with sensory avoiding, children with sensory sensitivity stay in situations and react to what is happening (Dunn, 2001). For example, children with sensory sensitivity may startle easily when adults or peers get too close, but do not move away like children who are sensory avoiding. It is also possible that children with sensory sensitivity are highly motivated to participate in certain social activities, or want be accepted within their peer group, and therefore, they engage in social situations regardless of their comfort

level (being in a sensory rich environment). Research highlights the importance of social belonging, and how children and adolescents are motivated to be accepted with their peer group (Booker, 2007; Ullrich-French, & Smith, 2009). Research also linked acceptance by one's peers to higher levels of social skills and social problem-solving (Pakaslahti, Karjalainen, & Keltikangas-Jaervinen, 2002). These might be reasons why sensitivity had lower influence in the social skills model than the remaining sensory patterns.

While previous research linked sensory processing to lower levels of socialization (Hilton et al., 2006; Liss et al., 2006; Watson, et al., 2011), studies did not show what specific social skills were mostly related. Our results added to previous research by suggesting that cooperation and responsibility are the social skills domains that might be most associated with differences in sensory processing. Given the importance of these skills within everyday activities for all children adds to the importance of our results. Cooperation and responsibility are critical social skills for children to learn and integrate in social and academic activities (Brock, Nishida, Chiong, Grimm, & Rimm-Kaufman, 2008). Care-providers devote time and effort to teach children to be self-reliant, responsible, and to do things cooperatively (Ochs, & Izquierdo, 2009). These skills are found to be essential at home and in the community. Research linked self-regulation factors to children's social competence and problem behaviors (Smith-Donald, Raver, Hayes, & Richardson, 2007). Because children's sensory processing preferences include their self-regulation strategies, it is reasonable that social skills requiring self-regulation (e.g., cooperation and responsibility) were most strongly associated with sensory processing. Cooperation and responsibility require responding to social situations that may not match children's sensory preferences, for example, cooperating with peers and teachers in the classroom, and being responsible of doing chores at home.

Considering findings from the problem behaviors canonical model, all sensory processing patterns, and mostly internalizing and hyperactivity/ inattention contributed to the strong positive relationship between sensory processing and problem behaviors. Our results were consistent with previous research (e.g., Baker et al., 2008; Lane et al., 2010) that found associations between sensory processing and maladaptive behavior. It is important to note that literature showed variable results in regards to which sensory patterns are associated with problem behaviors. For example, hypo-responsivity (registration) and seeking (Baker et al., 2008); sensitivity (Dean & Dunn, 2016; Lane et al., 2010) and avoiding (Dean & Dunn, 2016) were all found to influence problem behaviors. Perhaps because researchers used different measures, results show sensory processing and problem behaviors are related but are unable to explain how. Also, regardless of children's sensory processing patterns, perhaps care-providers easily notice problem behaviors as they reflect negative aspects of children's social functioning. Care-providers feel compelled to correct problem behaviors, which takes more of their time and energy than developing functional social behaviors. However, evidence suggests building on children's strength rather than focusing on their weaknesses requires minimal time and cost (Bellini & McConnell, 2010), and improves parents' outcomes (Steiner, 2011). Supporting care-providers to develop functional social behaviors may reduce the need to correct problem behaviors.

Our finding that internalizing and hyper-activity/ inattention were mostly associated with sensory processing strengthens our suggestion that problem behaviors occupy care-providers' attention and intervention. Because internalizing and hyperactivity/ inattention affect children themselves while externalizing and bullying affect their peers, interventions may not be devoted toward internalizing and hyperactivity/ inattention. Evidence recognizes the negative effects of externalized problem behaviors on children's mental health (Aluede, Adeleke, Omoike, & Afen-

Akpaida, 2008; Crosby, 2011). Many schools have “no bullying” policies and have developed school-wide interventions to address bullying as a problem behavior (Limber & Small, 2003). Perhaps the emphasis on externalizing and bullying has led to effective management for these behaviors (Malti, Ribeaud, & Eisner, 2011), while less dangerous problem behaviors (e.g., internalizing and hyperactivity/inattention) are not effectively addressed. Our results highlighted the importance of considering internalizing and hyperactivity/ inattention behaviors as these problem behaviors may be less apparent.

Strengths and Limitations

It is important to highlight that our sample is different from previous literature regarding sensory processing and social skills/problem behaviors. While numerous studies found associations between sensory processing and social functioning in children with conditions, it is also important to study typical children who may have extreme patterns of sensory processing. Therefore, it is strength for our study that we included a sample drawn from the general population of children. It is also strength that we used the Sensory Profile 2 to measure sensory processing, and the SSIS to measure social skills. Because the Sensory Profile is widely used in research and practice, our results might be more applicable to researchers, therapists and care-providers. Additionally, The SSIS measured several social skills domains that were not previously addressed in literature. While our sample size limited the number of variables we were able to include in the regression models, we addressed this limitation by further conducting canonical correlations. Both analyses enabled us to thoroughly answer our research question.

Similar to many data gathering methods, retrospective analyses have both advantages and disadvantages. Because the data was not initially gathered to answer our research question, analysis was limited by use of behavior levels for social skills and problem behaviors domains.

Using rank scores rather than total scores limits variability which may have influenced our results.

Conclusion

This study concludes that sensory processing predicts social skills and problem behaviors. Also, different sensory processing patterns are associated with specific social skills and problem behaviors domains. Therefore, it is important to consider sensory processing preference when working with children with or without conditions at home, school or in the community.

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Table 1

Demographic Characteristics of the Sample

Characteristics		54
Gender	Male	29
	Female	25
Age Group	3-6 years	20
	6-10 years	20
	10-14 years	14
School Grade	Preschool-2 nd	23
	3 rd -6 th	15
	7 th -9 th	8
	Missing	8
Race/Ethnicity	African American	8
	Hispanic	14
	White	19
	Other	13
Parental Education Level	No high school, diploma, GED, or equivalent	4
	High school graduate, GED, or equivalent	19
	Some college or technical school	18
	Four-year degree or higher	13

Table 2

Multiple Linear Regression Model 1: Predicting Social Skills

Predictor	B	β	p
Registration	-.408	-.308	.268
Seeking	.231	.177	.426
Sensitivity	.530	.407	.105
Avoiding	-.957	-.723**	.006
Adjusted R ²	.250		
F	5.418**		

* $p \leq .05$. ** $p < .01$

Table 3

Multiple Linear Regression Model 2: Predicting Problem Behaviors

Predictor	B	β	p
Registration	.504	.393	.111
Seeking	.324	.256	.193
Sensitivity	-.183	-.145	.509
Avoiding	.260	.203	.361
Adjusted R ²	.418		
F	10.532**		

* $p \leq .05$. ** $p < .01$

Table 4

Canonical Correlation Model 1: Sensory Processing and Social Skills

Two Canonical Variate Sets	Significant Canonical Function (Function 1 to 4)	
Sensory Processing Set	Weights	Loading
Registration	.156	.689
Seeking	.905	.861
Sensitivity	-.980	.450
Avoiding	.731	.756
Redundancy Index	.171	
Social Skills Set		
Communication	.005	-.609
Cooperation	-.688	-.707
Assertion	-.182	-.385
Responsibility	-.442	-.704
Empathy	.966	-.168
Engagement	-.703	-.533
Self-Control	.186	-.411
Redundancy Index	.098	
Wilks	.382	
<i>P</i>	.021	
Eigenvalue	.525	
Canonical Coefficient	.725	

Table 5

Canonical Correlation Model 2: Sensory Processing and Problem Behaviors

Two Canonical Variate Sets	Significant Canonical Function (Function 1 to 4)	
Sensory Processing Set	Coefficient	Loading
Registration	-.620	-.901
Seeking	-.028	-.793
Sensitivity	.547	-.711
Avoiding	-.856	-.944
Redundancy Index	.304	
Problem Behaviors Set		
Externalizing	.130	-.683
Bullying	-.195	-.499
Hyperactivity/ Inattention	-.522	-.810
Internalizing	-.670	-.849
Redundancy Index	.224	
Wilks	.464	
<i>P</i>	.002	
Eigenvalue	.749	
Canonical Coefficient	.865	

Figure 1

Canonical Correlation Model 1: Sensory Processing and Social Skills

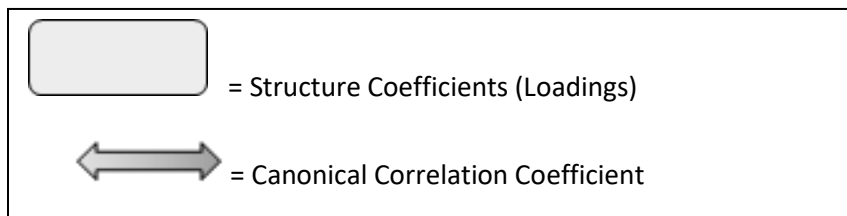
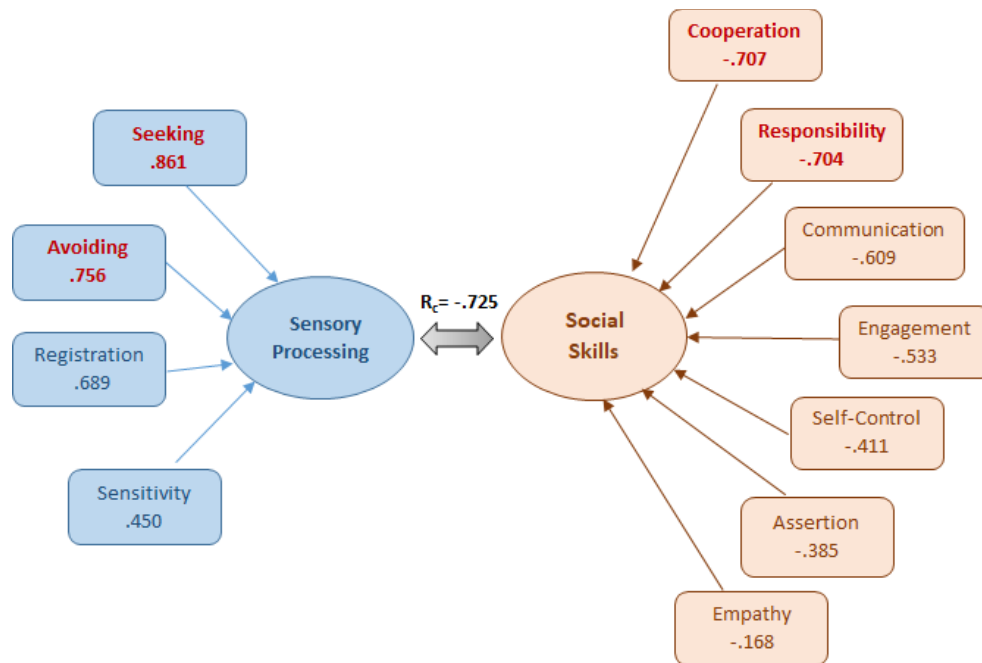
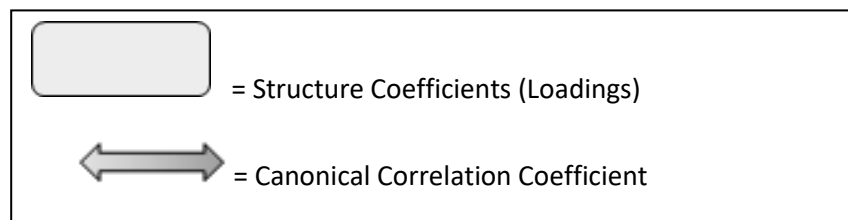
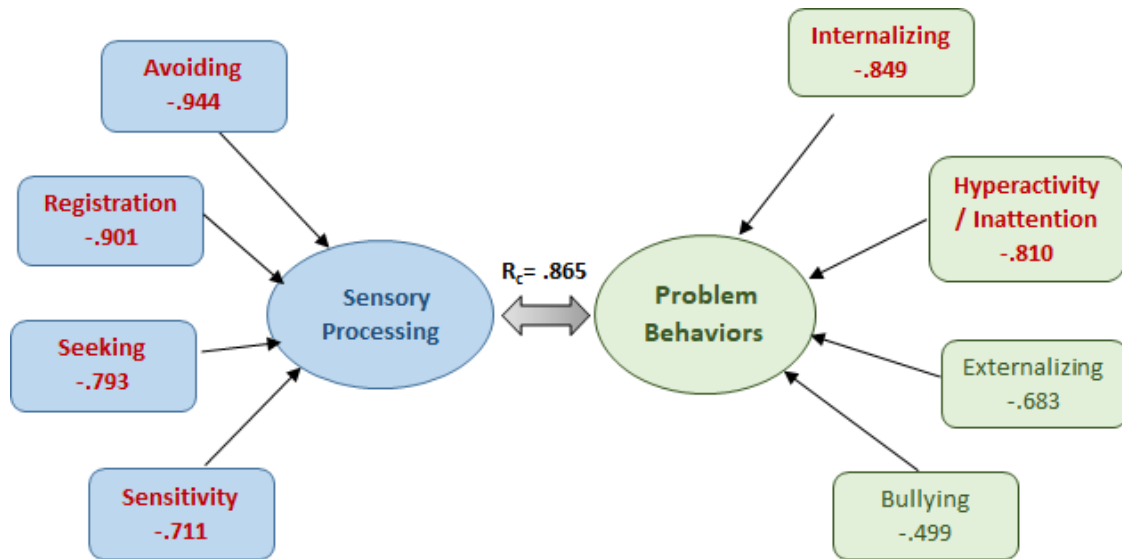


Figure 2

Canonical Correlation Model 2: Sensory Processing and Problem Behaviors



CONCLUDING THOUGHTS

My dissertation research concludes that sensory processing predicts social skills and problem behaviors. Also, different sensory processing patterns are associated with specific social skills and problem behaviors domains. The research I have pursued during my doctoral program supports my firm belief that sensory processing is an essential and central component of daily activities. Therefore, it is important to consider sensory processing preferences when working with children with or without conditions at home, school or in the community.

Implications for Practice

There are many potential practical implications from my research. I found that engaging in sensory avoiding behaviors limits children's social skills' development. I also found that children's sensory preferences are related to their social skills and problem behaviors. Considering that children who are sensory avoiding prefer routine activities with predictable sensory experiences, care-providers may design interventions within everyday routines. For example, parents may practice social skills during family dinner or when visiting friends with whom their children are familiar. Also, care-providers at schools may design the classroom environment and modify learning activities based on children's sensory preferences. Evidence shows the effectiveness of providing learning opportunities in the classroom for improving self-regulation and decreasing problem behaviors (Blackwell, Yeager, Mische-Lawson, Bird, & Cook, 2014). Blackwell et al. (2014) found that class wide intervention teaching self-regulation improved children's social functioning. All children received the intervention, regardless of condition/diagnosis, which was a critical component of the intervention. Teachers may target

social skills and problem behaviors for all children in everyday classroom activities like circle time or free play. For example, taking turns during these activities, and being responsible for doing classroom chores and returning toys materials back are positive social skills that children develop in school. By providing opportunity to develop positive social skills, problem behaviors, such as externalizing or bullying, may be minimized (Simonsen, Fairbanks, Briesch, Myers, & Sugai, 2008).

Future Research

My dissertation research investigated how sensory processing patterns predicted social skills and problem behaviors. Evidence regarding this topic with typical children is scarce. Children without conditions or with undiagnosed conditions, may not qualify for intervention services leaving them with unmet needs. Therefore, future research should sample children from the general population, and utilize more rigorous methods. Future research should investigate the effectiveness of interventions, based on children's sensory processing preferences rather than diagnosed conditions, to enhance social skills and reduce problem behaviors for all children at home, school and community.

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Appendix

Additional Data Analyses for Learning Purposes

CSP2 Quadrants' Summary Scores Mean and Standard Deviation Compared to Normal Range in Dunn (2014)

	Mean	SD	Normal Range
Registration	33.189	12.782	19-43
Seeking	34.811	13.022	20-47
Sensitivity	30.925	12.879	18-42
Avoiding	34.094	12.742	21-46

Frequencies of the Sensory Quadrants' Levels

Sensory Quadrant	Level	Frequency	Percent
Registration	Much less than others	1	1.9
	Less than others	2	3.7
	Just like the majority of others	41	75.9
	More than others	8	14.8
	Much more than others	2	3.7
Seeking	Much less than others	5	9.3
	Less than others	38	70.4
	Just like the majority of others	8	14.8
	More than others	3	5.6
	Much more than others	5	9.3
Sensitivity	Much less than others	1	1.9
	Less than others	4	7.4
	Just like the majority of others	42	77.8
	More than others	4	7.4
	Much more than others	3	5.6
Avoiding	Much less than others	1	1.9
	Less than others	4	7.4
	Just like the majority of others	41	75.9
	More than others	6	11.1
	Much more than others	2	3.7

Frequencies of the Social Skills and Problem Behaviors Levels

Scale	Behavior Level	Score	Frequency	Percent
Social Skills	Below Average	<85	10	18.5
	Average	85-115	37	68.5
	Above Average	>115	7	13
Problem Behaviors	Below Average	<85	8	14.8
	Average	85-115	34	63
	Above Average	>115	12	22.2

Correlations between Sensory Processing Quadrants and Social Skills Domains

	Registration	Seeking	Sensitivity	Avoiding
Social Skills	-.369**	-.297*	-.358**	-.405**
	.006	.029	.008	.002
Communication	-.378**	-.329*	-.350**	-.453**
	.005	.015	.009	.001
Cooperation	-.345*	-.349*	-.339*	-.402**
	.011	.010	.012	.003
Assertion	-.133	-.141	-.099	-.157
	.336	.308	.479	.257
Responsibility	-.292*	-.328*	-.252	-.346*
	.032	.016	.067	.010
Empathy	-.098	.020	-.217	-.171
	.482	.888	.115	.217
Engagement	-.191	-.144	-.149	-.277
	.167	.299	.283	.043*
Self-Control	-.295*	-.222	-.297*	-.386**
	.030	.107	.029	.004

*p<.05. **p<.01.

Correlations between Sensory Processing Quadrants and Problem Behaviors Domains

	Registration	Seeking	Sensitivity	Avoiding
Problem Behaviors	.545**	.569**	.525**	.552**
	.000	.000	.000	.000
Externalizing	.388**	.386**	.258	.367**
	.004	.004	.060	.006
Bullying	.340*	.299*	.262	.236
	.012	.028	.056	.086
Hyperactivity/Inattention	.490**	.399**	.380**	.448**
	.000	.003	.005	.001
Internalizing	.360**	.378**	.339*	.476**
	.008	.005	.012	.000

*p<.05. **p<.01.