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Sensory Processing and the Self Care Task of Eating in Children with Autism

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SENSORY PROCESSING AND THE SELF CARE TASK OF EATING IN CHILDREN WITH AUTISM

A Dissertation Presented

by

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DEDICATION

This dissertation is dedicated to the memory of Dr. Jane Koomar, Ph.D, OTR/L, FAOTA, an inspirational and talented occupational therapist, teacher and researcher. She never knew how much her support, time and help meant to me. Her willingness to sign on as one of my dissertation committee members was the vote of confidence I needed to tackle this project. My regret is she was unable to see the project to completion but I hope she would be pleased with the results of the finished product. I am sure she would be pleased to see the work of Dr. Jean Ayres continued and furthered developed.

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ABSTRACT

SENSORY PROCESSING AND THE SELF CARE TASK OF EATING IN CHILDREN WITH AUTISM

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The incidence of autism has increased from an average of one in 88 to one in 110 (Center for Disease Control, 2010; ADDM Network, 2012). Autism spectrum disorders are an important health and educational problem affecting many areas of daily living, (CDC, 2012; Cermak, S., et al, 2010). Over 80 percent of children diagnosed with autism demonstrate sensory modulation symptoms and related behaviors such as sensory seeking, sensory avoiding, self-stimulation, etc, (Kintwell, et al, 2011; Ben-Sasson, et al, 2009; Tomchek & Dunn, 2006).

There is some beginning evidence found in the literature that sensory processing of children on the autism spectrum interferes with their daily routines (Nadon, et al, 2011; Stein, et al, 2011/2012; Schaff, et al, 2011), and there is a paucity of research which addresses the impact sensory processing has on the daily routine of eating. This study will contribute to this expanding body of knowledge.

Eating difficulties are a frequent problem for children on the autism spectrum (Nadon, et al, 2011; Schreck & Williams, 2006) which impacts their physical health (Lukens & Linscheid, 2008), their functioning in the family (Schaff, et al, 2001) and their functioning in educational settings (Koenig & Rudney, 2010). This study assesses the differences in sensory processing and eating problem behaviors between two groups of children, aged 5 -12 years, those identified on the autism spectrum (N=34) and those typically developing (N=34).

Data was collected through parent and child questionnaires that assessed sensory processing and eating behaviors (BAMBI, Short Sensory Profile, Sensory Eating Checklist, and Touch Inventory for Elementary-Aged Children). Results of the t test, anovas and correlation analyses revealed statistically significant differences on all measures between both samples ($p<.001$) and demonstrated a moderate to strong positive correlation between eating problem behaviors and sensory processing difficulties with correlation coefficients ranging from .548-.947. This study provides preliminary data supporting the connection between sensory processing difficulties and eating difficulties in children with autism. It is important to identify these difficulties because with increased identification, improved and informed support and treatment can be provided for the children and their families.

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CHAPTER I

STATEMENT OF THE PROBLEM

This chapter provides a description of autism including definition, incidence, and the impending DSM V revisions of the diagnostic criteria. A discussion follows of the sensory processing differences in children with autism and the impact this presents for the comfortable completion of self-care tasks.

Autism Incidence

Autism is a developmental disorder characterized by qualitative impairments in social interaction and communication skills, as well as a restrictive repetitive and stereotyped patterns of behavior (American Psychiatric Association, APA, 2000). The incidence of autism is increasing, according to the Centers for Disease Control's website (www.cdc.gov), with an average of 1 out of 110 children currently being diagnosed. The CDC website also reported that from 1997-2008 the prevalence of autism increased by 289.5%. Additionally, the U.S. Department of Education reported that more than 160,000 school-aged children (3-21) received special education and related services in the public schools under the "autism" category (U.S. D.O.E., 2007). Figures like these make it evident that autism is a disorder that needs to be better understood and supported. The cause of the increased incidence of autism is unclear. It may be due to an increased frequency of the condition or it may be a reflection of differences in methodology (www.psychiatryonline.com) and a lack of clarity in diagnosis (American Medical Association, 2003).

Autism Revisions in DSM V

The Diagnostic and Statistical Manual of Mental Disorders (DSM) has been called "psychiatry's bible" (Rubin, 2010) and is the tool used by medical personnel to diagnose mental health related disorders. The current DSM-V revisions are overdue because of disagreements involving differential diagnosis. Autism is one of the diagnoses under review (Wing, et al, 2010). The current DSM-IV- TR is organized by sections. Autistic Disorder, 299.00, and Asperger's Disorder, 299.80, are two of the Pervasive Developmental Disorders under the section "Disorders usually First Diagnosed in Infancy, Childhood, or Adolescence"(APA, 2000). The draft DSM-V proposes a dimensional approach to diagnosing individuals on the autism spectrum including those individuals identified as "classic Kanner", with low IQ and non-verbal, and those individuals identified with "Asperger's Disorder" , those with average to high IQ , wide vocabulary and good grammar but impaired social interaction and communication (Wing, et al, 2011). Wing, et al, 2011, makes a case for the change of label to a "spectrum". This change would be preferable, in their opinion, because of the past difficulty defining boundaries between autism and the range of "typical" development. This includes the large number of individuals who have a mixture of both features as well as the changes that occur over the years when "a child who was appropriately diagnosed with Kanner's autism can grow into an adolescent who fits the criteria for Asperger's syndrome" (Wing, et al, 2011, p. 771).

This proposed change in DSM diagnoses is controversial, in part, because the loss of sub-group labels may make some individuals ineligible for medical or social services (Wing, et al, 2011). A change in DSM-V diagnosis of autistic disorder and the subgroup, Asperger's Disorder, to Autism Spectrum Disorder (ASD) would include dimensions of severity such as current language functioning and intellectual level/disability (www.dsm5.org). For the purposes of this study, the subjects involved will be those individuals diagnosed with Autism Spectrum Disorder (ASD). THE DSM-IV-TR outlines three behavioral criteria for diagnosis of Autism: qualitative social impairment, repetitive and restrictive stereotyped patterns of behavior and significantly decreased social functioning (APA, 2000). Differential diagnosis for Asperger's Disorder (AD) include the above features in addition to no clinically significant delay in language or cognitive development (www.psychiatryonline.com). Often people diagnosed with AD have average to above average intellectual functioning. However, the "impairment in social interaction is gross and sustained" (www.psychiatryonline.com, p. 33).

Autism and Sensory Processing

The current definition of Autistic Spectrum Disorder or Asperger's Disorder, outlined in the DSM-IV-TR (American Psychiatric Association, APA, 2000), does not contain explicit reference to differences in sensory processing as described by Hans Asperger (1944). In his seminal article describing four cases with this disorder, Asperger described a range of characteristics and behaviors including hypo and hypersensitivities to taste, tactile (touch) and auditory (sound) stimuli. The children discussed in his case studies showed a preference for very sour or strongly spiced foods. They strongly disliked tactile inputs such as textures of certain fabrics and fingernail cutting and were also very sensitive to noise during certain conditions or oblivious to sounds in other situations. In all of the cases, their sensory problems interfered with their daily routines, in particular, self-care skills such as eating, dressing and grooming.

A plethora of research studies establishing a link between autism and sensory processing difficulties are currently found in the literature (Kintwall, et al, 2011; Lane, et al, 2009; Ben-Sasson ,et al, 2009; Baker, et al, 2008; Dunn, et al, 2002; Kientz, M., Dunn, W., 1997; Bettison, 1996). As this link is now well supported by research, the American Psychiatric Association will be including hyper or hypo-reactivity to sensory input in the diagnostic criteria for Autistic Disorder in the revised version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) to be published May, 2013 (APA, 2010). Inclusion in the DSM-V is significantly important as it influences whether insurers will cover therapy for a condition, whether scientists will pursue research into its causes and treatments and whether the Food and Drug Administration will approve medications marketed for it (Rubin, 2010).

Autism and Self Care Skills

Self-care tasks or activities of daily living (ADLs) encompass some of the most important occupations children learn as they mature. Self-care tasks include those activities necessary to take care of one's body such as grooming, eating, dressing, etc. (Shepard, 2005). This paper's goal is to better understand one of the daily self-care routines, in particular, mealtimes, of children diagnosed on the autism spectrum. A firsthand account of how sensory processing difficulties interfered with her daily routine is eloquently written in the book, *Thinking in Pictures: My Life with Autism*, by Temple Grandin, 2006. Grandin is a world-renowned animal scientist, author and lecturer. She is also diagnosed as on the Autism Spectrum and writes about what it feels like to live with Autism. She describes extreme sensitivity to visual and auditory input, smell, taste and touch. These sensitivities frequently interfered with her behavior and social skill development. Grandin, 2006, writes that "Many children with autism are finicky and will eat only certain foods. Their eating problems usually have a sensory basis", p. 71. Grandin writes about the painful experiences of attending birthday parties, family gatherings, etc. when she was a child. Her extreme sensory sensitivities made attending these events unbearable, often resulting in temper tantrums or "meltdowns". There is increasing evidence that the significant differences in the sensory processing of children on the autism spectrum contributes to interference with their daily routines (Kay, S., 2001; Schaaf, R., et al, 2011). The following section will review the literature on sensory processing disorders in children with autism and the related self-care difficulties, in particular eating difficulties.

CHAPTER 2

LITERATURE REVIEW

The following literature review is a synthesis of the literature on sensory processing, and related mealtime difficulties in children with autism. To assist in the review of the literature a number of electronic databases were accessed to locate relevant literature published within the last 25 years. These databases include, PubMed, Cinahl, Web of Science and Psych Info. The search was limited to full length, peer-reviewed publications written in English with Autism, Eating and Sensory as the search terms.

Results of this search found that Autism, in general, has been widely researched with thousands of articles published. The search terms Autism and Sensory resulted in from 57 to over 400 peer reviewed articles. It is well documented that people diagnosed with autism have sensory processing issues (Ben-Sasson, et al, 2009; Tomchek and Dunn, 2007; Dunn, et al, 2002). For example, as reported in Kintwell, et al, 2011; Ben-Sasson, et al, 2009; Tomchek & Dunn, 2007, over 80 percent of children diagnosed with autism demonstrate sensory modulation symptoms and related behaviors such as sensory seeking, sensory avoiding, self-stimulation, etc. What is striking is the paucity of studies currently found in the literature linking these sensory processing differences to difficulties with self-care tasks, in particular eating, for children on the autism spectrum. This researcher's clinical experience and other anecdotal reports make a case for the link between the sensory processing disorder and eating difficulties. There are only five studies which describe, link, and document autism, sensory processing and eating difficulties. These studies will be reviewed but, first, a review of the literature and background regarding sensory processing will be provided. The theoretical framework, sensory integration, is described below.

Sensory Integration: The Theory

Sensory integration refers to both a neurological process and a theory of the relationship between the neurological process and behavior (Fisher, A., et al, 1991). A. Jean Ayres (1964, 1972, 1979), an occupational therapist, educational psychologist and neuro-scientist, first identified the concept of sensory integration in the 1960's. Ayres' (1979) defined sensory integration as "the organization of sensation for use" (p.5). Our senses receive information from stimuli both inside and outside our bodies which give us the information we need to survive and function (Kranowitz, 2005). The five sensory systems which people are most familiar with are called the external or far senses. They inform us of sensations coming from outside our bodies and include vision, hearing, smell, taste and touch. Less familiar are the internal or near senses (somatosensory) including the vestibular sense and the proprioceptive sense. Sensation received from the somatosensory system is unconscious and automatic. One part of the tactile system, the primitive, protective aspect, is considered as part of the somatosensory system as it, too, is automatic and not perceived at the unconscious level. For example, the rapid withdrawal of one's hand when touching a painful stimulus occurs without thinking about the response at the conscious level. Vestibular input provides information about how our bodies are moving (how fast, which direction). Proprioception provides information from our muscles and joints to inform us of body position (Kranowitz, 2006; Heller, 2002). The theory of sensory integration posits that the somatosensory system lays the foundation for all higher level behavior and learning. They are phylogenetically and ontogenetically the first sensory systems to develop and the most important (Ayres, 1972, 1979).

Sensory integration (or sensory processing as it is now called) is the complex interaction between brain function and thoughts, feelings and actions (Miller, 2006). Ayres' (1972) theorized that when there is sensory integration dysfunction social, emotional, motor and/or functional problems can result. In 1979, Ayres' posited that between 5 and 10 percent of children have difficulties with sensory integration which cause them to be slow learners or to have behavior problems. More recent estimates indicate that at least one in twenty children has difficulty processing sensory information (Miller, 2006). Individuals with this difficulty generally look typical; yet, subtle areas of their nervous systems are not functioning as they should. These changes result in behaviors that may confuse, frustrate, and anger parents and teachers (Kranowitz, 2005).

Numerous researchers have further developed Ayres' theory of sensory integration (Fisher, Murray, Bundy, 1991; Miller, 2006). Sensory integration is the most well developed and widely researched theory in the field of occupational therapy. In 2004 a group of occupational therapy researchers (Miller, Cermak, Lane, Greenspan) proposed a clarification of terminology (In Miller, 2006). Sensory integration dysfunction is now identified as Sensory Processing Disorder (SPD) with three classic forms: Sensory Modulation Disorder, Sensory-Based Motor Disorder and Sensory Discrimination Disorder and their subtypes (Miller, 2006).The diagnosis of Sensory Processing Disorder has been formally recognized in the Diagnostic Manual for Infancy and Early Childhood and the Diagnostic Classification: 0 to 3. Additionally, this group of researchers submitted a preliminary application for acceptance in the 2013 revision of the DSM-V. With official recognition of this diagnosis, increased support for further study and increased awareness of this diagnosis will occur, (Miller, 2006).

The following section reviews the current literature related to self-care and sensory processing in children with autism.

<u>Self care and Sensory Processing</u>

Self-care skills or daily living skills (DLS) encompass some of the most important occupations children learn as they mature (Shepard, 2005). Self-care tasks include those activities necessary to take care of one's body such as grooming, eating, dressing, etc. (Shepard, 2005). Again, the limited number of references found in the literature related to self-care function and sensory processing disorder was surprising. There are two studies which describe sleep difficulties in children with autism (Hollway, J.& Arman, M., 2011; Reynolds, A.& Mallow, B. (2011). The authors describe sleep disturbance as common and a significant problem in children with autism and the resultant effect on daytime and parent stress. The studies identify the problem and the need for further research to understand underlying causes of sleep problems in children with ASD. In these studies, there is no mention as to sensory processing difficulties contributing to sleep difficulties. It seems intuitive to think that oversensitivity to sounds would disrupt a child's sleep. Additionally, discomfort with touch sensations make the feel of bedding and/or sleepwear uncomfortable which also may interfere with sleep.

There were no studies found in the literature that describe grooming (other than oral care) or dressing difficulties with children on the autism spectrum. This researcher's clinical background and anecdotal report describe difficulty in these areas as common in children with ASD and assumed they likely resulted from sensory processing problems. Parents frequently describe their child's extreme discomfort with tasks such as hair combing or washing, nail cutting, face washing, etc. It is commonly reported that children with ASD have limited clothing preferences with complaints of discomfort with tags on shirts, seams on socks, etc. Discomfort with oral care is a self-care area frequently reported by families with children on the autism spectrum. The following studies researched this area and found compelling evidence of the impact sensory sensitivities have on oral care for children with autism.

Two recent studies examined oral care and sensory difficulties in children with autism (Stein, et al, 2012, Stein, et al, 2011). Results from a logistic regression analyses, revealed significant differences in oral care and sensory variables ($p<.0001$). The qualitative data revealed difficulties that parents report with oral care for their child, and these include sensory-related concerns such as extreme discomfort with the taste and smell of toothpaste or toothbrush and the sound, sights and smells of the dentist office. Of the 206 children involved, 62% of the parents reported that sensory sensitivities interfered with dental care. The authors make a case that poor oral health may result in difficulties with eating, sleeping, speaking in addition to decreased school attendance and reduced self-esteem (Stein, et al, 2012). The study results indicate that significantly more children with ASD experience difficulty with oral care and sensory-related factors at home and in the dental office. The authors suggest further research to examine sensory-based interventions to decrease sensory sensitivities and to help make the dental experience less anxiety producing and more successful. With knowledge of sensory sensitivities contributing to discomfort with oral care, sensory-based strategies can be recommended for parent and dentist such as touch-pressure input prior to dental care, verbal preparation of the child before the dental procedure, change in brush or paste type, etc.

An interesting, recent qualitative study conducted by Schaff, et al, 2011, examined the everyday routines of families of children with autism. This study explored the experiences of four families. Results indicated that all of the children fell in the range of "definite dysfunction" or "some problems" in all areas of the Sensory Performance Measure. Although not addressing eating behavior difficulties specifically, the authors illustrate how sensory-related behaviors had an impact on the child's participation in family activities and routines. Their results indicated that all of the children exhibited difficulty with sensory processing which impacted family routines on a daily basis. Although the study did not describe specific areas of self-care it did describe six main themes which emerged: "flexibility, familiar space vs. unfamiliar space, difficulty completing family activities, impact on siblings, the need for constant monitoring, and the importance of developing strategies to improve participation of the family as a whole"

(Schaff, et al, 2011, p. 378). The authors discuss the importance of helping parents identify sensory processing strengths, needs and the impact on family routines. Parents would benefit from additional sensory-based strategies for adapting or modifying the environment to make it more manageable for them and for their child to more successfully participate in activities.

Klintwall and colleagues conducted a study in 2011 involving 208 children in Stockholm, Sweden under age 4.5 years and diagnosed with ASD. They interviewed parents using the PARIS schedule which includes structured questions about the child's sensory reactions. They compared the responses of different ASD subgroups based on an assessment they developed which differentiates types of ASD based on DSM-IV autistic disorder criteria. They also compared the mean number of affected sensory modalities in relation to the following specific symptoms: food selectivity, toe walking, sleep problems, severe tantrums, stereotypic behavior, self-injurious behavior and muscular hypotonia. They found that the majority (76%) of children diagnosed with ASD had a least one sensory modality affected. The most common type of sensory abnormality was over-reactivity to sound (44%); over reactivity to touch and vision were found in 19% and oversensitivity to smell in 5%. Interestingly, the number of sensory modalities affected did not vary with cognitive level ($p=0.638$) or language ability ($p=0.422$). The group with autism was significantly different from the other group in the areas of food selectivity ($p=0.028$) and sleep problems ($p=0.001$) were significant in the group with autism.

Nadon, Feldman, Dunn and Gisel, 2011, conducted a study to determine if children with autism spectrum disorder (ASD) have more mealtime problems than their siblings who are typically developing. Matching sibling pairs were used to help control for the influence of their social environment. The researchers were also interested if age and sex were associated with eating problems. The study was conducted in Quebec, Canada from January 2006 to September 2006. Families of children identified as eligible were contacted through local rehab centers, pediatric hospital and parent associations in the Quebec area. The diagnoses and cognitive status of the children were established by the child's psychiatrist or by a multidisciplinary team. Parents completed two questionnaires, one for their child with ASD and the same questionnaire for their other child nearest to age of their child with autism. The questionnaire used was the *Eating Profile*, a modified clinical instrument developed for this study. Face validity was established for this instrument and pre-tested by a group of parents. The questionnaire, available in English and French versions, consists of 145 items from eleven domains including dietary history, infancy feeding behaviors food intolerances, mealtime behaviors, assistance needed, etc. A sample of the questions is included in the appendix of their article. Additionally, demographic information was collected for each family. Answers to questions were either dichotomized (yes/no) or on a Likert scale (e.g. always/often/rarely/never).

Of the 119 families contacted, 48 families completed consent forms and participated in the study. The age ranges were from 3.8 years to 12.9 years for the children with ASD and 3,1 to 12.8 years for the siblings and the differences in age between the two groups was not significant. Paired t-tests were used to evaluate differences in eating problems. Linear Mixed Models were used to account for the influence of age and sex. Results indicate that the children with ASD had a mean of 13.3 eating problems compared with 5.0 for their siblings ($F= 23.24$, $p <.001$). Older children had fewer problems than younger children, although not significant ($t=1.98$, $p=.051$). Children with ASD were more selective about food texture, temperature and recipe, had difficulty staying seated, refused foods eaten before, etc. Eating problems were shown to have an impact on the family's routine and were stressful ($p=.005$).

These results indicate that the "impact of the diagnosis is greater than that of the home environment" (Nadon, et al, 2011, p. 109). Children on the autism spectrum have a significantly more difficult time successfully participating in the self care task of eating than their siblings. A limitation of this study is the use of the modified *Eating Profile* with its limited psychometric properties. Using additional measures would have strengthened the design. Use of a parent report questionnaire has limitations such as parent bias. Supplementing the *Eating Profile* results with a mealtime observation would have added an additional subjective (qualitative) element, strengthening the design. The results validate this writer's clinical observations of the challenges of eating difficulties with children on the autism spectrum and their families. However, it was surprising that the authors did not discuss the sensory processing differences many children with ASD experience because these are often a contributing factor to eating difficulties. Another limitation was there was no random assignment. This was a sample of convenience

Lane, Young, Baker and Angley(2009), looked at the difficulties children on the autism spectrum have with completing self care tasks. Fifty four children with autistic disorder and their caregivers from South Australia Early Intervention Research Program or Headstart Intervention Services participated in the study. The age range was from 33 to 115 months with a mean age of 79 months. Eighty seven percent of the subjects were male. Also similar to the study previously reviewed, this study used parent report questionnaires. However, in contrast to Nadon's ,et al, 2011, the measures used for this study have demonstrated construct, content and criterion-related validity (Lane, et al, 2009). The Short Sensory Profile (SSP) (Dunn, 1999) is a 38-item questionnaire which describes a child's responses to various sensory experiences. The caregiver who has daily contact with the child completes the questionnaire by reporting the frequency of the behaviors (Always, Frequently, etc.). Scores are derived from seven sensory domains. Examples of questions include: "Becomes distressed when hair is brushed"; Avoids getting messy", etc. After scoring, the results of the child's sensory processing function for each domain are described as either: Typical Performance, Probable Difference, or Definite

Difference. The other instrument, The Vineland Adaptive Behavior Scales (VBAS) is a semi-structured interview administered to caregivers to assess adaptive behavior (Sparrow, et al., 1984). Adaptive behavior is defined "as the development and application of abilities required for the attainment of personal independence and social competence" (Lane, et al., 2009, p. 115). The VBAS includes five domains: communication, daily living, socialization, motor skills and maladaptive behavior. The VBAS has demonstrated adequate internal consistency reliability, good test-retest reliability, excellent inter-rater reliability (r=.80-.90) and good construct, content and criterion-related validity (Sparrow, et al., 1984). Scores are reported as Low= 69 and below; Moderately Low= 70-84; Adequate= 85-115; Moderately High= 116-130; High= 131 and above. The Daily Living domain was the domain of interest for this study. Correlation and multiple regression analyses were conducted with results as follows. Daily Living scores fell in the low range (mean=54.9). The SP results indicate that the majority (87%) of the participants present with SP dysfunction when compared with peers. Differences in sensory processing were most pronounced with Auditory Filtering (92%) and Under responsive/Seeks Sensation (66%). The correlational analyses revealed low to moderate correlations between Age and VBAS Total score (r=.27), Daily Living (r=.43) and Maladptive Behavior (r=.37) subscales. They went on to perform stepwise multiple regressions to predict SSP domain scores and adaptive behavior. Two of the SSP scores were significant predictors of communication performance but none predicted Daily Living. Their overall results suggest that global SP dysfunction is predictive of maladaptive behaviors in autism. Based on their study results, the authors suggest that "sensory-based intervention strategies may counteract the emergence of maladaptive behaviors in autism" (Lane, et al., 2009, p. 121). The results of this study did not strongly support my prediction of sensory processing differences interfering with successful completion of self-care tasks. There may not be enough items on the Daily Living subtest to allow a sensitive measure of self-care function. In addition to the objective measures, perhaps supplementing with qualitative observations and interview data would also bolster the results and add an interesting, subjective element.

A third study, Keen's 2008 case studies, was conducted with seven children from two UK health clinics. Keene, 2008, used a sample of convenience, and provided retrospective clinical data for seven children who had attended her clinic and presented with "unusually severe feeding problems", p.212. She presented their developmental and medical profiles in tables which include sex (6 females, 1 male), age at diagnosis (3.10-11.4 years), non verbal cognitive levels (average to above average), medical problems, abnormal food behaviors, intervention and outcome (body mass index, BMI). She briefly summarized the relevant literature and makes a case for the association of autism, feeding problems and abnormal food behavior. She states that this association has not been systematically studied. Keene, 2008, describes problem feeding behaviors which she reports occur in up to 80% of children with developmental delays. It is unclear where this statistic comes from. The feeding behaviors include failure to thrive (FTT), selective eating (SE), restrictive eating (RE), food refusals (FR), food phobia (FP), picky eating (PE) and perseverant eating behavior (PEB). Keene, 2008, explains that after their first year, many typical children start to be seen as "picky" and refuse to try new foods. However, typically developing children imitate others and will attempt new foods if they see others eating. This contrasts with those children with low levels of sociability, such as those with autism, and related low levels of social imitation who likely will not imitate others and refuse to try new food (neophobias).

She summarizes her findings by stating that "successful intervention will need to integrate management approaches to dysfunctional sensory processing, attachment, cognitive inflexibility and learnt behavior as well as associated anxiety or phobia", p. 215. This study was more of a theoretical article then a research article. Keene presents data of children from her clinic to make a case about the severity of some problem feeding difficulties. She also wanted to alert clinicians to the possibility that children who present with significant feeding difficulties may have an ASD. Results suggest that these children "present with unusual challenges which requires novel approaches", p. 215.

The fourth study reviewed was a descriptive study conducted at Montreal Children's Hospital (Jasmine, et al, 2009) . The researchers were interested in comparing the performance of sensori-motor (sensory/ gross motor/fine motor) skills and daily living skills. Sensory skills were assessed by the parent report questionnaire, Sensory Profile. Motor skills were assessed by scores on the Peabody Developmental Motor Scales and daily living skill function was assessed by the semi-structured interview assessment tools, The Functional Measure for Children (WeeFIM) and the Vineland Adaptive Behavior Scales (VBAS). The subjects were 35 preschool- aged children who were diagnosed with an ASD. Sixty eight (68%) had cognitive and language delays; seventy-one percent (71%) presented a significant cognitive delay, 69% had a receptive language delay, and 55% had an expressive language delay. Researchers performed Pearson product moment analyses to assess correlations between the various factors. Results indicated that this sample of preschool children with ASD showed very poor performance in self-care on the WeeFIM and the DLS section of the VBAS (49% of the sample scored 2 SD below the mean). The researchers found a very high percentage (94%)of the sample scored in the atypical range in the sensory processing domains. Thus, their results suggested that, even when cognitive performance was taken into account, the children with ASD showed atypical sensory responses, very poor motor and daily living skills. Thus, they concluded that, "sensory avoiding, an excessive reaction to sensory stimuli, and fine motor skills were highly correlated with DLS", Jasmine, et al, 2009, p. 231.

All four studies found differences in sensory processing among children with autism. Three of the four studies found an association between sensory differences and self-care. Limitations include non random assignment, samples of convenience, parent-report questionnaires and small sample size. Additionally, the self-care measure of the Vineland has only a few items involving feeding.

Additionally, a systematic review of the literature was conducted by Koenig & Rudney (2010). Their review identified research studies which addressed performance challenges (such as self care/ daily living skills) for children, not those specifically with autism, who have difficulty processing and integrating sensory information. The authors found and reviewed 35 studies on this subject conducted between 1980 and 2005 (Koenig & Rudney, 2010). The studies ranged from Level II to qualitative studies. All studied the effects of sensory processing on performance in areas such as play, leisure, social, sleeping, eating and self-care. Despite methodological limitations, the studies reviewed "demonstrated the effects that difficulties processing and integrating sensory information have on all areas of occupation" (Koenig & Rudney, 2010, p. 440). Only one study was reviewed which examined sensory processing specifically in children with autism (Rogers, Hepburn & Wehner, 2003). Although that study's results helped differentiate autism from other developmental disabilities by use of sensory measures it did not address specific performance areas such as eating, dressing, etc. in children with autism.

A narrative literature review of studies over the last 25 years on food selectivity and nutritional adequacy in children with ASD was conducted by Cermak, et al, (2010). Their review indicated that food selectivity is a "substantial problem" in children with autism and may be due to sensory sensitivities. Despite this substantial problem, they point out there is a very limited number of research studies on food selectivity in children with ASD, Cermak, et al, 2010. The authors reviewed a dozen studies pertaining to food selectivity in children with ASD. Some difficulties they noted with these studies included: inconsistent use of an operational definition for food selectivity, limited use of comparison groups and studies based on parent report not observed food intake. Cermak, et al, 2010, p. 244, further stated that " it is possible that sensory sensitivity experienced by many children with autism spectrum disorders may contribute to their difficulty with food texture and resultant food selectivity". Food textures, smells, color, temperature and tastes may contribute to the development of food selectivity. Cermak, et al, 2010, p.244, write that "food selectivity is a frequently occurring problem in children with autism spectrum disorder and their unusual eating patterns may be a significant stressor for their families". They make a case for further research to better inform appropriate interventions and an interdisciplinary approach to best address this complex problem.

There has only been one study to date which examined the association of sensory processing and eating problems in children with ASD (Nadon, et al, 2011). This experimental study compared responses of sensory processing and eating behaviors in a sample of 95 children ages 3-10 years with and without ASD. Results of analysis of variance and multiple linear regressions indicated that children with 'definite" sensory problems had significantly more eating problems than those with "typical" performance as assessed by the eating questionnaire developed for this study and the Short Sensory Profile (SSP). Of the seven sensory domains studied, children with tactile sensitivity (p.021), taste/smell sensitivity (p.0001), visual/auditory sensitivity (p.006), had significantly more eating problems than children with typical performance in those areas. Overall, close to 90% of the children with ASD scored differently than typically developing peers.

As described in this review of literature, numerous studies identified sensory processing difficulties in children on the autism spectrum (Klintwall, et al, 2011; Lane, et al, 2009; Ben-Sasson ,et al, 2009; Baker, et al, 2008; Dunn, et al, 2002). A few studies have identified mealtime difficulties in children with autism without mention of sensory difficulties (Nadon, et al, 2010; Jasmine, et al, 2009; Keen, 2008; Schreck, et al, 2004). Cermak in her 2010 systematic review of the literature suggests that sensory sensitivity may lead to food restrictions in children with ASD. Despite the compelling evidence for sensory processing challenges and the resultant eating difficulties for children on the autism spectrum, only one study to date, empirically studied these specific difficulties (Nadon, et al, 2011). This present study will contribute to this body of knowledge by further examining the association of eating behaviors and sensory processing difficulties in children with ASD. This information will be help caregivers and their children identify problem behaviors resulting from sensory processing difficulties, and which may be intervened by sensory strategies. These interventions will hopefully contribute to greater mealtime success and increased comfort and less stress during mealtimes for children with autism and their families.

This present study analyzed the data collected from parent and child report questionnaires which assessed sensory processing and eating behaviors. The following chapter describes the purpose of this study and proposed methodology to address the following research questions:

Research Questions

Research Question #1: Is there a statistically significant difference between sensory processing and eating behaviors for children diagnosed on the autism spectrum and typically developing children on the Short Sensory Profile, Sensory Eating Checklist, Touch Inventory and BAMBI?

Research Question #2: Is there a statistically difference on the seven sensory domains of the SSP between the autism sample and the typical sample?

Research Question #3: Is there a statistically significant difference in sensory processing and eating behavior scores between the three development levels of children- those typically developing, those identified as slightly delayed and those identified as very delayed on the Short Sensory Profile, Sensory Eating Checklist, Touch Inventory and BAMBI?

R**esearch Question #**4: is there a statistically significant difference in sensory processing and eating behavior scores between the three age groups of children: 5-7, 8-10, 11-12 on the Short Sensory Profile, the Sensory Eating Checklist, the Touch Inventory and the BAMBI?

Statistical Analyses

Data analyses for this study were calculated using the computer software, Statistical package for the Social Sciences (SPSS 19, 2012). Independent samples t tests were conducted to analyze the mean tests scores between both samples. Analysis of variance (ANOVA) is a hypothesis testing procedure that is used to evaluate mean differences between two or more populations. In analysis of variance the variable that designates the groups being compared is called a factor (Gravetter & Wallnau, 2007). Correlation analyses were conducted to determine association between the two variables, eating behaviors and sensory processing.

CHAPTER 3

METHODOLOGY

Purpose

The purpose of this study was to assess the association of sensory responses with eating behaviors in children with and without autism. There is some evidence that there are significant differences in the sensory processing of children on the autism spectrum resulting in interference with their daily routines (Nadon, et al, 2011; Lane, et al, 2010; Jasmin, et al, 2009; Keen, 2008). This experimental and descriptive study will contribute to this body of knowledge. The focus for this study will be the theoretical framework of sensory integration, and the related model of sensory processing.

Subjects

Prior to contacting subjects and conducting research, this researcher completed the University of Massachusetts School of Education's Institutional Review Board (IRB) training (see Appendix A) and submitted the appropriate documents and the study description to the IRB. The IRB reviewed the study and granted permission to conduct the study May 2012 The subjects were a sample of convenience as this researcher contacted local (Springfield/Amherst, Massachusetts area) school districts and agencies for assistance in recruiting families with children on the autism spectrum between the ages of 5-12 years (Refer to Table 1).

In order to participate, inclusion criteria included: a documented diagnosis of autism, to be between the ages of 5-12 years at the time of participation, and English speaking. Exclusion criteria included no additional diagnosis of a physical disability. Based on the general principle of the Central Limits Theorem, it was determined that at least 30 subjects with the autism diagnosis were needed to determine reliable results (Gravetter & Wallnau, 2007). There were a total of 34 children with autism and 34 children typically developing in this study.

Table 1. Demographic Characteristics

DEMOGRAPHICS	AUTISTIC	TYPICAL
Sex (Total N)	Female= 1 Male= 33 (N= 34)	Female= 7 Male= 27 (N= 34)
Age (Mean)	8.61 years SD+/-2.32	8.76 years SD+/-2.23
Age (Group %)	5-7 years= (13) 19.1% 8-10 years= (11) 16.2% 11-12 years= (10) 14.7%	5-7 years= (12) 17.6% 8-10 years= (12) 17.6% 11-12 years= (10) 14.7%
Development (Total N)	Typical= 0 Slight Delay= 23 Very Delayed= 11	Typical = 34 Slight Delay= 0 Very Delayed= 0
Ethnicity	White= 85% Other= 13%	White= 87% Other= 15%

Data Collection Process

Parents were sent a cover letter describing the study and this researcher's contact information, and an inquiry if they were interested in participating (Appendix B). After they expressed interest in participating, they were sent: two consent forms (one for their records, one for this researcher), a demographic form and the four questionnaires (Appendix B). Parents were contacted by this researcher and arrangements made to deliver and pick up the forms. Some parents preferred to meet in person, others preferred the forms be sent either by email or regular mail.

Over 350 packets were sent out with a final return rate of 34 children whose parents identified them as being on the autism spectrum (ASD) and 34 who were identified as typically developing (TD). Parents of children with ASD were asked to complete the date of diagnosis and identify the professional who diagnosed their child. Additionally, they rated their child as developing "typically, "slight delay" or "very delayed" in the areas of motor, language and social development. In the ASD sample, there were 13 children ages 5-7, 11 children ages 8-10 and 10 children ages 11-12. Twenty three of the children identified with ASD were identified as "slightly delayed" and 11 were identified as "very delayed". After obtaining permission from appropriate authorities, children who were identified by parent response to be typically developing were recruited by this researcher as a sample of convenience in local recreation programs, camps, etc. In the TD sample, there were 12 children ages 5-7, 12 children ages 8-10, and 10 children ages 11-12. All were identified as "typically" developing. The mean age of children with autism was 8.6 years and the mean age of children without autism was 8.5 years (see Table 1 in Chapter III for demographic details).

Following completion of forms, parents and children were given a choice of thank you gifts. Some preferred to have a copy of the test results (Appendix D) in lieu and/or in addition to a gift. Data was inputted and prior to being analyzed missing data points were calculated and inputted. Additionally, data from the SSP was recoded to match the Likert Scale of the other measures. After data was cleaned up and recoded, statistical analyses were applied to the data (see Chapter 4).

The following is a description of the four assessment tools employed.

Assessment Tools

Below is a description of each instrument including psychometric properties, when available. (Appendix C).

The Sensory Profile (SP) is a standard measure for professionals to assess a child's sensory processing abilities and to profile the effect of sensory processing on functional performance in the daily life of a child (Dunn, 1999). The Sensory Profile is a judgment-based caregiver questionnaire most appropriate for children 5-10 years of age (Dunn, 1999). It consists of 125 items grouped into three main sections: Sensory Processing, Modulation, and

Behavioral and Emotional Responses. Each item describes children's responses to various sensory experiences. The caregiver who has daily contact with the child completes the questionnaire by reporting the frequency with which these behaviors occur (Always (1), Frequently (2), Occasionally (3), Seldom (4) or Never(5). Examples of questions include "Becomes anxious or distressed when feet leave the ground"; Avoids getting "messy" (Dunn, 1999). After scoring, the results of the child's sensory processing abilities for each section and factor are described as either: Typical Performance, Probable Difference, or Definite Difference.

The research on the SP took place from 1993 to 1999, and included 1,037 non-disabled, children distributed over the four regions of the United States. The researchers conducted studies with smaller samples of children with various disabilities to establish validity. Researchers conducted a principle-components factor analysis on the sample of children without disabilities to determine whether items clustered meaningfully into independent groupings. A classification system was derived by establishing cut scores for each section and factor raw score totals (Pearson Education, Inc., 2008).

The *Short Sensory Profile* (Dunn, 1999) is the test version used for this study. Researchers selected 38 items from the *Sensory Profile* that were the most indicative of sensory processing issues that affect performance (Pearson Education, Inc., 2008). The *Short Sensory Profile* (SSP) is most appropriate for screening programs and research protocols (Pearson Education, Inc., 2008). The short form of the *Sensory Profile* targets sensory modulation rather than the more multidimensional aspects of development (Dunn, 1999). The SSP is a logical choice for this study because it provides a snapshot of the child's functioning in sensory processing domains based on observations by the child's caregiver.

The **Touch Inventory for Elementary-School-Aged Children** (TIE), Royeen & Fortune (1990) was developed as a screening tool of tactile defensiveness for use with children aged 6 to

12 years. It was designed for use with children whose language competency is at least that of a 6 year old, with an IQ of at least 80 and without physical disabilities such as blindness, cerebral palsy, or spina bifida. Normative data was collected using a random and stratified sample based on geography, race, sex and community size. More than 1,200 children were contacted with 415 subjects in the sample used to establish norms (Royeen & Fortune, 1990). The TIE is a child-report questionnaire requiring the child to answer 25 questions about aspects of sensory functioning such as: "Does it bother you to go barefooted"? (a little (1), a lot (2), not at all (3)) or "Does it bother you to stand in line?", etc.   A child who responds with "a lot" for many of the test items will receive a higher score than the child who answers "a little". The higher the score, the more the child's self-reported behaviors are associated with behaviors indicative of tactile defensiveness. Conversely, the lower the score, the less the subject's self-reported behaviors are associated with behaviors indicative of tactile defensiveness (Royeen & Fortune, 1990). Permission by the author and publisher was obtained to use the T.I.E. in this present study.

The **Brief Autism Mealtime Behavior Inventory (BAMBI)** is a standardized assessment tool designed to measure the mealtime behavior of children with autism. It is an 18 item parent-report questionnaire using a 5 point Likert scale, 1=never/rarely- 5=at almost every meal. Questions include: "My child cries or screams during mealtimes", My child is willing to try new foods", etc.

Validity and reliability studies were conducted on the BAMBI with the assessment of 40 typically developing children and 68 children with autism. According to the authors, "The BAMBI demonstrated good internal consistency, high test-retest reliability, a clear factor structure, and strong construct and criterion-related validity in the measurement of mealtime behavior problems in children with autism." (Luken & Linscheid, 2008, p.342). Permission from the author was obtained to use the BAMBI in this present study.

The **Sensory/ Eating Checklist (SEC)** was modified by this author for use in the present study from the Eating Checklist (p. 61) found in *Building Bridges* (Yack, Sutton, Aquilla, 2002). Permission was not received by the publisher for use of the modified questionnaire. The SEC is a parent report questionnaire consisting of 26 items which are rated on a five point Likert scale, 1=never/rarely- 5= almost always. It is not standardized, nor are there reliability or validity data to report. It is useful for this study because the questions glean information related to the child's response to sensory input at mealtimes in six sensory domains (touch, proprioception, vestibular, visual, auditory, smell/taste).

The following chapter describes the study results including subject demographics, analyses utilized and results found.

CHAPTER 4

RESULTS AND DISCUSSION

The results of the study are presented in this chapter. The statistical analyses used will be identified and findings of each research hypothesis will be described, presented and discussed. Following will be a discussion of the results and limitations of the study.

Research Hypotheses and Findings

The four hypotheses are phrased in the null form.

Hypothesis One: There are no statistically significant difference between sensory processing and eating behaviors for children diagnosed on the autism spectrum and children who are typically developing when comparing scores on the Short Sensory Profile, Sensory Eating Checklist, Touch Inventory and BAMBI.

Hypothesis one was rejected. An independent Samples t Test with a two -direction alpha set at .05 was employed. As can be seen in Table 3, mean tests scores were significantly higher (problematic) in the sample identified with autism compared with the sample typically developing ($P<.001$). The experimental (autistic) sample exhibited greater problem eating behaviors and greater sensory processing difficulties than the control (typical) sample. The statistical technique used to answer question number one was the t test for two independent samples (the independent-measures t-test). The goal of an independent-measures research study is to evaluate the mean differences between two populations (Gravetter & Wallnau, 2007). After recoding test scores for the Sensory Profile, a t-test was run and the results compared the means on all four measures between the control group (children typically developing) and the experimental group (children with autism)

(see results, Table 3).

Prior to running the t test, a test of the equality of variances was needed to determine the appropriate use of the t-test. Levene's test for equality of variances was run to answer the question, is the assumption of equal variances valid (Gravetter & Wallnau, 2007)? The t-test assumes equality of variance, and hence a test of the assumption of equality of variance was necessary. If the scores within each sample varied widely, a small degree of freedom (df) would be noted and the scores would be more spread out with the t distribution flatter (Gravetter & Wallnau, 2007). An optimal variance of scores (normal distribution) has a central peak (bell shaped) with scores varying less (smaller degrees of freedom) (Gravetter & Wallnau, 2007).

The results presented in Table 2, show that the variances of the two groups were not equal on two of the measures (Sensory Profile and Sensory Eating Checklist). The variances were at the .005 and .001 level respectively. These results indicated equality of variance could not be assumed. The BAMBI was significant at the .036 and this indicates the variances of the two groups were not equal. Levine's Test of Equality of variance was also applied to the Touch Inventory and was not significant at the .054 level. It is not unusual to find unequal variances when comparing children on the autism spectrum with children typically developing. The t-test is a proven and robust statistic that permits the violation of the assumption of equal variances. As a cautionary step, non-parametric tests were applied to the data and the results were the same (refer to Appendix E for non-parametric test results). All of the t-test results are significantly different whether or not we assume equality of variance. Therefore, the results of the t-tests are believed an accurate portrayal of the data results. There is, in fact, a statistically significant difference in test scores (eating behaviors and sensory processing) between the sample of children with ASD and the sample of children TD.

Table 2: Results of test for equality of variances.

Levene's Test for Equality of Variances		F	Significance
Sensory Profile	Equal variances not assumed	8.35	.005
Sensory Eating Checklist	Equal variances not assumed	17.72	.001
Touch Inventory	Equal variances assumed	3.86	.054
BAMBI	Equal variances not assumed	4.57	.045

Table 3: Independent samples t test results

Independent samples test		T Test results		
		df	Sig. (2-tailed)	Mean Difference
Sensory Profile	Equal variances assumed	63	.001	56.59867
	Equal variances not assumed	55.47	.001	56.59867
Sensory Eating Checklist	Equal variances assumed	66	.001	32.42410
	Equal variances not assumed	45.74	.001	32.42410
Touch Inventory	Equal variances assumed	58	.001	11.06452
	Equal variances not assumed	41.76	.001	11.06452
BAMBI	Equal variances assumed	66	.001	114.68975
	Equal variances not assumed	60.40	.001	14.68975

The independent samples t test was run to determine if there was a statistically significant difference between test scores for the typical sample and sample of children with autism. The t test was calculated with a .05 level of significance. Interestingly, on all four measures, the mean test scores between the control group (typical) and experimental group (autistic) were significantly different, all at the P .001 level. (Refer to table 3). This indicates that according to these tests results there is, in fact, a statistically significant difference between test scores in the groups on sensory processing and eating behaviors. The children with autism score significantly higher on test scores measuring sensory processing and eating behaviors.

The following observations about the data can be seen on Table 4. The mean test scores were analyzed for both groups. On all four measures (sensory processing and eating behaviors assessments), the higher the score the more problematic or the less desirable response. As noted on Table 4, on all four measures, the scores for the children with autism were significantly higher (problematic) than the scores for the children who are typically developing. The mean scores of the SSP were 113.3 for the sample with autism compared with the lower mean score of 55.3 for the sample typically developing. The mean test scores for the SEC were 66.0 for the autism sample and 35.5 for the typical sample. The mean test scores for the TIE was 46.7 and for the typical sample was 35.2. As noted in Chapter Three, there were four less respondents for the autism sample on the TIE due to the nature of the assessment. The TIE is a child-reported measure. The four children did not possess the language skills to respond to the questions asked of the TIE. The BAMBI mean score for the autism sample was 44.3 and the typical sample was 30.0. In all four measures assessing both sensory processing and eating behaviors the autism sample scores were higher (less desirable, more problematic) than the sample of children who were typically developing.

It should be noted here that the scores on the SSP were recoded to match the Likert scale response of the other three assessments. For example, problem behaviors on the SSP ("Reacts emotionally to touch") were originally reported as Always (1) to Never (5) with typical behaviors achieving high scores on the SSP and less desirable, problematic scores being low. In contrast, the other three measures the less desirable responses were high and the preferred, less problematic responses were scored as "1" or low.

Table 4: Comparing means of test scores

	Sample	N	Mean	Std. Deviation	Std. Error Mean
Sensory Profile	A*	34	113.34	28.71	4.92
	T**	34	55.31	18.00	3.08
Sensory Eating Checklist	A	34	66.02	18.05	3.09
	T	34	33.27	8.09	1.38
Touch Inventory	A	26	46.73	11.74	2.30
	T	34	35.58	7.96	1.36
BAMBI	A	34	44.39	10.83	1.85
	T	34	30.08	7.90	1.36

*A= Autistic; **T=Typical

Hypothesis Two: There is a statistically significant difference on the seven sensory domains of the SSP between the autism sample and the typical sample. The hypothesis of no differences between the two groups is rejected. These results found, in fact, that there is statistically significant difference between the two group's scores on all seven sensory domains, tactile, taste, movement, seeking sensation, auditory, weak. As can be seen in Table 5, a 2 x 7 ANOVA with alpha set at .05 revealed a significant difference between scores of the two groups.

In this factorial design there are two groups (autistic and typical) and seven different sensory measures (or factors) of the SSP. An ANOVA is the appropriate hypothesis-testing procedure to employ for this hypothesis because this study evaluated results between the two groups on four factors (four sensory and eating behavior tests). The test statistic for an ANOVA is called an F-ratio and is based on sample variance instead of sample mean difference between two or more treatments (Gravetter & Wallnau, 2007). A large F-ratio (the functional equivalent of a low p value) provides evidence that the sample mean difference is more than would be expected by chance alone (Gravetter & Wallnau, 2007).

The results of the ANOVA on tables 5 and 6 show that the F-ratio is high on all seven measures with significances at the .000 level for all but the movement subtest which was .001, also statistically significant. Interestingly, the lowest F-ratio calculated was for the movement subtest (7.99); the only subtest to achieve significance at the .001 level compared with the other subtests which achieved significance at the .000 level. But, again, as The f-ratio was statistically, significantly high enough to determine adequate variance, the differences between both control group (typical) and experimental group (autistic) is considered great enough to report these differences.

Table 5: 2 x 7 ANOVA

ANOVA

		Sum of Squares	df	P (Significance)	F
TACTILE	Between Groups	1428.561	2	.001	25.213
	Within Groups	1756.454	62		
	Total	3185.015	64		
TASTE	Between Groups	750.794	2	.001	19.099
	Within Groups	1218.652	62		
	Total	1969.446	64		
MOVEMENT	Between Groups	170.823	2	.001	7.993
	Within Groups	662.561	62		
	Total	833.385	64		
SEEKS SENSATION	Between Groups	2506.064	2	.001	38.733
	Within Groups	2005.721	62		
	Total	4511.785	64		
AUDITORY	Between Groups	1794.485	2		42.744
	Within Groups	1280.453	61	.001	
	Total	3074.938	63		
WEAK	Between Groups	1570.914	2		29.174
	Within Groups	1642.320	61	.001	
	Total	3213.234	63		
VISUAL/AUD. SENS.	Between Groups	1016.395	2	.001	29.284
	Within Groups	1058.605	61		
	Total	2075.000	63		

Table 6: Multiple Comparisons, Development

Dependent Variable	(I) Development_num	(J) Development_num	Sig.	95% Confidence Interval Lower Bound
TOTAL_SSPscore_sum	1.00	2.00	.000*	-71.3034
		3.00	.000*	-66.3329
	2.00	1.00	.000*	47.2520
		3.00	.305	-7.7385
	3.00	1.00	.000*	35.6612
		2.00	.305	-24.2998
TOTAL_SECscore_sum	1.00	2.00	.000*	-41.3438
		3.00	.000*	-40.7556
	2.00	1.00	.000*	25.3126
		3.00	.603	-7.8829
	3.00	1.00	.000*	20.3118
		2.00	.603	-13.4718
TOTAL_TIEscore_sum	1.00	2.00	.000*	-17.3200
		3.00	.017*	-16.4163
	2.00	1.00	.000*	6.4630
		3.00	.462	-4.8567
	3.00	1.00	.017*	1.6697
		2.00	.462	-10.5537
TOTAL_Bscore_sum	1.00	2.00	.000*	-21.4304
		3.00	.001*	-18.4174
	2.00	1.00	.000*	10.8416
		3.00	.210	-2.5822
	3.00	1.00	.001*	4.9140
		2.00	.210	-11.5229

(1= Typical; 2= Slight delay; 3= very delayed)

Interesting different results, however, were found when post hoc analyses were conducted. Post hoc tests are done after an analysis of variance to determine which mean differences are significantly different from the others (Gravetter, Wallnau, 2007).

As can be seen by the results displayed on Table 6, the Typical sample always scored significantly different on all measures, eating and sensory, when compared with either the Slight Delay or Very Delayed samples (p values ranged from .001 -.017). In contrast, there were no significant difference in test scores between the Slight Delay and Very Delayed samples (P> .05). This suggests that any level of autism contributes to difficulty in eating behaviors and sensory processing as measured by these assessments.

Hypothesis three: There are no statistically significant differences in sensory processing and eating behavior test scores between the three different levels of children- those *typically* developing, those identified as *very delayed* and those identified as *slightly delayed.* Hypothesis three was rejected. As can be seen in Table 7, a 3 x7 ANOVA with alpha set at .05 revealed a significant difference between scores of the three groups. All results were highly significant at the .001 level

A post hoc analysis (Tukey's HSD) was computed to compare test scores from all four measures to compare performances between the three levels of children, typical very delayed, slightly delayed. The Tukey's test allows one to compute a value that determines the minimum difference between means that is necessary for significance. This value, called the HSD (honestly significant difference), is then used to compare any two treatment conditions (Gravetter, Wallnau, 2007, p.420) which, in this case, was a comparison among the three development levels.

As noted on Table 8, a strikingly, consistent pattern emerged with interesting results on all measures. On all four measures the scores of the typical children were significantly different when compared with either the slightly delayed or the very delayed children with autism. In contrast however, the scores of the children who were slightly delayed or very delayed did not differ significantly from each other. Based on these results, it would seem that any level of autism contributes to difficulties with sensory processing and eating behavior difficulties. There is not a difference between children with autism who are identified as slightly delayed compared with those identified as very delayed.

Table 7. 3 x 4 ANOVA, Development

		Sum of Squares	df	F	Sig.
Sensory Profile	Between Groups	57685.237	2	50.012	.001
	Within Groups	37486.315	65		
	Total	95171.552	67		
Bambi	Between Groups	3645.247	2	20.539	.001
	Within Groups	5768.216	65		
	Total	9413.463	67		
Sensory Eating Checklist	Between Groups	18305.757	2	46.332	.001
	Within Groups	12840.615	65		
	Total	31146.372	67		
Touch Inventory	Between Groups	1940.695	2	10.190	.001
	Within Groups	5427.888	57		
	Total	7368.583	59		

Table 8. Multiple Comparisons, Age

Dependent Variable	(I) DevInt	(J) DevInt	Mean Difference (I-J)	Std. Error	Sig.
SSP_RE	1.00	2.00	-60.47824*	6.48356	.000
		3.00	-52.93369*	8.33010	.000
	2.00	1.00	60.47824*	6.48356	.000
		3.00	7.54455	8.80357	.669
	3.00	1.00	52.93369*	8.33010	.000
		2.00	-7.54455	8.80357	.669
BambiTotal2	1.00	2.00	-15.83785*	2.54330	.000
		3.00	-11.09358*	3.26764	.003
	2.00	1.00	15.83785*	2.54330	.000
		3.00	4.74427	3.45337	.360
	3.00	1.00	11.09358*	3.26764	.003
		2.00	-4.74427	3.45337	.360
SECTotal2	1.00	2.00	-33.78320*	3.79464	.000
		3.00	-30.57786*	4.87536	.000
	2.00	1.00	33.78320*	3.79464	.000
		3.00	3.20534	5.15247	.809
	3.00	1.00	30.57786*	4.87536	.000
		2.00	-3.20534	5.15247	.809
TIETotal2	1.00	2.00	-12.52288*	2.84449	.000
		3.00	-8.03676	3.83458	.100
	2.00	1.00	12.52288*	2.84449	.000
		3.00	4.48611	4.14652	.529
	3.00	1.00	8.03676	3.83458	.100
		2.00	-4.48611	4.14652	.529

(1=5-7; 2=8-10; 3=11,12)

Hypothesis Four: There are no statistically significant differences in sensory processing and eating behavior test scores between the three age groups of children: 5-7 (1), 8-10 (2), 11-12 (3). As can be seen in Table 9, a 3 x 4 ANOVA with alpha set at .05 did not reveal a significant difference between scores of the three groups. All results were much greater than a p .05 significance level and ranged from significance levels of .531 - .909. These results indicate that scores on these four measures seem to remain constant and do not vary between the three age levels of children, 5-7, 8-10, 11-12. Suggesting that with this sample, children did not outgrow the sensory processing and eating difficulties measured by the four assessments.

Table 9. 3 x 4 ANOVA , Age

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
SSP_RE	Between Groups	730.387	2	365.193	.251	.779
	Within Groups	94441.165	65	1452.941		
	Total	95171.552	67			
BambiTotal2	Between Groups	181.405	2	90.703	.639	.531
	Within Groups	9232.058	65	142.032		
	Total	9413.463	67			
SECTotal2	Between Groups	28.835	2	14.417	.030	.970
	Within Groups	31117.538	65	478.731		
	Total	31146.372	67			
TIETotal2	Between Groups	24.560	2	12.280	.095	.909
	Within Groups	7344.024	57	128.843		
	Total	7368.583	59			

This table displays the results of the analysis of variance. No significant difference was found between age groups on any of the measures. The children who were 5-7 years scored similarly to the children who were 8-10 and 11-12 years.

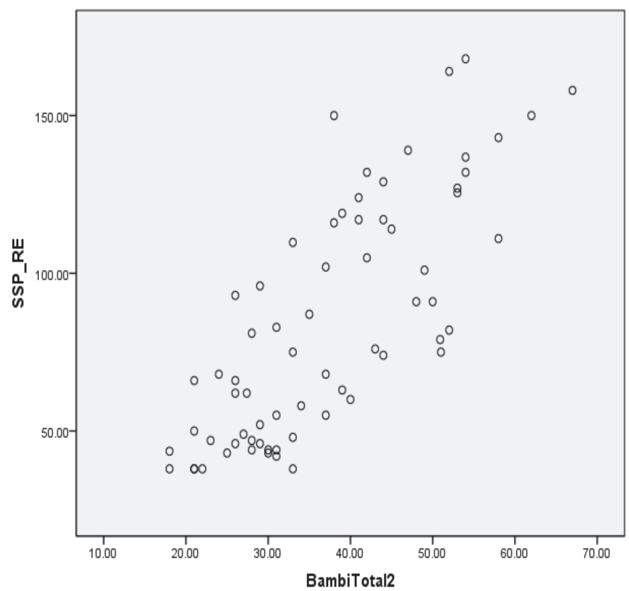
The following tables reveal results of correlation analyses. Results indicate a strong positive correlation between eating behaviors and sensory processing when analyzing the BAMBI and SSP and the BAMBI and SEC. There is a moderate positive correlation with the BAMBI TIE. As noted on the scatterplots, all three of the sensory measures are positively correlated with the eating measure (BAMBI). As the sensory score increases (greater sensory difficulties) the increased problem eating behaviors are exhibited (higher BAMBI score). The TIE scores, although significantly correlated with the BAMBI scores, are a little more scattered and not as tightly distributed around the plot line, suggesting some increased variability and less stability then the other two measures. Additionally the TIE correlation value was .528 compared with the higher correlation values of .780 (SSP) and .813 (SEC). Interestingly, the highest correlation was between the SSP and the SEC (.943). This suggests that the SSP and SEC are more closely measuring the same construct. Perhaps the TIE scores were not as tightly correlated because, as noted earlier, there were less completed TIE forms (30 instead of 34) due to the language required by the child to complete the form.

Table 10. Correlations

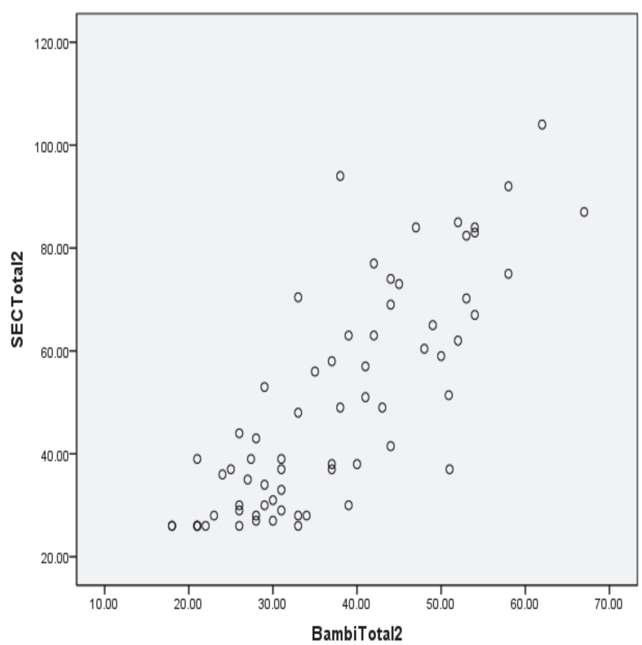
		BambiTotal2	SECTotal2	TIETotal2	SSP_RE
BambiTotal2	Pearson Correlation	1	.813**	.528**	.780**
	Sig. (2-tailed)		.000	.000	.000
	N	68	68	60	68
SECTotal2	Pearson Correlation	.813**	1	.726**	.943**
	Sig. (2-tailed)	.000		.000	.000
	N	68	68	60	68
TIETotal2	Pearson Correlation	.528**	.726**	1	.769**
	Sig. (2-tailed)	.000	.000		.000
	N	60	60	60	60
SSP_RE	Pearson Correlation	.780**	.943**	.769**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	68	68	60	68

**. Correlation is significant at the 0.01 level (2-tailed).

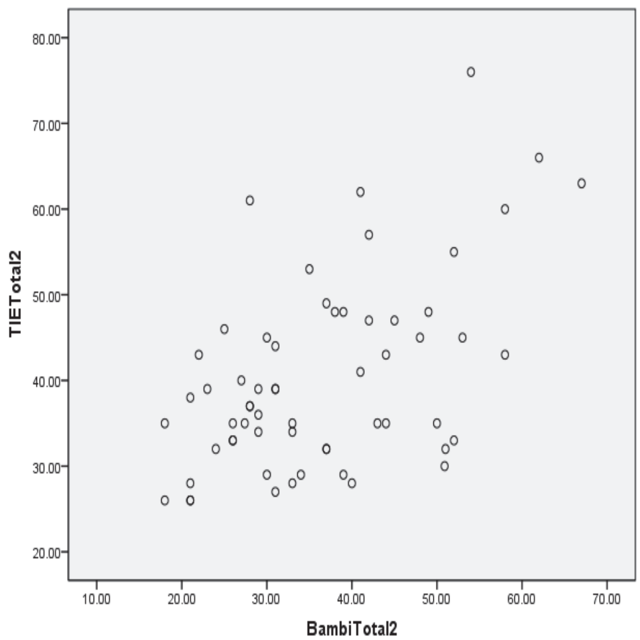
Figure 1. Scatterplots



a. SSP and BAMBI



b. SEC and BAMBI



c. TIE and BAMBI

Summary

Overall, analysis of the data demonstrated the following findings:

There is a statistically significant difference between sensory processing and eating behaviors for children diagnosed on the autism spectrum and children who are typically developing when comparing scores on the Short Sensory Profile, Sensory Eating Checklist, Touch Inventory and BAMBI. The children with autism scored higher (more problematic) on the assessment measures of sensory processing and eating behaviors.

There is a statistically significant difference among the seven sensory domains of the SSP within the autism sample and the typical sample. Hypothesis two of no differences was rejected. There is statistically significant difference between the two group's scores on all seven subtests sensory domains: tactile, taste, movement, seeking sensation, auditory, weak, and visual.

There are statistically significant differences in sensory processing and eating behavior test scores between the three different levels of children- those *typically* developing, those identified as *very delayed* and those identified as *slightly delayed.* Hypothesis three of no differences was rejected. Further analyses revealed that any level of autism contributes to difficulties with sensory processing and eating behavior difficulties.

Results of testing for Hypothesis four revealed there are statistically significant differences in sensory processing and eating behavior test scores between the three age groups of children: 5-7 (1), 8-10 (2), 11-12 (3). Hypothesis four of no differences between age groups on performance of these tests was accepted. This suggests that, with this sample, children did not outgrow the sensory processing and eating difficulties measured by the four assessments.

The following section will discuss these results followed by implications for families and professionals who live and work with children diagnosed with autism spectrum disorder, limitations of the study and suggestions for future research.

Results Summary

The first hypothesis proposed there would be a statistically significant difference in sensory processing and eating between children with ASD and those TD when comparing scores. The mean test scores on all four measures were higher (more problematic, less desirable) in the ASD sample than the TD sample. Results of the independent t- test with a two-sided alternative and set at the .05 level was statistically significant on all four measures ($p = .0001$). These results indicate that according to these results there is a statistically difference between test scores of both groups on these measures assessing sensory processing and eating behaviors.

The second hypothesis proposed there would be a statistically significant difference among results of the seven sensory domains of the SSP between the ASD and the TD samples. Hypothesis two was accepted. Results of the 2x7 ANOVA with alpha set a .05 revealed a statistically significant difference in all measures ($p =.001$). The ASD sample scored significantly different than the TD sample in all sensory domains.

The third hypothesis proposed there would be a statistically significant difference in sensory processing and eating behavior test scores between the three different levels of children- those typically developing, those identified as very delayed and those identified as slightly delayed. Results of the factorial ANOVA with alpha set at .05 revealed a significant difference between scores of the three groups. All results were highly significant at the .0001 level.

The final hypothesis proposed there would be no statistically significant differences in sensory processing and eating behavior test scores between the three age groups of children: 5-7, 8-10, 11-12. Hypothesis four was rejected. A factorial ANOVA with alpha set at .05 did reveal a significant difference between scores of the three groups. The typically developing children were significantly different from the slightly delayed and the very delayed autistic groups.

Results Discussion

The first hypothesis proposed that there would be a statistically significant difference between sensory processing and eating behaviors for children diagnosed on the autism spectrum and children who are typically developing when comparing scores on the Short Sensory Profile, Sensory Eating Checklist, Touch Inventory and BAMBI. The research hypothesis was accepted as results of the independent t tests revealed a statistically significant difference between samples on all measures ($p < .001$). This researcher understands the risk of creating a Type I error, with the use of multiple t- tests, however in light of the extremely strong findings it was felt that a cumulative probability of Type I error was so small as to be negligible. Therefore, more structured analyses were not executed to further test this hypothesis.

These results were not surprising. Given the compelling anecdotal evidence from the literature, this researcher's clinical experiences and testimonials from parents and other professionals, it was expected that the two groups would score significantly different on eating behaviors and sensory processing. On all measures, the ASD sample had higher (more problematic) mean scores than the TD sample. Correlation analyses were run (see Table 11 and Figures 1) to further support the association of eating behaviors and sensory processing. On all four measures there are strong positive correlations. These results did not calculate the percentage of children with ASD scoring high (poorly) in these areas. However, results support the findings of Nadon's e al, 2011 study of the association of eating problems and sensory processing problems in children with ASD. Their study detected these difficulties were present in half to two-thirds of their sample.

The second hypothesis proposed there would be a statistically significant difference on the seven sensory domains of the SSP between the autism and the typical sample. The results of the 2 x 7 ANOVA revealed statistically significant differences ($p<.001$) between the two samples on all seven of the sensory domains. These results were somewhat surprising. As based on anecdotal observations from this therapist's clinical experiences, parent and child report as well as evidence found in the literature, it was expected that the ASD sample would score differently in the sensory domains of tactile, auditory and taste/smell when compared with the other sensory domains. Tactile sensitivity was suggested to be associated with food selectivity by Nadon, et al, 2011; Cermak, et al, 2010; Smith, et al, 2005. Oral, auditory, smell and visual sensitivities were reported (Stein, et al, 2012; Stein, et al, 2011) in children identified with ASD. Sensory defensiveness in taste and smell was found to be associated with eating problems (Nadon, et al, 2011; Smith, 2005). The results of this present study did not differentiate between the tactile, auditory, taste/smell sensory domains and the other sensory domains on the SSP as expected based on anecdotal information and that found in the literature. As reported and predicted, all scores of seven of the sensory domains on the SSP were significantly different between the two groups. However, it was surprising that all seven sensory domains showed a similar difference between groups. Perhaps the statistical analysis employed to analyze this hypothesis was not sensitive and/or sophisticated enough to detect differences among the seven sensory domains as was expected.

Hypothesis three was also rejected. This hypothesis asked if there are statistically significant differences in sensory processing and eating behavior test scores between the three different levels of children- those typically developing, those identified as very delayed and those identified as slightly delayed. Results based on a 3 x 4 ANOVA demonstrated that there was a statistically significant difference between the three levels of children with ASD and the results of the eating behaviors and sensory processing measures (p <.001). Further, post hoc, analysis discovered an interesting pattern. There was a statistically significant difference between test scores of the two samples with the typically developing and both the slightly delayed and very delayed groups. However, the results, when comparing the ASD identified as slightly delayed compared with very delayed, were not at all significant with significant ranges much greater than p .05 from p .360- p .809. This suggests that the performance on these four measures do not vary much, there is not much difference in scores on sensory and eating behaviors in the slightly delayed compared with very delayed children. Any level of autism contributes to difficulty with eating behaviors and sensory processing. The study conducted by O'Donnell, et al, 2012, comparing SSP scores and cognitive/adaptive functioning in a group of children identified with autism and a group identified with PDD-NOS, showed a similar result. Any level of sensory impairment (definite difference, probable difference, typical) was not correlated with cognitive ability. Although the sample size was small (n=28 compared with n=14) and the scores were highly variable, their results suggest "that cognitive functioning is not predictive of sensory processing difficulties or vice versa", p. 592.

In the present study, although it was not surprising to see a significant difference in scores of the typical children compared with those with ASD, it was surprising to see there was not a significant difference between the slightly and very delayed children. It was expected, based on clinical experience, that the slightly delayed children would have more eating and sensory difficulties than the very delayed children. When more closing looking at the data it was noted there were only 11 children identified as being "very delayed" compared with 23 identified as "slightly delayed" and compared with 34 children identified as typically developing. Perhaps if the numbers of subjects were more evenly distributed for this measure, different results would have been found. Or, perhaps, the children who are identified as slightly delayed have the language ability to express discomfort with sensory/eating tasks more so than the very delayed children. Therefore, this therapist's observations may not accurately reflect what is actually being experienced by the children among both groups.

Hypothesis four asked if there were significant differences between the three age groups. The null hypothesis was not accepted. Results of the 3 x 4 ANOVA indicated there are no statistically significant differences in sensory processing and eating behavior test scores between the three age groups of children: 5-7, 8-10, 11-12 on the four measures. These results were also surprising as it was expected that the younger children would perform with greater difficulty on both the eating behaviors and sensory processing measures. The Schreck, et al, 2004, study looked at eating behaviors only of children on the ASD with an age range of 7-9.5. The authors stated they purposefully excluded preschool and toddler-aged children to avoid the potential problems found when transitioning from liquid (formula) to solid foods. Among other findings, Schreck's, et al, 2004, results suggest that "feeding issues continue in children with autism", p. 438. Based on their results, the authors suggest that health care providers continue to address feeding issues in children in the well child visits longer than the typical age expectations (Schreck, et al, 2004).

Implications

This information will be important for caregivers and their children who exhibit problem eating behaviors. These behaviors may be intervened by sensory strategies that may contribute to greater mealtime success and increased comfort during mealtimes. Strategies can be modified based on the child's age, physical and development level , but a "sensory diet" (Miller, 2006) may be a helpful addition to the family's routine around mealtimes. This may include extra movement and "heavy work" activities prior to mealtime to better prepare the child's sensory system. This could be provided by activities such as moving chairs around the table, setting the table using heavy, ceramic plates and/or carrying trash cans outside. To prepare the child's oral motor system prior to eating, a number of sensory strategies could be tried such as blowing whistles, bubbles, using a vibrating toy or toothbrush, etc. During the meal sensory strategies to improve mealtime success may include use of a positioning chair, air cushion and/or use of a weighted lap pillow or vest (Therapro, 2013). Additionally, some families have found playing soothing, rhythmical music in the background is a helpful strategy to make mealtimes more successful for their child with autism. There are numerous sensory strategies and suggestions to provide to families to help make mealtimes with their child more successful and less stressful.

Limitations

The present study has a number of strengths. This is the first study conducted which researched eating behaviors and sensory processing in children with autism and compared their results to a typically developing cohort using these measures. The two samples were of equal size and large enough to provide for an adequate effect size. Additionally, there were multiple measures utilized to assess both eating behaviors and sensory processing. Nevertheless, the study is limited by a number of factors. These include limitations inherent to survey data (parent-report questionnaires). As the study process required the parents to be informed of the purpose of the study and to volunteer to participate perhaps they self-selected if they had interest and/or concern about their child's sensory/eating behaviors. The child's diagnoses of autism and development level were reported by parent without validation by formal standardized testing or documentation of diagnosis and functioning level. There were uneven subject numbers and small sample sizes when separating the children with ASD into three levels of development. This likely made those results less robust and reported with less confidence. Gathering additional quantitative data with additional eating measures and qualitative data through direct observations of eating/ sensory behaviors would have contributed more depth and breadth to the study. Finally, as the subjects all were from the Springfield/Amherst area results could not be confidently extrapolated to children from other areas. This was a non-randomized, sample of convenience. Regarding use of a sample of convenience, Pan, 2008, writes “an unbiased sample is the best way to obtain data that can be generalized to a population with a high degree of confidence”, p. 26.

Future Research

It would be interesting to replicate this study with a larger sample size for improved analysis of the three age groups and three development levels. When the groups were separated there were only from 10 – 13 children per group. Perhaps if those samples were larger the results would look different. Use of additional assessment tools would also be interesting, i.e. other sensory and eating assessments, to further compare function between both samples. Are there differences in these two constructs, eating behavior and sensory processing, on these same measures in different cultures? Replicating this study with a sample of children from Puerto Rico, for example, would be extremely interesting. The population of children with autism is much higher in Puerto Rico than it is in the United States. It would be interesting to learn more about this population and to better understand why there is a higher incidence in Puerto Rico when compared with the U.S.

APPENDIX A

INSTITUTIONAL REVIEW BOARD DOCUMENT

CITI Collaborative Institutional Training Initiative (CITI)

Social and Behavioral Responsible Conduct of Research Curriculum
Completion Report
Printed on 9/11/2010

Learner: Jeanne Zobel (username: jeannezobel)
Institution: University of Massachusetts Amherst
Contact Information Department: CFS
Phone: 4135673826
Email: jzl@student.umass.edu

Social and Behavioral Responsible Conduct of Research: This course is for investigators, staff and students with an interest or focus in **Social and Behavioral** research. This course contains text, embedded case studies AND quizzes.

Stage 1. Basic Course Passed on 09/11/10 (Ref # 4920305)

Elective Modules	**Date Completed**	
Introduction to the Responsible Conduct of Research	09/10/10	no quiz
Research Misconduct 2-1495	09/11/10	4/5 (80%)
Data Acquisition, Management, Sharing and Ownership 2-1523	09/11/10	4/5 (80%)
Publication Practices and Responsible Authorship 2-1518	09/11/10	4/5 (80%)
Peer Review 2-1521	09/11/10	4/5 (80%)
Mentor and Trainee Responsibilities 01234 1250	09/11/10	5/6 (83%)
Animal Welfare 13301	09/11/10	6/8 (75%)
Conflicts of Interest and Commitment 2-1462	09/11/10	5/6 (83%)
Collaborative Research 2-1484	09/11/10	5/6 (83%)
Human Subjects 13566	09/11/10	9/11 (82%)
The CITI RCR Course Completion Page.	09/11/10	no quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI participating institution. Falsified information and unauthorized use of the CITI course site is unethical, and may be considered scientific misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Course Coordinator

Return

APPENDIX B

LETTERS TO SUBJECTS

Dear___________________________,

I am conducting a study which looks at the eating behaviors and sensory processing of children on the autism spectrum. The study will involve children between **five and twelve years of age**, with a documented **diagnosis of autism** without any known physical disabilities**.** This study completes partial fulfillment of my doctoral studies at the University of Massachusetts, Amherst. If your child meets the above criteria and you agree to participate, please complete the enclosed informed consent form. **You and your child's responses and identity will remain confidential.**

If you agree to participate and have completed the consent form, I will send you five questionnaires, four parent and one child, to fill out. One is demographic/developmental history form. Two of the parent questionnaires will help identify your child's response to sensory processing; one evaluates your child's mealtime behaviors. The fifth form is a child questionnaire which helps identify your child's response to touch. The questionnaires should take about 20 minutes to complete. I will contact you about a convenient way for you to receive and return the questionnaires.

After completion, you and your child can receive a gift card to a local, child-friendly establishment and/or a small gift for your child. Additionally, you can receive the scores and written summary of the tests results; over a $250 value which you may forward to your child's service providers.

I appreciate your help with my study!

Please do not hesitate to contact myself or my advisor:

Jeanne Zobel-Lachiusa (doctoral candidate)

(413) 887-9090

jzl@educ.umass.edu

Ernest Washington (advisor)

(413) 543-6985

ewashington@educ.umass.edu

ASE (Autism, Sensory and Eating Study)

<u>Informed Consent for Voluntary Participation</u>

I volunteer to participate in the Autism, Sensory and Eating (ASE) study and understand:

1. I will be contacted by Jeanne Zobel-Lachiusa who will give me five questionnaires to fill out.

2. The questionnaires include: a demographic/ developmental history form; a parent report sensory questionnaire; a second parent report sensory questionnaire; a parent report eating behavior questionnaire and, a child report sensory questionnaire.

3. My name or my child's name will not be used, nor will I be identified personally, in any way or at any time.

4. I may withdraw from part or all of this study at any time.

5. I have the right to review material prior to the oral exam or other publication.

6. I understand that the results from this study may be included in Jeanne Zobel-Lachiusa's doctoral dissertation and may also be included in manuscripts submitted to professional journals for publication.

If you have any questions about this research or your participation in it, you may reach me at:

Jeanne Zobel-Lachiusa
413 887 9090(c)
413 567 3826 (h)
JZL@ educ.umass.edu

You may also contact my advisor:
Dr. Ernest Washington: 413 545 6985
School of Education 123 Furcolo Hall
ewashington@educ.umass.edu

(Participant signature, Date) **(Researcher signature, Date)**

Please sign two copies. One copy should be retained for your records, the other for my records.

APPENDIX C

ASSESSMENT FORMS

Autism, Sensory,Eating Study (ASE) Demographics and Developmental History

Parent/Guardian.:.{first only,______________________________Phone:.____________________

Address:.____E-Mail:.________________

Child's Name:(first only).________________________________Birthdate:.________________

Age: _______ Grade:.________________________School: ____________________

Child's Ethnicity:___________________________ Dominant Language:.________________

More than one language spoken at home?: Y/N If so,which language?:.______________

1. Special Education services received in school (Circle all that apply,fill in

times): Para,time; Consult,time; Speech,time; OT,time: PT,time; Other

2. Other specialized services/ programs received after school (use reverse if needed):

3. ASD Diagnosis (date, professional}:____

4. IQ score (date,professional):____

5. Other diagnoses/ Significant medical conditions:________________________________

6. How would you describe your child's overall *motor* development? (Circle the best choice) Typical; Slight delayed; Very delayed

7. How would you describe your child's overall *language* development? (Circle the best choice) Typical; Slight delayed; Very delayed

8. How would you describe your child's overall *social* development? (Circle the best choice) Typical; Slight delayed; Very delayed

9. At what age did your child accept: Pureed baby food (_________};Finger foods(._______); Liquids

10. Please describe mealtimes with your child:_____________________________________

Short Sensory Profile

SENSORY PROFILE
Winnie Dunn, Ph.D., OTR, FAOTA

Child's Name: ______________________ Birth Date: __________ Date: __________

Completed by: ______________________ Relationship to Child: __________

Service Provider's Name: ______________________ Discipline: __________

INSTRUCTIONS

Please check the box that **best** describes the frequency with which your child does the following behaviors. Please answer all of the statements. If you are unable to comment because you have not observed the behavior or believe that it does not apply to your child, please draw an X through the number for that item. Please do not write in the Section Raw Score Total row.

Use the following key to mark your responses:

- **ALWAYS** When presented with the opportunity, your child always responds in this manner, 100% of the time.
- **FREQUENTLY** When presented with the opportunity, your child frequently responds in this manner, about 75% of the time.
- **OCCASIONALLY** When presented with the opportunity, your child occasionally responds in this manner, about 50% of the time.
- **SELDOM** When presented with the opportunity, your child seldom responds in this manner, about 25% of the time.
- **NEVER** When presented with the opportunity, your child never responds in this manner, 0% of the time.

Item	Tactile Sensitivity	ALWAYS	FREQUENTLY	OCCASIONALLY	SELDOM	NEVER
1	Expresses distress during grooming (for example, fights or cries during haircutting, face washing, fingernail cutting)					
2	Prefers long-sleeved clothing when it is warm or short sleeves when it is cold					
3	Avoids going barefoot, especially in sand or grass					
4	Reacts emotionally or aggressively to touch					
5	Withdraws from splashing water					
6	Has difficulty standing in line or close to other people					
7	Rubs or scratches out a spot that has been touched					
	Section Raw Score Total					
Item	**Taste/Smell Sensitivity**					
8	Avoids certain tastes or food smells that are typically part of children's diets					
9	Will only eat certain tastes (list: ______)					
10	Limits self to particular food textures/temperatures (list: ______)					
11	Picky eater, especially regarding food textures					
	Section Raw Score Total					
Item	**Movement Sensitivity**					
12	Becomes anxious or distressed when feet leave the ground					
13	Fears falling or heights					
14	Dislikes activities where head is upside down (for example, somersaults, roughhousing)					
	Section Raw Score Total					
Item	**Underresponsive/Seeks Sensation**					
15	Enjoys strange noises/seeks to make noise for noise's sake					
16	Seeks all kinds of movement and this interferes with daily routines (for example, can't sit still, fidgets)					
17	Becomes overly excitable during movement activity					
18	Touches people and objects					
19	Doesn't seem to notice when face or hands are messy					
20	Jumps from one activity to another so that it interferes with play					
21	Leaves clothing twisted on body					
	Section Raw Score Total					

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Item	Auditory Filtering	Always	Frequently	Occasionally	Seldom	Never
22	Is distracted or has trouble functioning if there is a lot of noise around					
23	Appears to not hear what you say (for example, does not "tune-in" to what you say, appears to ignore you)					
24	Can't work with background noise (for example, fan, refrigerator)					
25	Has trouble completing tasks when the radio is on					
26	Doesn't respond when name is called but you know the child's hearing is OK					
27	Has difficulty paying attention					
	Section Raw Score Total					

Item	Low Energy/Weak	Always	Frequently	Occasionally	Seldom	Never
28	Seems to have weak muscles					
29	Tires easily, especially when standing or holding particular body position					
30	Has a weak grasp					
31	Can't lift heavy objects (for example, weak in comparison to same age children)					
32	Props to support self (even during activity)					
33	Poor endurance/tires easily					
	Section Raw Score Total					

Item	Visual/Auditory Sensitivity	Always	Frequently	Occasionally	Seldom	Never
34	Responds negatively to unexpected or loud noises (for example, cries or hides at noise from vacuum cleaner, dog barking, hair dryer)					
35	Holds hands over ears to protect ears from sound					
36	Is bothered by bright lights after others have adapted to the light					
37	Watches everyone when they move around the room					
38	Covers eyes or squints to protect eyes from light					
	Section Raw Score Total					

FOR OFFICE USE ONLY

Summary

Instructions: Transfer the score for each section to the Section Raw Score Total column. Plot these totals by marking an X in the appropriate classification column (Typical Performance, Probable Difference, Definite Difference).*

SCORE KEY

1 = Always
2 = Frequently
3 = Occasionally
4 = Seldom
5 = Never

Section	Section Raw Score Total	Typical Performance	Probable Difference	Definite Difference
Tactile Sensitivity	/35	35 — 30	29 — 27	26 — 7
Taste/Smell Sensitivity	/20	20 — 15	14 — 12	11 — 4
Movement Sensitivity	/15	15 — 13	12 — 11	10 — 3
Underresponsive/Seeks Sensation	/35	35 — 27	26 — 24	23 — 7
Auditory Filtering	/30	30 — 23	22 — 20	19 — 6
Low Energy/Weak	/30	30 — 26	25 — 24	23 — 6
Visual/Auditory Sensitivity	/25	25 — 19	18 — 16	15 — 5
Total	/190	190 — 155	154 — 142	141 — 38

*Classifications are based on the performance of children without disabilities ($n = 1{,}037$).

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BAMBI

Think about mealtimes with your child over the past 6 months. Rate the following items according to how often each occurs, using the following scale:

Never/Rarely	Seldom	Occasionally	Often	At Almost Every Meal
1	2	3	4	5

Circle YES if you think an item is a problem for you or NO if you think it is not a problem.

1. My child cries or screams during mealtimes.	1	2	3	4	5	YES	NO
2. My child turns his/her face or body away from food.	1	2	3	4	5	YES	NO
3. My child remains seated at the table until the meal is finished.	1	2	3	4	5	YES	NO
4. My child expels (spits out) food that he/she has eaten.	1	2	3	4	5	YES	NO
5. My child is aggressive during mealtimes (hitting, kicking, scratching others).	1	2	3	4	5	YES	NO
6. My child displays self-injurious behavior during mealtimes (hitting self, biting self).	1	2	3	4	5	YES	NO
7. My child is disruptive during mealtimes (pushing/throwing utensils, food).	1	2	3	4	5	YES	NO
8. My child closes his/her mouth tightly when food is presented.	1	2	3	4	5	YES	NO
9. My child is flexible about mealtime routines (e.g., times for meals, seating arrangements, place settings).	1	2	3	4	5	YES	NO
10. My child is willing to try new foods.	1	2	3	4	5	YES	NO
11. My child dislikes certain foods and won't eat them.	1	2	3	4	5	YES	NO
12. My child refuses to eat foods that require a lot of chewing (e.g., eats only soft or pureed foods).	1	2	3	4	5	YES	NO
13. My child prefers the same foods at each meal.	1	2	3	4	5	YES	NO
14. My child prefers "crunchy" foods (e.g., snacks, crackers).	1	2	3	4	5	YES	NO
15. My child accepts or prefers a variety of foods.	1	2	3	4	5	YES	NO
16. My child prefers to have food served in a particular way.	1	2	3	4	5	YES	NO
17. My child prefers only sweet foods (e.g, candy, sugary cereals).	1	2	3	4	5	YES	NO
18. My child prefers food prepared in a particular way (e.g., eats mostly fried foods, cold cereals, raw vegetables).	1	2	3	4	5	YES	NO

SENSORY/EATING CHECKLIST Please check:

	My child:	Never 1	Seldom 2	Occasi. 3	Often 4	Almost Always 5	Comments
1	Prefers food of consistent texture & temperature						
2	Gags w/ certain foods						
3	Has difficulty using utensils, prefers finger foods						
4	Does not feel food on face or is overly neat						
5	Has poor awareness of pain or temperature (circle)						
6	Prefers chewy or crunchy foods (circle one/both)						
7	Does not appropriately chew food						
8	Easily tires when chewing						
9	Does not use enough force to bite or cut						
10	Props body up (hand under chin) or leans head						
11	Has difficulty with sitting balance						
12	Needs movement; frequently sits & stands						
13	Constantly shifts position in chair						
14	Tires easily						
15	Difficulty maintaining attention						
16	Difficulty using eyes and hands together						
17	Difficulty finding food against background						
18	Is bothered by patterns on table or plate						
19	Is distracted by visual input						
20	Holds head close to food						
21	Is distracted by the noise of food, people talking, etc.						
22	Dislikes the sound in his/her head when chewing						
23	Has difficulty eating when someone else is talking						
24	Appears to not hear, even when called						
25	Has difficulty with certain tastes/odors						
26	Becomes upset when smelling food cooking						

JZL(5/12) Modified from Yack, Sutton, Aquilla,, 2002 in *Building Bridges*.

TOUCH INVENTORY FOR ELEMENTARY SCHOOL-AGED CHILDREN (TIE)

By Charlotte Brasic Royeen

Please have *your child* respond to the following questions:	**NO**	**A Little**	**A LOT**	**Comments**
Does it bother you to go barefooted?				
Do fuzzy shirts bother you?				
Do fuzzy socks bother you?				
Do turtleneck shirts bother you?				
Does it bother you to have your face washed?				
Does it bother you to have your nails cut?				
Does it bother you to have your hair combed by someone else?				
Does it bother you to play on a carpet?				
After someone touches you, do you feel like scratching that spot?				
After someone touches you, do you feel like rubbing that spot?				
Does it bother you to walk barefooted in the grass and sand?				
Does getting dirty bother you?				
Do you find it hard to pay attention?				
Does it bother you if you cannot see who is touching you?				
Does finger painting bother you?				
Do rough bedsheets bother you?				
Do you like to touch people, but it bothers you when they touch you back?				
Does it bother you when people come from behind?				
Does it bother you to be kissed by someone other than your parents?				
Does it bother you to be hugged or held?				
Does it bother you to play games with your feet?				
Does it bother you to have your face washed?				
Does it bother you to be touched if you don't expect it?				
Do you have difficulty making friends?				
Does it bother you to stand in line?				
Does it bother you when someone is close by?				

APPENDIX D

SAMPLE TEST RESULTS REPORT

Autism, Sensory, Eating (ASE) Study Questionnaire Results

Child: *** **Age**: 9.11 years **Date forms were completed:** 6/20/2012

1. Sensory Profile: The Short Sensory Profile is a 38 item caregiver questionnaire which asks questions of the child's responses to a variety of sensory inputs. Scores are reported as "Typical Performance", "Probable Difference", "Definite Difference".

SECTION	TYPICAL	PROBABLE DIFFERENCE	DEFINITE DIFFERENCE
Tactile Sensitivity			*
Taste/Smell Sensitivity			*
Movement Sensitivity	*		
Seeks Sensation			*
Auditory Filtering			*
Low Energy/ Weak			*
Visual/Auditory Sensitivity			*

According to the SSP results, Zac exhibits a definite difference when compared with similarly-aged peers in sensory processing in all areas except for movement sensitivity (he does not exhibit behaviors demonstrating over sensitivity to movement).

2. Brief Autism Mealtime Behavior Inventory (BAMBI) is an18 item parent questionnaire designed to measure mealtime behaviors of children with autism. The items are rated according to how often each behavior occurs. The higher the percentile score, the more problematic the eating behaviors.

Child's Raw Score	Maximal Score	Child's Percentile Score
49	74	66%

Zac's score of 66% indicates he likely exhibits moderate problem eating behaviors as he scored in the top third when compared with scores of similarly-aged children. Parent comments report difficulties with mealtimes as indicated by comments such as: limits himself to primarily "crunchy, chewy" foods and will eat only certain tastes such as "bland, white foods -rice, pasta, tofu" and, "Mealtimes are stressful".

3. **<u>The Sensory/Eating Checklist</u>** is a 26 item checklist which asks questions about eating behaviors of the child's caregiver. The questions ask about eating behaviors related to six sensory domains. The higher the percentile score, the less typical or less desirable the response.

Tactile	**Proprioception**	**Vestibular**	**Visual**	**Auditory**	**Olfactory**
18/25	15/25	21/25	12/25	10/20	8/10
72%	60%	**84%**	48%	50%	**80%**

Four out of six scores were in the above average (problematic) range except for visual and auditory processing which were in the moderate range. Tactile (touch), movement (vestibular) input and Olfactory (smell) were the relative highest scores.

4. **<u>Touch Inventory for Elementary-School-Aged Children</u> (TIE)** is a 26 item screening scale which asks questions of the child to assess tactile defensive behaviors (over sensitivity to touch). The ***higher the percentile score***, the more the child's self-reported behaviors are associated with behaviors indicative of ***tactile defensiveness***.

TIE Results:

Percentile Score	0	10	25	50	75	90	95	100
Raw Score	25	30	35	40	**45(47)**	50	55	60

Raw Score= 47; Percentile Score: 75% (greater than average). Zac's self-report behaviors suggest an above average level of sensitivity to touch input (tactile defensiveness).

<u>Overall Summary:</u> According to these test results, Zac exhibits exhibits moderate problem eating behaviors as he scored in the top third when compared with scores of similarly-aged children. Zac exhibits a definite difference when compared with similarly-aged peers in sensory processing in all areas, particularly movement seeking, touch and olfactory, except for movement sensitivity (he does not exhibit behaviors demonstrating over sensitivity to movement). Zac reported feeling bothered by touch input greater than 75% of his peers (over sensitive to touch or "tactile defensive"). Parent reports that mealtimes are "stressful", he does not like to eat and there is "alot of power struggle at mealtimes". Some of his eating difficulties may be explained, in part, by a difference in sensory processing. The following suggestions may help make mealtimes more successful.

Suggestions include:

- Increasing Zac's self-awareness of his sensory sensitive/seeking behaviors (oversensitive to touch, smells and seeking extra movement) through use of cognitive/behavior strategies such as "How Does your Engine Run", or similar programs.
- Increase Zac's comfort with prolonged sitting required at mealtimes through use of alternate seating devices ("move 'n sit" cushion,

"positioning chair", weighted lap or shoulder cushion, etc.).

- Refer to Therapro website for catalog of sensory-related items and information(www.Therapro.com; (800) 257-5376).

Thank you for the opportunity to assess your son's functioning in the above areas and for participating in my study! Please contact me with questions:

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APPENDIX E

NON PARAMETRIC TESTS RESULTS

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of BambiTotal2 is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
2	The distribution of SECTotal2 is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
3	The distribution of TIETotal2 is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
4	The distribution of SSP_RE is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of BambiTotal2 is the same across categories of DevInt.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
2	The distribution of SECTotal2 is the same across categories of DevInt.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of TIETotal2 is the same across categories of DevInt.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of SSP_RE is the same across categories of DevInt.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of BambiTotal2 is the same across categories of age_group.	Independent-Samples Kruskal-Wallis Test	.563	Retain the null hypothesis.
2	The distribution of SECTotal2 is the same across categories of age_group.	Independent-Samples Kruskal-Wallis Test	.890	Retain the null hypothesis.
3	The distribution of TIETotal2 is the same across categories of age_group.	Independent-Samples Kruskal-Wallis Test	.915	Retain the null hypothesis.
4	The distribution of SSP_RE is the same across categories of age_group.	Independent-Samples Kruskal-Wallis Test	.439	Retain the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of tactile is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
2	The distribution of taste is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
3	The distribution of seeks is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
4	The distribution of auditory is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
5	The distribution of weak is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.
6	The distribution of move is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.002	Reject the null hypothesis.
7	The distribution of visuals is the same across categories of Sample.	Independent-Samples Mann-Whitney U Test	.000	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

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