

Sensory Modulation and Affective Disorders in Children and Adolescents With Asperger's Disorder

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OBJECTIVE. The purpose of the study was to determine if there were significant relationships between dysfunction in sensory modulation, symptoms of affective disorders, and adaptive behaviors in children and adolescents with Asperger's disorder between 6 and 17 years of age.

METHOD. Parents of 50 children and adolescents between 6 and 17 years of age diagnosed with Asperger's disorder based on the *Diagnostic and Statistical Manual of Mental Disorders-IV* criteria completed the (a) Sensory Profile for children 6 to 10 years of age or the Adolescent/Adult Sensory Profile for adolescents 11 to 17 years of age; (b) the Adaptive Behavior Assessment System: Parent Version; (c) Revised Children's Manifest Anxiety Scale Adapted Parent's Version; and (d) the Children's Depression Inventory Adapted Parent's Version. Descriptive statistics and the Pearson product-moment coefficient of correlation calculations were used for data analysis.

RESULTS. The results indicated that there were significantly strong positive correlations between sensory defensiveness and anxiety ($r = .476, p = .000$) in children and adolescents with Asperger's disorder. There were also significant relationships between symptoms of depression and hyposensitivity in the total group ($r = .214, p = .05$) and the older group ($r = .492, p = .027$). There were no significant relationships between depression and overall adaptive behavior ($r = -.243, p = .089$) or anxiety and overall adaptive behavior ($r = -.108, p = .455$). Significantly strong inverse relationships were found between the specific adaptive behaviors of functional academics, leisure, social skills, and symptoms of depression. Functional academics were also significantly inversely related to anxiety. Specifically, sensory hyper- and hypersensitivity were significantly inversely related to community use and social skills.

CONCLUSION. The data supports positive relationships between anxiety and sensory defensiveness in all age ranges and a relationship between depression and hyposensitivity in older children. Stronger inverse relationships were apparent between specific adaptive behaviors including: (a) symptoms of depression and functional academics, leisure, social skills; (b) anxiety and functional academics; and (c) both sensory hyper- and hyposensitivity and community use and social skills. In this study, as the symptoms of affective disorders increased in children and adolescents with Asperger's disorder, the functional performance in the adaptive behaviors of functional academics and social skills appeared to decrease. Performance in the adaptive behaviors of community use and social skills appeared to decrease as symptoms of dysfunction in sensory modulation increase. Further research is necessary to determine the impact of treatment for dysfunction on sensory modulation on affective disorders and performance in specific adaptive behaviors.

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Introduction

Asperger's disorder is a neurodevelopmental disability characterized by social deficits and restricted interests (Volkmar & Klin, 2000). It is categorized as a pervasive developmental disorder (PDD) in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV; American Psychiatric Association [APA] 1994). Asperger's disorder is a condition affecting approximately 36 persons for every 10,000 (Cumine, Leach, & Stevenson, 1998) and is considered serious and chronic with many functional implications. It is associated with motor awkwardness, clumsiness, learning difficulties, and symptoms of anxiety (Martin, Patzer, &

Volkmar, 2000). Sensory processing issues have been identified by numerous researchers as prevalent in individuals with Asperger's disorder and other PPDs (Baranek & Berkson, 1994; Dawson & Lewy, 1989; Lincoln, Courchesne, Harms, & Allen, 1995; Ornitz, 1989; Wainwright-Sharp & Bryson, 1993). In particular, individuals with PDDs may have sensory modulation disorders that lead them to under or overrespond to sensory stimuli in their environment (Ornitz).

Dysfunction in sensory modulation is a pattern in which a person under or overresponds to sensory input from the body or environment (Hanft, Miller, & Lane, 2000). Individuals who underrespond do not react to the intensity or frequency of sensory stimuli with the same magnitude as others (Lane, 2002). They demonstrate "a less intense reaction than that seen in most individuals under the same circumstances" (p. 108). In her model, Dunn (1997) identifies that individuals who underrespond to sensory stimuli demonstrating hyposensitivity have a high neurological threshold requiring more intense amounts of input in order to register and elicit a response. In some of the literature, this is called sensory dormancy (Lai, Parham, & Johnson-Ecker, 1999). In contrast, children who overrespond have a low neurological threshold resulting in strong reactions to sensory stimuli with very minimal input. Often, this phenomenon is termed sensory defensiveness due to the behavioral responses associated with hypersensitivity or overresponsiveness. For example, individuals with sensory defensiveness often avoid or demonstrate distressed responses to sensory stimuli in the environment. Specifically, sensory defensiveness is a fight or flight reaction to the same sensory stimuli by others considered non-noxious (Bundy, Lane, & Murray, 2002).

Affective disorders such as depression and anxiety have been theorized to have a relationship with hyposensitivity and hypersensitivity to environmental sensory stimuli (Johnson, 1975; Lader & Matthews, 1968; Neal, Edelman, & Glachan, 2002). Similar central nervous system arousal levels are associated with both sensory modulation and affective disorders. It is speculated that depression and sensory hyposensitivity are associated with low levels of arousal whereas anxiety and sensory defensiveness are associated with high levels of arousal (Johnson; Lane, 2002). Along with this, both depression and anxiety are considered comorbid conditions with Asperger's disorder. Thirty-nine of 60 children with Asperger's disorder in one study identified symptoms of high anxiety (Martin, Scchill, Klin, & Volkmar, 1999) whereas approximately 15 of 99 children diagnosed with Asperger's disorder in another study (Klin & Volkmar, 1997) had the comorbid condition of depression. It is theorized that anxiety occurs initially due to faulty

information processing resulting in hypersensitivity to information and stimuli in the environment (Johnson). The person becomes anxious due to constant overreactions to insignificant information in the environment. Johnson speculates that depression is a defense reaction in order to cope with anxiety. In order to cope, the person decreases his response to incoming sensory information through the activation of physiological mechanisms normally responsible for inducing sleep. Therefore, the person with depression often demonstrates lethargy and a lack of responsiveness, which is also common in hyposensitivity (Bundy & Murray, 2002). This view presents hyper- and hyposensitivity as two sides of the same coin. This was proposed in a research study by Lai, Parham, and Johnson-Ecker (1999). They theorized that children with severe hypersensitivity attempt to shut off sensory input in order to protect themselves from sensory overload. Results of this study identified that both were interrelated, but the association was not strong enough without further research to determine if they reflect the same modulation disorder. Other studies based on information processing and behavioral inhibition theory have provided support for reactivity to environmental information and anxiety and depression (Axelson & Birmaher, 2001; Kagan, Reznick, & Snidman, 1987; Warren, Huston, Egeland, & Srouffe, 1997). There is additional research regarding the relationship between anxiety and sensory defensiveness in a study by Kinnealey and Fuiiek (1999). This study established a significant positive relationship between the two constructs in adults identified with sensory defensiveness. Further support for the relationship between sensory defensiveness and anxiety was provided by Neal and colleagues (2002). They completed a study with adults revealing that higher levels of anxiety were associated with self-reported sensitivity to environmental stimuli. There is still a need for further research exploring the relationship between hyposensitivity and depression and between sensory modulation and affective disorders such as anxiety and depression in children and adolescents with Asperger's disorder.

Clarification of the relationships between sensory modulation and affective disorders in children and adolescents with Asperger's disorder can assist with diagnosis, evaluation, and treatment. This is particularly relevant to occupational therapy as the domain of the profession is to assist others to be able to attain, regain, or maintain their ability to participate in occupations (Youngstrom, 2002). Occupational therapists are involved in evaluating and treating both dysfunction in sensory modulation and affective disorders in a wide range of individuals including those with Asperger's disorder. The diagnostic criteria of both anxiety disorders and depression identify that the person

must have deficits in social occupations or other areas of functioning (APA, 1994). Dysfunction in sensory modulation also has significant effects on the successful ability to engage in occupations. Behaviors associated with this disorder can lead a person to avoid certain life occupations or have difficulty participating in the occupation successfully (Kinnealey, 1998; Kinnealey, Oliver, & Wilbarger, 1995; Pfeiffer, 2002).

Another area needing clarification that is relevant to the treatment and evaluation of Asperger's disorder is adaptive behavior. Adaptive behavior is the ability to function and meet environmental demands. This includes the skills necessary to effectively and independently take care of one's self and the social skills for interactions with other people (Harrison & Oakland, 2000). Although previous studies have identified that children with PDDs have deficits in adaptive behaviors (Loveland & Kelley, 1991; Rodrigue, Morgan, & Geffken, 1991), research specifically with individuals who have Asperger's disorder is limited (Klin, Sparrow, Marans, Carter, & Volkmar, 2000). McLaughlin-Cheng (1998) compared the adaptive behaviors of children with autism and Asperger's disorder in a meta-analysis and revealed a significant effect size ($ES = 0.86$), indicating that the children with Asperger's disorder performed better than the children with autism in overall adaptive behavior functioning. The author suggested that differences in adaptive behavior performance differentiate the two conditions and provide support for two distinct diagnostic categories. In contrast, another study (Klin et al.) reported that children with Asperger's disorder demonstrated the same patterns on an adaptive behavior measure as children with high functioning autism except for higher scores in communication skills and lower scores in motor skills. Although overall profiles were similar, this continues to provide some support for differences in the areas of motor and communication skills between the two groups. These differences may provide further diagnostic criteria to differentiate children with Asperger's disorder versus those with high functioning autism. Furthermore, research identifying the relationship between adaptive behavior, affective disorders, and sensory modulation disorders is scant for the individual with Asperger's disorder. Insight into the profiles of adaptive behavior and the influence of sensory modulation and affective disorders in children and adolescents with Asperger's disorder provides necessary information for evaluation and intervention. It allows interventionists to identify the most appropriate assessment tools for use during the evaluation process which then provide the basis for the treatment planning process. This is particularly relevant for occupational therapists whose role is to promote optimal performance in life roles and occupa-

tions. Adaptive behavior is synonymous with optimal performance in life roles and occupations. Occupational therapists address those underlying conditions and influences such as sensory modulation disorders that impact on a person's adaptive behavior.

In summary, Asperger's disorder shares common diagnostic features with other disorders. Previous research has identified relationships between Asperger's disorder and affective disorders and Asperger's disorder and dysfunction in sensory modulation although no studies discuss the relationships between affective disorders and dysfunction in sensory modulation in children with Asperger's disorder. Also, there is minimal research on how these relationships impact adaptive behaviors. This study explored the relationships between sensory modulation disorders, the affective disorders of anxiety and depression, and adaptive behavior in children and adolescents diagnosed with Asperger's disorder. Specifically, the purpose of the study was to determine if there were significant relationships between dysfunction in sensory modulation, affective disorders, and adaptive behaviors in children and adolescents between 6 and 17 years of age. There were four main hypotheses: (a) there will be a positive relationship between sensory defensiveness and anxiety, (b) there will be a positive relationship between sensory hyposensitivity and symptoms of depression, (c) there will be a negative relationship between the levels of anxiety and depressive symptoms and overall adaptive behaviors, and (d) there will be a negative relationship between levels of hyper- and hyposensitivity and overall adaptive behavioral functioning. Understanding the relationships between these conditions and adaptive behaviors in children and adolescents with Asperger's disorder allows occupational therapists to identify and use the most appropriate assessments in the evaluation process. This further guides the therapist in using the most effective treatment interventions.

Methods

This correlational study explored the relationship of sensory modulation disorders, the affective disorders of anxiety and depression, and adaptive behaviors.

Participants

Participants were a volunteer convenience sample of parents of children and adolescents between the 6 and 17 years of age diagnosed with Asperger's disorder by a medical doctor or psychologist based on the DSM-IV criteria. As determined by a power analysis based on a sample-size reference table (Cohen, 1988), the study was adequately powered with 50 participants.

Measurement Tools

There were five instruments used to measure sensory modulation, anxiety, symptoms of depression, and adaptive behaviors. The instruments were all parent report as Attwood (1998) identified that children and adolescents with Asperger's disorder often have difficulty expressing and understanding their feelings and emotions.

Sensory Profile. The Sensory Profile (Dunn, 1999) measured sensory hypersensitivity and hyposensitivity in children 6 to 10 years of age. This is a judgment-based questionnaire (Law, Baum, & Dunn, 2001) completed by the parents or caregivers of the individual. It has 125 questions and is based on a 5-point Likert scale ranging from always (1) to never (5). The caregiver ranks the frequency in which the child engages in each behavior. The Sensory Profile is divided into the four areas of low registration, sensory seeking, sensory avoidance, and sensory sensitivity based on a factor analysis completed and validated by Dunn (1999).

Both convergent and discriminant validity were established by comparing the Sensory Profile to the School Function Assessment (SFA) (Dunn, 1999). Cronbach's α , calculated to determine internal consistency for each factor, varied for each factor between .7245 to .9151 (Dunn, 1999).

Adolescent/Adult Sensory Profile. The Adolescent/Adult Sensory Profile (Brown & Dunn, 2002) is a self-report measure standardized for individuals between the 11 and 65 years of age. It was completed by a parent or caregiver for the purpose of this study. There are 60 questions based on a 5-point Likert scale ranging from almost never (1) to almost always (5). Scores are provided in four quadrants including low registration, sensation seeking, sensory sensitivity, and sensation avoiding.

Cronbach's α was calculated to determine internal consistency coefficients that ranged from .646 to .748 in the four quadrants for the adolescent population. Discriminative validity of .30 was determined using the New York Longitudinal Scales. Convergent validity was assessed by comparing the results of the physiological measure of skin-conductance responses, which are used as a physiological measure of the response to sensory information. Results were consistent with Brown and Dunn's (2002) hypotheses that people with low neurological thresholds would have greater responsivity and those with higher scores in sensation avoiding and low registration would be quicker to habituate to the sensory stimuli. Results of an analysis of variance indicated a significant difference ($p = .001$) across the four quadrant groups.

Adaptive Behavior Assessment System. The Adaptive Behavior Assessment System (ABAS) is a norm-referenced rating scale designed to assess typical daily adaptive living

skills of individuals 5 to 21 years of age (Harrison & Oakland, 2000). The parent version used for the study has a total of 232 questions divided into 10 sections in a Likert scale format. The ABAS assesses the parent's perception of the adaptive skill areas of communication, community use, functional academics, home living, health and safety, leisure, self-care, self-direction, social, and work. The ABAS demonstrates a high degree of internal consistency across all ages and adaptive skill areas. Test-retest reliability ranged from .75 to .96 and interrater reliability was .83.

Revised Children's Manifest Anxiety Scale Adapted Parent's Version. The Revised Children's Manifest Anxiety Scale (RCMAS) is a 37-item self-report that measures the level and nature of anxiety in children and adolescents from 6 to 19 years of age (Reynolds & Richmond, 2000). An adaptive parent's version of the scale was used in the study based on the research of Cole, Hoffman, Maxwell, & Scott (2000). It is scored on a 3-point scale of yes, sort of, and no. The total anxiety score was used for the purpose of this study. The parent's version demonstrated internal consistency of .90 and test-retest reliability of .68.

Children's Depression Inventory Adapted Parent's Version. The Children's Depression Inventory (CDI) Adapted Parent's Version (Cole et al., 2000) was used to assess symptoms of child and adolescent depression. There are 27 items rated on a 3-point scale. The overall depression score was used for the purposes of this study. The Adapted Parent's Version of the CDI demonstrated internal consistency of .87. Cronbach's α s were .87. Scores were stable over a 6-month period of time ($r = .74$). Both concurrent and convergent validity was moderately high in multiple studies.

Procedures

The researcher obtained approval from the Nova Southeastern University Institutional Review Board prior to the start of the study. A convenience sample of participants were recruited through various Asperger's disorder and autism support groups, private occupational therapy clinics, and through the ASCEND Web site, an organization supporting parents and professionals involved with individuals with Asperger's disorder. Information was provided to members of the support groups and staff at the clinics either through a presentation by the researcher or a letter provided to the parents through the contact people. At the presentations, self-addressed, stamped packets of the questionnaires were provided to parents who were interested and who qualified for the study. The contact people for the various organizations also provided packets or letters with a permission form to contact the parents regarding the study at support group meetings where the researcher was not present. The researcher contacted the parents who provided

permission to contact them through the letter to provide further information on the study and determine initial eligibility. Information regarding the study in a letter format was also posted on the ASCEND Web site. Parents interested in the study contacted the researcher via e-mail or telephone and information was provided. If the parents qualified, a packet with a self-addressed, stamped return envelope was mailed and also returned via mail within a suggested 2-week period of time after receiving the packet.

The packet contained an introductory letter with brief instructions on how to complete the packet, a demographic form, informed consent form, and the five measurement tools. All forms were coded with a participant number in order to maintain confidentiality. Parents were informed of their rights and the costs and benefits of the study in the informed consent. A letter requested information regarding the diagnosis of Asperger's disorder and permission to contact the person who diagnosed the child or adolescent. Forty-eight of the professionals who diagnosed the children confirmed the use of the DSM-IV as the criteria to diagnose Asperger's disorder. The parents of the other two children confirmed the use of the DSM-IV in diagnosing their children through professional written reports as the diagnostician relocated and was not able to be contacted. These professional reports documented the diagnoses of Asperger's disorder according to the guidelines of DSM-IV and therefore were included in the study.

If the scores of the anxiety and/or the depression measures fell above average ranges, the parents were contacted via telephone and referred to appropriate mental health services for his or her child. Clinically significant ranges were a *T*-score of 70 on the Child Depression Inventory Adapted Parent's Version and a raw score of 40 on the RCMAS Adapted Parent's Version.

Data Processing and Analysis

The raw scores of the Sensory Profiles, the RCMAS Parent's Adapted Version, and the CDI Adapted Parent's Version were used in the analysis. The standard scores of the ABAS were used as it reflects the level of adaptive behavior within specific age ranges.

The raw scores of the Sensory Profile and Adolescent/Adult Sensory Profile were transformed into a hundred point range in order for the scores to reflect the same point structure. To do this, the range of the scale was divided by 100 and multiplied by the raw score value. This was completed for the factors on the Sensory Profile that reflect low registration, sensory seeking, sensory sensitivity, and sensory avoiding. Once the scores were transformed on the Sensory Profile, they were then inverted by subtracting them from 100 in order to reflect the same direction as the

Adolescent/Adult Sensory Profile. High scores on the Adolescent/Adult Sensory Profile reflect higher levels of hyposensitivity and hypersensitivity while originally low scores on the Sensory Profile reflected this. The transformation of scores allowed for high scores on both to represent higher levels of hyposensitivity and hypersensitivity. In regard to the other measures, higher scores on the RCMAS Parent's Adapted Version and the CDI Parent's Adapted Version reflect higher levels of anxiety and depressive symptoms respectively. Higher scores on all of the measures with the exception of the ABAS reflect areas of dysfunction. Lower standard scores on the ABAS reflect dysfunction in adaptive behaviors. Reflecting the scoring procedure, an inverse relationship is hypothesized between adaptive behavior and the other study variables.

Data were analyzed using the SPSS (version 11). A descriptive analysis of the demographic data was completed on the aggregate of the subjects including the frequencies of gender, place of residence, ethnicity, and adoptive versus biological parents. Along with this, the age range and mean age were calculated. The Pearson Product Correlation Coefficient was used to determine if relationships existed between scores of the RCMAS Adapted Parent's Version, the CDI Adapted Parent's Version, the ABAS, and the Sensory Profiles. A Pearson Product Correlation Coefficient was calculated. This parametric statistic was chosen because of the sample size, the ranges of scores, and the ratio level of data.

Results

Descriptive Demographics

Forty-six biological parents and four adoptive parents participated in the study. Forty-seven of the participants were from the state of Pennsylvania, one from New Jersey, one from Nevada, and one from North Carolina. The children of the participants were all between 6 and 16 years of age with a mean age of 9.8 years. Forty-two of the children were males and eight were female. Forty-eight of the parents identified their children as Caucasian and two as Asian. Demographics of the data collected were based on the U.S. 2002 National Census. Table 1 provides study demographics of the younger group (6–10-year-olds), the older group (11–17-year-olds), and the total group. Two parents were excluded from the study as their children were diagnosed with Pervasive Developmental Disorder—Not Otherwise Specified. These parents were informed of this via telephone, but they still wanted to complete the questionnaires so that they could receive the scored information. Based on parent perception, six children fell within an above average range on the depression scale and five on the anxiety scale.

Table 1. Demographics for the Younger, Older, and Total Group

Demographic	Number in Each Group		
	Older Group (<i>n</i> = 20)	Younger Group (<i>n</i> = 30)	Total Group (<i>N</i> = 50)
Gender			
Males	16	26	42
Females	4	4	8
Ethnicity			
Caucasian	20	28	48
Asian	0	2	2
Other	0	0	0
Parents			
Biological	17	29	46
Adoptive	3	1	4

Out of these children, two scored within above average ranges on both the depression and anxiety scales. Eight of the nine children were already being treated through medications or other mental health services. Table 2 outlines intervention services received by the younger, older, and total group. A *t* test for independent samples was used to determine if there were significant differences between the older and younger group in regards to the intervention services received. There were significant differences in the areas physical therapy, $t(48) = 2.701, p < .01$ and number of children taking medications, $t(48) = -2.162, p < .05$ although no significant differences in any other areas. There were a higher percentage of children in the younger group receiving physical therapy than in the older group and a higher percentage of children in the older group being treated with medications.

Sensory Processing and Affective Disorders

Data exploring the relationships between sensory processing and affective disorders was analyzed for the total group,

Table 2. Intervention Services and Corresponding Percentages

Intervention Service	Percentage Receiving Intervention Service		
	Older Group (<i>n</i> = 20)	Younger Group (<i>n</i> = 30)	Total Group (<i>N</i> = 50)
Occupational therapy	75	83.3	80.4
Physical therapy	5	36.7	23.9
Speech and language therapy	60	83.3	78.3
Audiology	20	6.7	13
Psychological	55	66.7	60.9
Social work	0	10	6.5
Counseling	30	26.7	26.1
Resource room	30	33.3	32.6
Auditory Integration Training	10	3.3	6.5
Applied Behavioral Analysis	5	10	8.7
Sensory Integration Therapy	30	40	37
Other services	50	50	50
Medications	90	63.3	73.9

Table 3. Correlations Between the Hypersensitivity Scores of the Sensory Profiles and the Revised Children's Manifest Anxiety Scale Adapted Parent's Version

Category	<i>n</i>	<i>r</i>	<i>p</i>
Total group	50	.476	.000*
Older group	20	.701	.001*
Younger group	30	.591	.001*

**p* < .01

younger group, and older group. The younger group consisted of those children whose parents completed the Sensory Profile for their children 6 to 10 years of age and the older group consisted of those children whose parents completed the Adolescent/Adult Sensory Profile for their adolescents between of 11 to 17 years of age. There were 30 parents with children in the younger group and 20 parents with children in the older group.

The hypothesis suggesting a relationship between sensory hypersensitivity and anxiety was supported for the entire group ($r = .476, p < .000$) and the two groups divided by age. Both the younger group ($r = .591, p = .001$) and the older group ($r = .701, p = .001$) demonstrated significance at the .001 level. Results are outlined in Table 3. For the entire group, there was also a significant relationship between anxiety and both of the components of sensory hypersensitivity, sensory sensitivity ($r = .443, p = .001$) and sensory avoiding ($r = .467, p = .001$). The strengths of the correlations between anxiety and sensory hypersensitivity were all within adequately strong (.3 and above) to strong (.5 and above) ranges.

In regard to sensory hyposensitivity and symptoms of depression, there was a significant relationship for the whole group ($r = .214, p = .05$) although the strength of the relationship was within a low range (.3 and below). This means that although the relationship reached significance, the effect of the relationship is small. There was significance between symptoms of depression and hyposensitivity in the older group ($r = .492, p = .027$) with a moderately strong relationship but not in the younger group ($r = .083, p = .662$). Results are outlined in Table 4. There were no significant relationships between symptoms of depression and the subscales of sensory seeking and low registration in the younger group. In the total group, there was a significant

Table 4. Correlations Between the Hyposensitivity Scores of the Sensory Profiles and the Children's Depression Inventory Adapted Parent's Version

Category	<i>n</i>	<i>r</i>	<i>p</i>
Total group	50	.214	.05*
Older group	20	.492	.027*
Younger group	30	.083	.662

**p* < .05

relationship between sensory seeking and symptoms of depression ($r = .299, p = .035$) and in the older group a significant relationship between symptoms of depression and low registration ($r = .483, p = .031$). In contrast to the initial hypothesis, there was a significantly strong positive relationship between symptoms of depression and sensory hypersensitivity ($r = .394, p = .005$) in the total group. This relationship was also apparent with the younger group at a significant level ($r = .449, p = .013$) but not with the older group ($r = .230, p = .329$).

Adaptive Behavior and Affective Disorders

In regard to adaptive behavior, the hypothesis suggesting a relationship between the general adaptive behavior score and the raw score of the RCMAS Adapted Parent's Version was not significant ($r = -.108, p = .455$). A subsequent analysis revealed that there was a significant negative relationship between scores on the ABAS subscale of Functional Academics and the raw scores of the RCMAS Adapted Parent's Version ($r = -.274, p = .05$). A negative relationship suggests that as the level of anxiety increases, the level of adaptive behavior functioning in functional academics decreases. However, the strength of the correlation was within a lower range.

The hypothesis suggesting a relationship between depression and the level of adaptive behavior functioning was not significant for the total group ($r = -.243, p = .089$). A subsequent analysis revealed significant negative correlations between the subscales of functional academics ($r = -.330, p = .019$), leisure ($r = -.369, p = .008$), and social skills ($r = -.341, p = .016$) and the raw score from the CDI Adapted Parent's Version with the strength of the relationships in adequately strong ranges. Table 5 presents the cor-

relational relationships between adaptive behavior and affective disorders as well as adaptive behavior and sensory processing.

Adaptive Behavior and Sensory Processing

The hypothesis suggesting a negative relationship between sensory hypersensitivity and adaptive behavioral functioning was not supported ($r = -.249, p = .081$). A subsequent analysis revealed significant negative correlations between sensory hypersensitivity and the subscales on the ABAS of community use ($r = -.291, p = .041$) and social skills ($r = -.278, p = .05$). This hypothesis comparing the total hyposensitivity score and general scores of the ABAS ($r = -.260, p = .068$) was not significant. There were significant negative correlations between sensory hyposensitivity and the subscales on the ABAS of community use ($r = -.271, p = .05$) and social ($r = -.298, p = .036$).

In summary, the results indicated that there were significantly strong positive correlations between sensory defensiveness and anxiety in children and adolescents with Asperger's disorder. This was supported for the total group and both the younger and older group. There was also a significant relationship between symptoms of depression and hyposensitivity in the total group and the older group. In contrast, there was a significant relationship between depression and hypersensitivity in the total and younger group. There were no significant relationships between overall adaptive behavior and affective disorders. There were also no significant relationships between overall adaptive behavior and both hypersensitivity and hyposensitivity.

Discussion

Previous literature has documented the high prevalence of anxiety, depression, and dysfunction in sensory modulation in children and adolescents with Asperger's disorder. It has also identified patterns of adaptive behavior functioning in this population. This research study examined the interrelatedness of affective disorders, dysfunction in sensory modulation, and adaptive behavior in children and adolescents with Asperger's disorder in order to better guide occupational therapy evaluation and treatment.

Researchers have identified relationships between sensory defensiveness and anxiety in adults (Kinnealey & Fuiiek, 1999; Pfeiffer & Kinnealey, 2003) diagnosed with no medical or mental health issues. One study specifically identified an association between levels of anxiety and self-reported sensitivity to environmental stimuli in adult subjects who participated in anxiety and depression self-help organizations (Neal et al., 2002). As the level of anxiety increased, the adults reported an increased sensitivity to

Table 5. Correlations Between the Scales Measuring Anxiety, Depression, Sensory Hypersensitivity, and Sensory Hyposensitivity and the Adaptive Behavioral Assessment System

Scales	<i>r</i>	<i>p</i>
Anxiety		
Overall Adaptive Behavior	-.108	.455
Functional Academics	-.274	.05*
Depression		
Overall Adaptive Behavior	-.243	.089
Functional Academics	-.330	.019*
Leisure	-.369	.008**
Social Skills	-.341	.016*
Sensory Hypersensitivity		
Overall Adaptive Behavior	-.249	.081
Community Use	-.291	.041*
Social Skills	-.278	.05*
Sensory Hyposensitivity		
Overall Adaptive Behavior	-.260	.068
Community Use	-.271	.05*
Social Skills	-.298	.036

$n = 50$ * $p < .05$ ** $p < .01$

environmental stimuli. For children and adolescents with Asperger's disorder, there is ample evidence supporting a higher incidence of anxiety (Martin et al., 1999) and sensory modulation dysfunction (Dunn, Myles, & Orr, 2002) although prior to this study there was no specific literature that the author could find linking the two conditions in this population.

Researchers (Clark & Watson, 1991; Johnson, 1975; Neal et al., 2002) have suggested that individuals with anxiety tend to overrespond to environmental stimuli (sensory hypersensitivity) whereas those with depression tend to under-respond to environmental stimuli (sensory hyposensitivity) (Clark & Watson; Dickens, McGowen, & Dale, 2003; Johnson, 1975). It has been further proposed that as a defense mechanism to anxiety, an individual may shut down his or her responses to incoming sensory information leading to a state of depression and hyposensitive reactions. This suggests that anxiety and a state of sensory hypersensitivity over time may precede a state of depression and hyposensitive responses to sensory stimuli in the environment. This might further explain the differences in the results between the younger and older age groups. In the younger group, hyper- and hyposensitivity were both positively related to anxiety whereas in the older group hypersensitivity was related to anxiety and hyposensitivity related to depression.

Lane (2002) theorizes a more circular relationship between hyper- and hyposensitivity instead of a continuum. A child with mixed reactivity may demonstrate behaviors of defensiveness until they overload and go into shutdown. They then present with behaviors indicative of hyposensitivity. Others (Dunn, 1997; Wilbarger & Wilbarger, 1991) have theorized that poor modulation is the difficulty in finding and maintaining the appropriate level of arousal in the middle ground between hyper- and hyposensitivity resulting in fluctuation between the two extremes of reactions. It is important to note that a subsequent analysis revealed that 54% ($n = 25$) of the children and adolescents in the study did not meet criteria for a purely hypersensitive or hyposensitive group suggesting that mixed reactivity was present. Further research is also necessary to determine if mixed reactivity is related to the comorbidity of anxiety and depression.

With regard to adaptive behaviors, relationships between specific adaptive behaviors and affective disorders were discussed previously in the literature. The current study identified significant inverse relationships between anxiety and functional academics. Along with this, there were significant inverse relationships between symptoms of depression and functional academics, leisure, and social skills. This was consistent with previous research that identified that academic performance and social interactions

were effected by depression (Field, Diego, & Sanders, 2001; Rudolph, Hammen, & Burge, 1997). Functional academics and social skills are necessary for participation in many childhood and adolescent occupations. These occupations vary depending on the child's age but contribute to quality of life and overall development.

It is difficult to determine whether the relationships between depression and anxiety and specific adaptive behaviors were significant due to the presence of Asperger's disorder or the affective disorder. Previous studies have identified that children with Asperger's disorder tend to perform normally on most areas of adaptive behavior with the exception of social and motor skills (McLaughlin-Cheng, 1998). In the current study, there was no specific subscale measuring motor performance. Relationships were found not only in social skills but also in functional academics and leisure skills. Leisure may have been incorporated into the social measures on other adaptive behavior measures as this is sometimes the case. This would help explain the current findings.

There were significant inverse relationships between sensory hypersensitivity and community use and social skills in the current study. These skills involve interactions with others or integrating into environments within the community. For individuals with sensory defensiveness, social interactions and environments over which they have no control may make the person feel uncomfortable or distressed and lead to the avoidance behaviors identified in previous studies. A previously published case study on an adult with sensory defensiveness (Pfeiffer, 2002) discussed the impact of sensory defensiveness on leisure interests and community participation. The individual modified his leisure interests to include only solitary types of activities and would often avoid community use during certain times of the day. For example, he would only go shopping late at night when no one else was in the store. In general, this individual was able to implement some coping strategies that were effective in allowing him to be more functional. Children and adolescents with Asperger's disorder may not have the same ability to integrate effective coping strategies in functioning with sensory defensiveness, and therefore present with difficulties in these areas.

In the current study, hyposensitivity was related inversely with community use and social skills. There is limited previous research on the relationship between adaptive behaviors and hyposensitivity. Case studies and expert reports (J. D. Burpee, personal communication, January 7, 2003; Pfeiffer, 2002) have identified that the decreased body awareness often associated with hyposensitivity can have an impact on nonverbal social cues and motor planning necessary to participate in certain community use

activities. It is apparent that there is a further need for research in this area.

Limitations

Limitations of this study include the use of a volunteer convenience sample and possible confounding factors such as medication and therapeutic interventions. The sample represented only one geographical region and race.

Occupational therapists frequently work with individuals who are diagnosed with Asperger's disorder to enhance and promote adaptive behavior functioning. In the current study, over 80% of the parents reported that their child received occupational therapy services while many also reported that their child received other services. It is possible that occupational therapy and other interventions affected the scores on the adaptive behavior measure within the current study. Adaptive behavior scores may be higher in the population receiving services and therefore could have potentially decreased the strength of the relationships between affective disorders, dysfunction in sensory modulation, and both general and specific adaptive behaviors. Along with this, approximately 74% of the children and adolescents were on medications. Medication can impact on the presentation of symptoms of affective disorders and dysfunction in sensory modulation further impacting on the strength of the relationships within the study. There were also significant differences between the amount of services received in physical therapy and the use of medications between the older and younger groups. The younger group received a significantly greater amount of physical therapy and there were significantly more older children taking medications than younger children. This may have influenced the differences found between groups when analyzing the relationships between affective disorders and dysfunction in sensory modulation.

Implications for Future Research

This study provides a foundation for future research. The significance of the relationship between affective disorders and dysfunction in sensory modulation in children with Asperger's disorder identifies a need for research focused on the effectiveness of interventions for dysfunction in sensory modulation on anxiety and depression. Affective disorders can influence quality of life and participation in occupations. The possibility of not only reducing dysfunction in sensory modulation with intervention but also impacting on the mental health of children and adolescents provides a link to functional outcomes when measuring changes from sensory-based occupational therapy interventions.

A multifaceted approach to occupational therapy treatment using appropriate measures in functional adaptive

behavior, social skills, and emotional outcomes are relevant to the effectiveness of occupational therapy interventions with this population. Avoidance behaviors are common in individuals with anxiety disorders and sensory defensiveness, which are identified in the research as closely associated conditions with Asperger's disorder. Therefore, research is also needed on the effect of occupational therapy interventions on participation and engagement in occupation and society.

Longitudinal research following anxiety and sensory defensiveness over time to see if it predicts depression and hyposensitivity at a later time is recommended to determine if sensory defensiveness and sensory hyposensitivity are "two sides of the same coin" (Lai et al., 1999, p. 1). This would test the theory that an overreactive sensory system goes into shutdown after prolonged periods of hypersensitivity. Further research is also necessary to determine if mixed reactivity, the presence of symptoms of both sensory defensiveness and sensory hyposensitivity concurrently, reflect the comorbidity of anxiety and depression. In any case, these findings suggest the need for intervention for preventative mental health reasons.

Implications for Practice

The results of the study support the need for measurement tools to assess symptoms of affective disorders and associated behaviors in children and adolescents with Asperger's disorder in order to guide treatment. Assessment tools, not only measuring dysfunction in sensory modulation, but also symptoms of anxiety and depression may be helpful in measuring changes with occupational therapy interventions and to guide the development of goals for treatment. The possibility of decreasing anxiety and depressive symptoms with sensory-based treatment intervention needs further research to determine effectiveness. Although there may be potential to improve quality of life by addressing sensory issues related to anxiety and depression.

The results also identify the importance of providing occupational therapy interventions in psychiatric settings in which children and adolescents identified with symptoms of anxiety and depression receive occupational therapy. It is important to acknowledge through the assessment process the possible relationship between affective disorders and sensory modulation in this population, especially with children diagnosed with Asperger's disorder. Exploration of the influence of sensory based interventions versus medication for affective symptoms is an important area of consideration in the intervention process. Parents often struggle with decisions on whether medications are needed and if the potential side effects balance the benefits. Sensory based interventions may provide another option when making

decisions based on the unique needs of each child with Asperger's disorder and their family.

Occupational therapists are trained in the influence of the environmental context on the functional performance of an individual. Functional performance in the areas of social, community use, and leisure skills were related most significantly to symptoms of affective disorders and dysfunction in sensory modulation in children and adolescents with Asperger's disorder in the study. Environmental adaptations and education on the influence of sensory stimuli on functional performance pose another important occupational therapy intervention for children and adolescents with Asperger's disorder.▲

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