Sensory Processing Issues Associated With Asperger Syndrome: A Preliminary Investigation

Winnie Dunn, Brenda Smith Myles, Stephany Orr

KEY WORDS
• low thresholds
• sensory seeking
• sensory sensitivity

OBJECTIVE. The purpose of this study was to identify the sensory processing patterns of children with Asperger syndrome.

METHOD. Researchers compared the performance of 42 children with Asperger syndrome and 42 children without disabilities on section and factor scores of the Sensory Profile.

RESULTS. As reported by parents on the Sensory Profile, the children with Asperger syndrome were significantly different from children without disabilities on 22 of 23 items. This result was obtained with good power estimates (.997–1.00) and large effect sizes (O2 = .267–.732). Both groups of children performed the same on modulation of visual input affecting emotional responses and activity level.

CONCLUSION. This study provides initial evidence that clear differences exist in the sensory processing patterns of children with Asperger syndrome when compared with peers without disabilities.


Individually with Asperger syndrome, their parents, and professionals have debated whether sensory processing issues are a salient part of Asperger syndrome (Attwood, 1998; Fling, 2000; Myles & Simpson, 1998; Myles & Southwick, 1999; Stagnitti, Raison, & Ryan, 1999; Willey, 1999), despite original assumptions that sensory issues were integral to the syndrome. Psychiatrist Hans Asperger (1944) first described a syndrome that he referred to as a social disability. In a study of four children, he observed a unique group of characteristics that set these children apart from any he had studied (Frith, 1991; Wing, 1991). Although each child was unique, Asperger noted the following traits common among the children: (a) social isolation and awkwardness, (b) self-stimulatory responses, (c) insistence on environmental sameness, (d) normal intellectual development, and (e) normal communication development.

The children in Asperger’s (1944) study displayed a range of hyposensitivities and hypersensitivities to taste, tactile, and auditory stimuli. In taste, they found them to have very specific likes and dislikes. For example, many preferred very sour or strongly spiced foods. Similarly, the children had a strong dislike for certain fabrics or an aversion to specific daily life activities containing strong tactile sensory input, such as cutting fingernails. The children displayed extreme levels of noise sensitivity; at times, they were hypersensitive to noise in certain environments and appeared to be hyposensitive to the same noises in other environments. Further, the children manifested a lack of respect or understanding for other people and their space. Asperger reported that they leaned on total strangers or touched them as if they were pieces of furniture.

However, these impressions about sensory processing challenges are not directly reflected in current diagnostic criteria for Asperger syndrome. Currently, the fourth edition of the American Psychiatric Association’s (APA’s) Diagnostic and...
Statistical Manual of Mental Disorders (DSM-IV; APA, 1994) is the source containing the most widely used diagnostic criteria for identifying Asperger syndrome. DSM-IV places Asperger syndrome under the category of pervasive developmental disorders (PDD). According to these criteria, Asperger syndrome can be recognized by three behavioral criteria and three exclusion criteria. Behavioral criteria are (a) qualitative social impairment, (b) repetitive and restrictive stereotyped patterns of behavior, and (c) significantly decreased social function. Exclusion criteria are (a) language delays; (b) cognitive delays; and (c) other significant conditions, including schizophrenia or autism.

Further criteria are specified. For example, under “qualitative social interaction impairment” (APA, 1994, p. 65), the DSM-IV describes (a) significant impairment in nonverbal communication skills, (b) inability to establish appropriate peer relationships, (c) inability to initiate interactions with others, and (d) difficulty reciprocating socially or emotionally as ways social interaction might be impaired. The specific criteria listed under “repetitive and restricted stereotyped patterns of behavior, activities, and interests” (p. 65) are (a) abnormal preoccupation with stereotyped, specific areas of interest; (b) inflexible adherence to nonfunctional routines or rituals; (c) high repetition of nonfunctional motor movements; and (d) preoccupation with parts of an object. Some authors view these patterns as reflections of poor sensory processing (Huebner, 2000; Zero to Three, 1994), but sensory processing has not been incorporated into formally accepted definitions (Frith, 1991; Gillberg, 1992).

Scholars have reported about the relationships between sensory processing and functions in daily life, including learning, play, work, and socialization (e.g., Anderson & Emmons, 1996; Ayres, 1972, 1979; Cook & Dunn, 1998; Fisher, Murray, & Bundy, 1991). No empirical evidence exists, however, regarding whether children with Asperger syndrome tend to have difficulties with sensory processing. Thus, the purpose of this study was to provide initial evidence about the sensory processing patterns of children and youth with Asperger syndrome.

Method
Design
This study used a group comparison design to identify possible differences in sensory processing between children with and without Asperger syndrome on the Sensory Profile. The Sensory Profile is a standardized parent report measure of sensory processing.

Sample
Parents of 42 children (39 boys, 3 girls) with Asperger syndrome, ranging in age from 8 to 14 years (M = 11.33 years) completed the Sensory Profile. All the children attended public school; a licensed professional diagnosed these children as having Asperger syndrome consistent with criteria in the DSM-IV (APA, 1994).

Using the random selection function of the Statistical Package for the Social Sciences (SPSS) version 9.0 computer program, (SPSS, 2001) we selected a random sample of 42 children without disabilities between 8 and 14 years of age (M = 9.6 years) from the Sensory Profile standardization sample to serve as a comparison group (Dunn, 1999). Although this group is somewhat younger, all previous studies indicate that virtually no differences exist in scores on the Sensory Profile from preschool-age to school-age children (Dunn, 1999).

Instrument
The Sensory Profile (Dunn, 1999) is a 125-item questionnaire that describe responses to sensory events in daily life. The caregiver reports on a 5-point Likert scale how frequently the child uses that response to particular sensory events (i.e., always, frequently, occasionally, seldom, never).

This Sensory Profile was normed on more than 1,000 children without disabilities and 150 children with disabilities (Dunn, 1999). Reliability includes internal consistency estimates (range = .47–.91) and standard error of measurement (range = 1.0–2.8). Dunn (1999) also reported on content (three types established) and construct validity (i.e., convergent, discriminant). The validity findings indicate that the Sensory Profile has higher correlations with measures of sensory perception and behavioral regulation and lower correlations with particular skill demands.

The Sensory Profile measures the degree to which children exhibit problems in (a) sensory processing, (b) modulation, (c) behavioral and emotional responses, and (d) responsiveness to sensory events (i.e., hyporesponsive, hyperresponsive). The instrument evaluates the possible contributions of sensory processing to a child’s individual performance patterns, provides information about the child’s responses to stimuli, and identifies systems that contribute to or create barriers to functional performance. For this study, we used the children’s raw summary scores for section and factor clusters as specified in the manual (Dunn, 1999). To make it easier for family members to understand scores, lower scores reflect poorer performance (i.e., a higher rate of behavior because items are written to reflect potential difficulty with the sensory experience). Hence, if a child never engages in the behavior, he or she obtains a raw score of 5, whereas if the child always engages in the behavior, he or she yields a raw score of 1.
Procedure

The researchers mailed packets containing several questionnaires, including the Sensory Profile, to families who indicated an interest in being part of a comprehensive research study on Asperger syndrome being conducted by a large midwestern university. In most cases, the parent completed the Sensory Profile at home; some completed the instrument at a clinic while their child was being tested as part of the larger study.

Data Analysis

The researchers conducted two multivariate analyses of variance (MANOVAs) to identify differences between the groups. The first MANOVA addressed comparisons between groups on the Sensory Profile section scores (i.e., sensory processing, modulation, behavioral responses), and the second addressed comparisons between groups on the factor scores (Dunn, 1999; Dunn & Brown, 1997). We used SPSS 9.0 to conduct the analyses.

Results

This study was designed to determine the sensory processing characteristics of children with Asperger syndrome. Specifically, we sought to determine the (a) sensory processing, (b) modulation, (c) behavioral and emotional responses, and (d) responsiveness as characterized in the factor scores that might be characteristic of children with Asperger syndrome as tested by the Sensory Profile.

Tables 1 and 2 contain the results of the MANOVAs. We had a sufficient sample size to identify real differences (i.e., all power estimates were .997–1.00), and effect sizes were large (i.e., $\eta^2 = .310–.692$), suggesting that differences would be clinically meaningful. (See Green, Salkind, and Akey [1997] for interpretation of $\eta^2$ calculation used in SPSS, and Cohen [1992] for a conceptual discussion of effect size.) Of the 23 possible statistical comparisons, 22 were significantly different ($p < .05$), with the children having Asperger syndrome reported as performing more poorly than the children without disabilities in each case.

Tables 3 and 4 contain the means, standard deviations, and 95% confidence intervals for the two groups on each comparison. Evident from these tables is that the 95% confidence interval raw score ranges for the two groups are quite separate from each other.

Discussion

Beginning with Asperger (as translated by Frith, 1991), researchers have reported that behaviors of children with Asperger syndrome suggest difficulty with sensory processing (Attwood, 1998; Bettison, 1996; Fling, 2000; Iwanaga, Kawasaki, & Tsuchida, 2000; Myles & Simpson, 1998; Myles & Southwick, 1999; Stagnitti et al., 1999; Willey, 1999). Others have reported on the link between sensory processing and the ability to conduct daily life successfully (e.g., Ayres, 1979; Cook & Dunn, 1998; Dunn, 1997, 1999; Fisher et al., 1991). In this study, we report about the performance of children with Asperger syndrome on the Sensory Profile, a validated measure of sensory processing in daily life.

Interpretation of Specific Findings

Group performance (raw) scores reveal that the confidence intervals for the two groups are quite separate from each other, making differentiation between performance of children with and without Asperger syndrome clear (see Tables 3 and 4). That is, children with Asperger syndrome consistently have lower scores (i.e., always displays the behavior = 1) than children without disabilities. For example, when considering the scores on auditory processing (see Table 3), the lower boundary of the confidence interval for the children without disabilities was 33.03, whereas the upper boundary was only 25.28 for the children with Asperger syndrome. Therefore, it is highly likely that children with Asperger syndrome will have poor

<table>
<thead>
<tr>
<th>Section</th>
<th>F</th>
<th>p</th>
<th>Effect Size ($\eta^2$)</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auditory processing</td>
<td>112.22</td>
<td>&lt;.001</td>
<td>.63</td>
<td>1.00</td>
</tr>
<tr>
<td>Visual processing</td>
<td>41.18</td>
<td>&lt;.001</td>
<td>.39</td>
<td>1.00</td>
</tr>
<tr>
<td>Vestibular processing</td>
<td>47.70</td>
<td>&lt;.001</td>
<td>.42</td>
<td>1.00</td>
</tr>
<tr>
<td>Touch processing</td>
<td>130.10</td>
<td>&lt;.001</td>
<td>.67</td>
<td>1.00</td>
</tr>
<tr>
<td>Multisensory processing</td>
<td>104.11</td>
<td>&lt;.001</td>
<td>.61</td>
<td>1.00</td>
</tr>
<tr>
<td>Oral sensory processing</td>
<td>42.17</td>
<td>&lt;.001</td>
<td>.39</td>
<td>1.00</td>
</tr>
<tr>
<td>Sensory processing related to endurance/tone</td>
<td>59.67</td>
<td>&lt;.001</td>
<td>.48</td>
<td>1.00</td>
</tr>
<tr>
<td>Modulation related to body position and movement</td>
<td>45.79</td>
<td>&lt;.001</td>
<td>.41</td>
<td>1.00</td>
</tr>
<tr>
<td>Modulation of movement affecting activity level</td>
<td>70.68</td>
<td>&lt;.001</td>
<td>.52</td>
<td>1.00</td>
</tr>
<tr>
<td>Modulation of sensory input affecting emotional responses and activity level</td>
<td>108.60</td>
<td>&lt;.001</td>
<td>.62</td>
<td>1.00</td>
</tr>
<tr>
<td>Modulation of visual input affecting emotional responses and activity level</td>
<td>0.05</td>
<td>.82</td>
<td>.00</td>
<td>0.05</td>
</tr>
<tr>
<td>Emotional/social responses</td>
<td>129.19</td>
<td>&lt;.001</td>
<td>.69</td>
<td>1.00</td>
</tr>
<tr>
<td>Behavioral outcomes of sensory processing</td>
<td>175.10</td>
<td>&lt;.001</td>
<td>.73</td>
<td>1.00</td>
</tr>
<tr>
<td>Items indicating thresholds for response</td>
<td>23.26</td>
<td>&lt;.001</td>
<td>.26</td>
<td>0.99</td>
</tr>
</tbody>
</table>

Note. MANOVA = multivariate analysis of variance.
auditory processing on the basis of the Sensory Profile. These findings are consistent with other reports that children with Asperger syndrome have difficulty with auditory processing. Bettison (1996) reported specific sensitivity to sounds that led to distress. Bettison then provided an auditory intervention, and participants demonstrated significantly improved behavior over a 12-month period in conditions of auditory training or listening to music, suggesting that interventions addressing sensory processing differences may be fruitful once a pattern of sensory processing is identified.

In the current study, children with Asperger syndrome were the same as the children without disabilities on modulation of visual input affecting emotional responses and activity level. Reports in the literature suggest that children with Asperger syndrome have strengths in visual-perceptual skills (Miller & Ozonoff, 2000; Quill, 1995, 1997, 1998). This section of the Sensory Profile addresses a child’s way of using visual information to keep track of the context (e.g., watches everyone as they move around the room). However, the children with Asperger syndrome had a significantly lower score on visual processing. This section contains items related to basic responsivity (e.g., How does the child respond to particular visual stimuli? Prefers to be in the dark or bothered by bright lights). These data suggest that children with Asperger syndrome can process visual-perceptual information in context and, perhaps, can orient to social situations using their visual systems in a similar manner to other children, even though other behavioral responses might be different. Quill (1995, 1997, 1998) suggested that children with Asperger syndrome are visual learners and described visually cued instruction as a method to support them in instructional situations and communication. By providing direct cuing related to the visual environment, perhaps professionals and parents can link contextual cues, which the child notices, to expected behavioral patterns, which the child may not know how to select or use appropriately. The role of visual processing in the performance of children with Asperger syndrome, particularly in social contexts, will be important to study further.

Table 2. MANOVA Results for Factor Scores

<table>
<thead>
<tr>
<th>Factor</th>
<th>F</th>
<th>p</th>
<th>Effect Size (η²)</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensation seeking</td>
<td>44.93</td>
<td>&lt; .001</td>
<td>.37</td>
<td>1.00</td>
</tr>
<tr>
<td>Emotionally reactive</td>
<td>168.24</td>
<td>&lt; .001</td>
<td>.69</td>
<td>1.00</td>
</tr>
<tr>
<td>Low endurance/tone</td>
<td>75.05</td>
<td>&lt; .001</td>
<td>.50</td>
<td>1.00</td>
</tr>
<tr>
<td>Oral sensory sensitivity</td>
<td>31.30</td>
<td>&lt; .001</td>
<td>.29</td>
<td>1.00</td>
</tr>
<tr>
<td>Inattention/distraction</td>
<td>79.32</td>
<td>&lt; .001</td>
<td>.51</td>
<td>1.00</td>
</tr>
<tr>
<td>Poor registration</td>
<td>64.86</td>
<td>&lt; .001</td>
<td>.46</td>
<td>1.00</td>
</tr>
<tr>
<td>Sensory sensitivity</td>
<td>33.68</td>
<td>&lt; .001</td>
<td>.31</td>
<td>1.00</td>
</tr>
<tr>
<td>Sedentary</td>
<td>49.98</td>
<td>&lt; .001</td>
<td>.37</td>
<td>1.00</td>
</tr>
<tr>
<td>Fine motor/perceptual</td>
<td>71.76</td>
<td>&lt; .001</td>
<td>.48</td>
<td>1.00</td>
</tr>
</tbody>
</table>

Note. MANOVA = multivariate analysis of variance.

On examination of the factor scores (see Table 4), it is interesting that the children with Asperger syndrome had difficulty with factors associated with both hyporesponsiveness and hyperresponsiveness. Low endurance/tone and poor registration are associated with hyporesponsiveness (i.e., the children do not notice stimuli that others notice), whereas emotionally reactive and sensory sensitivity are associated with hyperresponsiveness (i.e., the children notice stimuli more readily than others) (Dunn & Brown, 1997). These score patterns suggest that the children with Asperger syndrome in this study may have poor modulation (i.e., poor ability to regulate responses) rather than one way of responding. When children have poor modulation, their responses can vary dramatically from one situation to another, and predicting how the child will behave can be difficult (Dunn, 1999; Fisher et al., 1991; Huebner, 2000). The resulting behavioral repertoire may reflect a vulnerability to input rather than erratic performance per se.

Implications for Diagnostic Criteria for Asperger Syndrome

As reported by the parents, the children with Asperger syn-

![Table 3. Means, Standard Deviations, and 95% Confidence Intervals for Groups on Each Section](https://example.com/table3)

<table>
<thead>
<tr>
<th>Section</th>
<th>Typical M (SD)</th>
<th>Asperger M (SD)</th>
<th>Typical CI</th>
<th>Asperger CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modulation of sensory input affecting emotional responses and activity level</td>
<td>18.43 (0.36)</td>
<td>12.46 (0.45)</td>
<td>17.71–19.14</td>
<td>11.57–13.35</td>
</tr>
<tr>
<td>Emotional/social responses</td>
<td>72.03 (1.23)</td>
<td>49.81 (1.52)</td>
<td>69.57–74.48</td>
<td>46.68–52.85</td>
</tr>
<tr>
<td>Behavioral outcomes of sensory processing</td>
<td>26.13 (0.48)</td>
<td>16.12 (0.59)</td>
<td>25.18–27.07</td>
<td>14.94–17.29</td>
</tr>
<tr>
<td>Items indicating thresholds for response</td>
<td>13.53 (0.32)</td>
<td>11.08 (0.40)</td>
<td>12.89–14.16</td>
<td>10.29–11.87</td>
</tr>
</tbody>
</table>

Note. CI = 95% confidence interval. Lower scores indicate poorer performance; that is, the children engage in the difficult behaviors more often (always = 1, never = 5). Children without disabilities (typical) have a low rate of the behaviors on the Sensory Profile; fewer behaviors yield a higher score.
drome demonstrated a significantly different pattern of sensory processing from their peers without disabilities according to the Sensory Profile, suggesting a sensory processing correlate in Asperger syndrome that needs to be included in the diagnosis. Bagnato and Neisworth (1999) described methods for early identification of regulatory disorders as described in the Zero to Three (1994) diagnostic classification system; this classification contains a predominance of items reflecting poor ability to process sensory information and is associated with early identification of autism spectrum disorders (Greenspan, Wieder, & Simons, 1998). Revisiting the diagnostic criteria to consider the contributions of sensory processing to Asperger syndrome may be useful.

For example, socialization challenges are criteria of the Asperger syndrome diagnosis (APA, 1994). Some evidence suggests that difficulties with socialization can be linked to poor sensory processing. Persons with Asperger syndrome have reported on the relationships among sensory processing functions in daily life, including learning, play, work, and socialization (Grandin, 1995; Shore, 2001; Willey, 1999). Shore (2001), an adult with Asperger syndrome, reported that as a toddler he would not kiss his father because the smell of coffee on his father’s breath and the scratchiness of his moustache were too much to tolerate. As an adult, Shore stated that he was unable to work in companies that had traditional presentation would verify the findings of this initial study and performance in daily life.

However, these relationships do not reveal which problem leads to the other; people might exhibit poor sensory processing because they have not been able to engage in their environment to gather appropriate experiences or may not be able to engage because they have poor sensory processing. Researchers have attempted to uncover the nature of these relationships with intervention studies. For example, in intervention studies using sensory processing approaches with children who have PDD, researchers have reported improvements in play schemas and social engagement with decreases in disruptive social behaviors (Case-Smith & Bryan, 1999; Linderman & Stewart, 1999), suggesting that poor sensory processing underlies the child’s ability to engage in the complexities of social situations and communication.

The current diagnostic criteria for Asperger syndrome also address unusual patterns of behavior (i.e., repetitive and restricted patterns of stereotyped behavior). Some researchers hypothesized a “sensory generating” function in repetitive and stereotypic behaviors (see Huebner & Dunn, 2000). Willemsen-Swinkels, Buitelaar, Dekker, and van-Engeland (1998) created a subtyping structure for stereotypic behaviors, and four of the five subtypes related to sensory intensity of the behavior. Our findings indicate that children with Asperger syndrome have difficulty with sensory modulation; perhaps the stereotypic behaviors serve an organizing function in that their repetitiveness provides a method for equalizing the tendency for hyporesponsiveness and hyperresponsiveness. If so, including sensory processing status in diagnostic criteria might be warranted.

**Limitations and Directions for Future Research**

It must be noted that this study used a convenience sample of children with Asperger syndrome and selected a comparison group from the standardization data of the Sensory Profile. A larger sample reflecting broader geographic representation would verify the findings of this initial study about sensory processing in children with Asperger syndrome. The dramatic differences found between the two groups suggest that further study about the nature of sensory processing challenges for children with Asperger syndrome would be useful for the field.

We also did not evaluate the impact of these sensory processing differences on the children’s and their families’ daily routines. A person’s sensory processing patterns are only important to evaluate if we link their patterns to successes and challenges in daily life. People with all types of sensory processing patterns are living satisfying lives; it is only when a particular pattern of sensory processing interferes with life choices that this information becomes relevant to quality of life. In future studies, researchers need to study the relationship between the differences we found here and performance in daily life.
Further studies about the sensory processing aspects of performance in children with Asperger syndrome are needed to validate the observations that professionals and families make about the children’s behaviors and responses during daily life. If we can understand this aspect of their performance more clearly, we can design more refined interventions to support adaptive responses to the demands of development and learning. ▲

References


