



CENTRE FOR AUTISM  
MIDDLETOWN

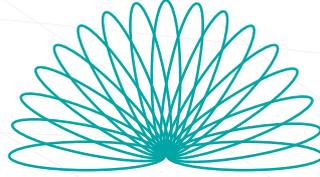
## SENSORY PROCESSING



RESEARCH BULLETIN ISSUE NO. 11

Supporting the promotion of excellence throughout Northern Ireland and  
Ireland in the education of children and young people with autism.





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MIDDLETOWN

## SENSORY PROCESSING

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**The focus of this eleventh Research Bulletin is on the sensory processing patterns, difficulties and strengths commonly associated with autism. There is extensive international research examining the prevalence and nature of sensory processing deficits in autism and how these impact the individual's ability to learn, play, interact and engage in daily activities.**

These research studies reinforce the autobiographical accounts of individuals with autism who eloquently describe how they perceive and experience sensory input, such as sights, sounds and touch. The publication of this Bulletin is timely given the recent inclusion of “Hypo- or hyper-reactivity to sensory input” within the diagnostic criteria for autism in DSM V (APA, 2013)\*.

The Bulletin opens with an interview conducted with Amy Laurent. Amy is a paediatric occupational therapist and holds a Masters in Special Education. She is co-author of the SCERTS (Social Communication/Emotional Regulation/Transactional Support) Model. Her interview provides a valuable and comprehensive insight into the sensory processing needs of children with autism. This interview is followed by 11 summaries of relevant research papers published in peer review journals during the period 2010 to 2013.

Please note that the views represented in this document do not necessarily reflect the views of Middletown Centre for Autism. Reviewers have, where possible, used the original language of the article, which may differ from UK and Ireland usage and the usage of a range of terminologies for autism.

\*American Psychiatric Association (2013). *Diagnostic and Statistical Manual of Mental Disorders. (5th ed.)* Text Revision. Washington DC



**There is commonly used terminology throughout these reviews and the explanations below will facilitate your understanding of these terms. The terms low registration, sensory seeking, sensory sensitivity and sensory avoidance are used by Dunn (1999)\* to explain behavioural responses to sensory input.**

## **Sensory Modulation**

The ability to independently regulate the sensory input from within the environment and from our own bodies. This requires the ability to focus on the important/relevant input and to filter out the background/irrelevant input. Many individuals with autism have difficulties modulating or regulating sensory input, leading to emotional and behavioural responses.

## **Sensory Hyper-reactivity**

This describes individuals who tend to be very aware of all sensory input around them and have difficulty filtering out unimportant stimuli. This can lead to feelings of sensory overload and aversive responses to sensory input. Other terms used to describe hyper-reactivity include over-responsiveness and hypersensitivity.

There are two sensory processing sub-categories under the umbrella term sensory hyper-reactivity:

### **Sensory Sensitive**

An individual who is sensory sensitive is easily overloaded by sensory input and becomes distressed in sensory overwhelming environments (e.g., busy classroom, shopping centre) or in response to specific sensory input, such as certain noises, smells or textures. The individual tends to respond emotionally and is easily distracted by stimuli in the surrounding environment.

### **Sensory Avoidant**

An individual who is sensory avoidant also over-responds to sensory input and is easily overloaded, but responds by withdrawing from sensory-rich environments and refusing to participate in specific sensory-based activities. Examples include avoidance of messy play, running from noisy places and seeking quiet solitude.

## **Sensory Hypo-reactivity**

This describes individuals who do not seem to be aware of sensory input and need increased levels of sensory input before they register and respond to stimuli. Other terms used to describe hypo-reactivity include under-responsiveness and hyposensitivity.

There are two sensory processing sub-categories under the umbrella term sensory hypo-reactivity:

### **Low Registration**

An individual with low registration does not respond to sensory input, or is slow to respond to sensory input, such as verbal instructions or a tap on the shoulder. The individual will appear to be disengaged from activity and interaction, but when given increased sensory input (e.g., movement, music) he/she becomes more alert and engaged.

### **Sensory Seeking**

An individual who sensory seeks is also under-registering sensory input but compensates for this by seeking out increased input themselves in order to increase alertness. Examples of sensory seeking behaviours may include fidgeting, craving frequent movement or a preference for strong smells and flavours.

Please note that there is variation in the literature in the categorisation of these sensory processing patterns and the above definitions are only intended to clarify the terminology used in this Research Bulletin.

\*Dunn W (1999). *Sensory Profile Manual*. NCS Pearson: USA



# AN INTERVIEW WITH AMY LAURENT

## 1. What are the common patterns of sensory processing difficulties associated with autism?

Sensory processing generally refers to the ability of an individual to register sensory information, make sense of that information, and to respond to it. This is a complex and fluid process involving all of the sensory systems (e.g., environmental senses – auditory, gustatory, visual, and olfactory – and self-senses – tactile, proprioceptive, and vestibular). When sensory processing is working well, an individual's responses to sensory information are adaptive and support engagement. However, efficient sensory processing does not always occur. Indeed, sensory processing difficulties are quite prevalent in the profiles of individuals with ASD, to the point that odd responses to sensory stimuli are listed as an associated feature according to the DSM IV-TR diagnostic criteria for Pervasive Developmental Disorder (PDD).

The specific patterns of sensory processing differences associated with autism are quite varied, as are the associated difficulties that arise from these challenges. The age and maturity of the individual, as well as the particular sensory systems that are impacted, and environmental factors, all play a part in the presentation of difficulties.

In general, it is common to consider sensory processing difficulties in the context of challenges modulating responses to stimulation. This perspective typically focuses on two profiles: 1) a hyper-reactive bias and 2) a hypo-reactive bias. Individuals with a hyper-reactive bias tend to respond to all types of sensory stimulation strongly and often exhibit “fight and flight” behavioural responses. Individuals with a hypo-reactive bias often appear to be unaware of sensory events in their environments, and as such their responses to them and interactions may be infrequent.

While these broad categorisations can be helpful in conceptualising how individuals with ASD experience their sensory environment, they may also be limiting. It is important to acknowledge that sensory processing is fluid and dynamic and therefore results in variability. For example, many individuals may be sensitive to one type of stimulus (e.g., noise) but not to another (e.g., touch). In addition, an individual may demonstrate variability in responding to a given type of sensory stimulation. Several factors such as time of day, qualities of the stimulation, and

the social environment may play a role in the variability. For example, an individual may be extremely sensitive to loud environmental noises, but enjoy creating loud sounds by banging on things. So, in essence a person may have reactivity bias, but not always respond to sensory events in a predictable manner consistent with their bias.

Sensory processing difficulties may also contribute to difficulties with motor planning and coordination.

## 2. Why are sensory processing difficulties so prevalent in children and young people with autism?

No-one can answer this question with any degree of certainty, although associations are often drawn between the neuro-developmental nature of autism and the neurological processes involved in the development and maturation of sensory processing. It is important to point out that while sensory processing differences are prevalent in individuals with ASD, they are not unique to individuals with ASD, and in fact many individuals without any formal diagnosis do demonstrate sensory processing differences.

## 3. How do sensory processing difficulties impact a child's learning in school?

Sensory processing difficulties become a concern when they interfere with a child's ability to function adaptively. This can often happen in the school environment. Consider the two reactivity biases discussed earlier. If a child is hyper-reactive to most information in his environment his arousal level will tend to be high, he will appear distractable, and he may actively seek to avoid situations he anticipates to be unpleasant. Conversely, if a student has a hypo-reactive bias, he will likely demonstrate a low arousal level, appear unfocused, and be difficult to engage.

From these brief examples, it is easy to see how pervasive the impact of sensory processing difficulties may be on accessing and participating in the school curriculum if accommodations are not made for the learner. A sample accommodation that may be helpful for the student with a hypo-reactive bias is adopting a multi-sensory approach to instruction (e.g., infusing movement, rhythm, texture, etc. in lessons). Sample accommodations that may be helpful

# INTERVIEW

for the student with a hyper-reactive bias are increasing the predictability of an activity (e.g., providing a schedule) and offering alternative ways for engagement (e.g., allowing them to use a paint brush to complete a “finger painting” project).

## 4. What are the main sensory processing difficulties experienced by a child with autism in the home environment?

This question is difficult to answer given that each individual with autism has a unique sensory processing profile, and since the social and physical characteristics of each home environment are also unique. However, it is fairly common to hear parents speak of children who are sensitive to touch having difficulties with self-care routines, and of children who crave pressure and movement to be in constant motion, making meal times and homework a struggle. Additionally, sensory processing challenges (e.g., hyper-reactivity), which may result in heightened arousal levels, can impact bedtime routines and sleep schedules.

## 5. Do sensory processing difficulties affect the communication and interaction skills of children and young people with autism?

Sensory processing difficulties can impact the communication and interaction skills of individuals with autism. In particular, sensory processing difficulties can affect the type of information that an individual processes easily. For example, if a child has difficulty processing visual information, he may avoid looking around his environment or at his communicative partners, resulting in his missing important contextual information.

Additionally, sensory processing challenges may also impact an individual with autism’s willingness to interact with others, if the social complexity of a situation or a partner’s interactive style are not a good fit for a child (e.g., if partners are perceived as being too loud or overly enthusiastic a child with auditory sensitivities may withdraw). Conversely, if there is a good match between a partner’s interactive style and the child’s sensory processing profile, the child may initiate and maintain interactions more frequently.

Sensory processing difficulties are also considered to be at play in children whose speech is dyspraxic.

## 6. What are your three top tips for managing sensory processing difficulties in the classroom?

1. Most importantly, school staff must know their students’ sensory processing profiles. This may mean working with a professional who has knowledge and expertise in this area to develop an understanding. With this knowledge, staff can try to anticipate difficult situations and help their student implement strategies to avoid or cope with stimulation. However, it is important to keep in mind that despite proactive planning, challenges to a student’s sensory profile may still occur. In these instances, it is important to have a recovery plan to help regroup and re-engage.
2. Consider infusing sensory strategies in the classroom that tend to be organising for everyone regardless of reactivity bias (e.g., rhythm, routine, predictable movement, supportive seating options, etc.). These types of accommodations will support engagement of all learners in the classroom environment.
3. Create a quiet space in the classroom for students to utilise and to access sensory supports that are focusing and organising (e.g., books, music, cosy/supportive seating, etc).

## 7. What are your three top tips for managing sensory processing difficulties at home?

1. Again, start with knowing your child’s sensory processing profile. This may mean working with a professional who has knowledge and expertise in this area to develop an understanding. With this knowledge, you can try to anticipate difficult situations and help your child implement strategies to avoid or cope with stimulation. However, it is important to keep in mind that despite proactive planning, challenges to your child’s sensory profile will still occur. In these instances, it is important to have a recovery plan to help regroup and re-engage.
2. Consider what types of sensory input your child seeks out and finds to be organising. Find ways to infuse this type of input into his day (e.g., for a young child who

enjoys and seeks out music, consider singing during difficult transitions).

3. Create and implement organising sensory routines prior to activities that require sustained focus (e.g., for a child who is organised by movement, have them gather materials from different parts of the house prior to starting their homework).

### 8. Is there research evidence to support the strategies commonly used to manage sensory processing difficulties for children and young people with autism (e.g., sensory diet, weighted equipment)?

There are a limited number of published studies that support the effectiveness of sensory-based interventions. Several reasons are often cited for the lack of a robust research basis. Two of the most frequently discussed, which impact the ability to create a study with a substantial sample and effect size, are: 1) that each individual is unique in terms of his sensory processing profile and 2) that the fluid nature of sensory processing makes it difficult to conduct a controlled study. Despite the relative lack of solid research evidence, both clinical evidence and first-person accounts lend credibility to the effectiveness of sensory strategies for some individuals. Temple Grandin even speaks clearly about the use of sensory strategies and their impact on her arousal level and ability to focus. However, sensory strategies are not a “one size fits all” support. Educated thought should be used when implementing a strategy for an individual and data should be collected to determine its effectiveness.

### 9. If you were to suggest one piece of equipment to assist in sensory regulation at home and/or school, what would it be and why?

This is a tough question to answer since sensory strategies are not universal in their appropriateness or effectiveness. I would suggest that parents and caregivers look to what organising input a child seeks out and to try to help teach them an efficient, socially acceptable way to get the same type of stimulation. It is often more organising for a child to help them meet a sensory need than to try to extinguish it. For example, if a child seeks out texture, providing opportunities to finger-paint, to use foam soap or to play in sand may be appropriate. If a child seeks out pressure,

providing the child with a beanbag chair to squish into, with spandex garments to wear under clothing, or with heavy blankets to bury under may be helpful. If a child seeks out movement, providing opportunities to dance, creating a standing desk to use for homework, or a small trampoline may be helpful. These strategy ideas are provided as examples and are not intended to be tailored advice for a specific child. Consultation with a professional specialising in sensory support is recommended to help develop targeted strategies to meet individual children’s needs.

### 10. Is there a relationship between the sensory processing difficulties and emotional regulation difficulties often associated with autism?

Sensory processing difficulties are one aspect or risk factor impacting an individual’s emotional regulation abilities. As previously discussed, if a child has a hyper-responsive bias towards sensory stimulation, his arousal level will tend to be high and in turn he will often exhibit strong reactions to stimulation. These reactions can contribute to dysregulation and difficulty maintaining active engagement. Conversely, if a child has a hypo-responsive bias and has difficulty discerning important sensory information in the environment, he will frequently exhibit low arousal levels, which are also indicative of dysregulation and difficulty engaging.

It is important to remember that while sensory processing difficulties can put a child at risk for dysregulation and limited engagement, they can also provide the child’s partners with important information to help devise sensory-based strategies to support active engagement such as those discussed in earlier questions.



## Anxiety Disorders and Sensory Over-Responsivity in Children with Autism Spectrum Disorders: Is There a Casual Relationship?

### RESEARCH AIMS

Functional performance is negatively affected by increased levels of anxiety and sensory over-responsiveness. Anxiety disorders and sensory over-responsivity are common in children with autism.

This study reviewing the relationship between anxiety and sensory over-responsivity (SOR) in children with autism spectrum disorder focussed on examining the current literature regarding three theories:

- SOR is caused by anxiety
- Anxiety is caused by SOR
- SOR and anxiety are causally unrelated.

### RESEARCH METHODS

A narrative review was conducted to investigate the three theories regarding SOR and anxiety. The authors did not report the methodology used.

### RESEARCH FINDINGS

#### **SOR is caused by anxiety**

Evidence indicates that increased levels of anxiety heighten levels of autonomic arousal such as hypervigilance. If children are hypervigilant they are more likely to notice and react to environmental sensory stimuli. This type of anxious hypervigilance and poor regulation of negative arousal through attention bias could contribute to SOR.

Once over-reactivity has been established through hyperarousal or hypervigilance, it may be maintained or exacerbated by classical aversive conditioning. When this occurs, avoidance of the stimuli usually occurs, which decreases the possibility that the child will learn to regulate their behaviour in response to the stimuli in an adaptive way.

Therefore SOR could result from hypervigilance, difficulty regulating reactions to aversive sensory stimuli, and then through conditioning and avoidance, which strengthens the association of over-reactivity with those stimuli.

#### **Anxiety is caused by SOR**

Unpleasant sensory stimuli are associated with certain objects or situations, which over time become capable of eliciting a conditioned response, such as fear or anxiety. This fear and anxiety response may shift from being triggered by a specific object to a location. This can be particularly concerning as fear and anxiety usually result in avoidance behaviours.

#### **SOR and anxiety are causally unrelated**

SOR and anxiety may not be causally related. It is postulated that amygdala abnormalities or overlapping diagnostic criteria may independently contribute to SOR and anxiety, but the two states (SOR and anxiety) may exacerbate each other.

### IMPLICATIONS FOR PRACTICE

*(by the author)*

The most common interventions for SOR include sensory integration therapy, the sensory diet, sensory stimulation techniques and auditory integration therapy.

Cognitive behavioural therapy has been found to be effective for treating anxiety disorders in children with ASD, as have psychopharmacological treatments such as SSRIs. Children with autism may benefit from an integrated intervention programme, but further research is recommended by the authors.

#### **FULL REFERENCE**

Green, S. and Ben-Sasson, A. (2010). Anxiety Disorders and Sensory Over-Responsivity in Children with Autism Spectrum Disorders: Is There a Causal Relationship? *Journal of Autism Developmental Disorder*, 40, p. 1495-1504.

## Atypical Sensory Processing in Adolescents with an Autism Spectrum Disorder and their Non-Affected Siblings

### RESEARCH AIMS

1. To assess sensory processing in adolescents with autism
2. To assess sensory processing in non-affected adolescent siblings of individuals with autism (i.e. siblings who do not have autism)

The authors hypothesise that sensory processing may be an intermediate phenotype for autism, meaning that sensory processing dysfunction is a trait which occurs in autism and that it occurs in non-affected family members more frequently than in the general population. They hypothesise that siblings without autism will still have unusual sensory processing.

### RESEARCH METHODS

The study included 80 adolescents with autism and 56 non-affected siblings from 87 different families. There were also 33 control adolescents who did not have autism and were not the siblings of individuals with autism. The age range of the sample was 11 years to 17.9 years. The following assessments were carried out with participants and caregivers:

- **Adolescent/Adult Sensory Profile (AASP) (Brown & Dunn, 2002):** This is a self-report questionnaire completed by the individuals themselves. Scores are provided on the four quadrants of Low Registration, Sensation Seeking, Sensory Sensitivity and Sensation Avoidance.
- **Developmental, Dimensional and Diagnostic Interview (3di) (Skuse et al., 2004):** This is semi-structured interview completed with parents/caregivers. It assesses social interaction, communication, repetitive behaviours/interests and other areas of development and general functioning.
- **Social Responsiveness Scale (SRS) (Constantino & Gruber, 2005):** This is a questionnaire which assesses

interpersonal behaviour, communication and repetitive/stereotypic behaviour.

### RESEARCH FINDINGS

The adolescents with autism in this study presented with the following patterns in the AASP:

- Significantly high scores on the Sensation Avoidance quadrant, indicating a drive to avoid many sensory experiences.
- Significantly low scores on the Sensation Seeking quadrant, indicating that they do not actively seek out additional sensory input.
- Typical scores in the Low Registration and Sensory Sensitivity quadrants.

This pattern suggests that adolescents with autism have a low neurological threshold for sensory input and actively avoid a range of sensory stimulation. This partly supports the findings of other studies, although previous research had additionally found differences in Sensory Sensitivity and Low Registration. This may be explained by inherent differences in the samples and research methodologies.

The non-affected siblings had lower scores in Sensation Seeking than the control adolescents. This shows that the tendency to seek fewer sensory sensations is a pattern common to both adolescents with autism and non-affected siblings, and is different from the pattern shown in the general population. Reduced Sensation Seeking is therefore a potential intermediate phenotype for autism, but further research is required before it can be used to contribute towards genetic research in autism.

### IMPLICATIONS FOR PRACTICE

*(by the author)*

- Sensory processing differences are a common feature in autism, affecting the majority of children, adolescents and adults with autism. It is therefore essential that

## Atypical Sensory Processing in Adolescents with an Autism Spectrum Disorder and their Non-Affected Siblings

professionals always consider and assess the sensory issues of individuals with autism as they are likely to have a significant impact on independence in daily activities, academic skills, emotional state, behaviours and parental stress.

- Siblings of individuals with autism may present with atypical sensory processing, but this does not necessarily mean that the sibling has autism. It will be important to clarify this to parents who may have concerns about a sibling's sensory processing.

- Further research should be conducted to confirm if a lower score in the Sensation Seeking quadrant is a reliable intermediate phenotype for autism.

### FULL REFERENCE

De la Marche, W., Steyaert, J. and Noens, I. (2012). *Atypical Sensory Processing in Adolescents with an Autism Spectrum Disorder and their Non-Affected Siblings. Research in Autism Spectrum Disorders*, 6, p. 639-645.

# RESEARCH PAPER

## Children with Autism and Attention Difficulties: A Pilot Study of the Association between Sensory, Motor, and Adaptive Behaviours

### RESEARCH AIMS

1. To compare sensory processing, motor skills and adaptive behaviours in children with a dual diagnosis of High Functioning Autism (HFA) and Attention Deficit Hyperactivity Disorder (ADHD) with children who have only one diagnosis of either HFA or ADHD.
2. To explore the relationship between sensory processing and motor skills with adaptive behaviours.

N.B. The term “adaptive behaviours” refers to daily activities, including personal care, independence, social communication and academic skills.

### RESEARCH METHODS

The study sample included 34 children aged 5-14 years from the greater Quebec area in Canada. Thirteen children had a dual diagnosis of HFA and ADHD, four had HFA alone and 17 had ADHD alone. All children in the sample were assessed using the following measures:

- Social Communication Questionnaire (SCQ) (Rutter, Bailey & Lord, 2003).
- Autism Diagnostic Observation Schedule (ADOS) (Lord, Rutter, DiLavore & Risi, 1999).
- Conners' Parent Rating Scale - Revised (CPRS-R) (Conners, 1997).
- The Weschler Intelligence Scale for Children - Fourth Edition (WISC-IV) (Weschler, 1999; 2004).
- Sensory Profile (SP) (Dunn, 1999). The Short Sensory Profile (SSP) was also used.
- Bruininks-Oseretsky Test of Motor Proficiency – Second Edition (BOT-2) (Bruininks & Bruininks, 2005).
- Adaptive Behaviour Assessment System – Second Edition (ABAS-II) (Harrison & Oakland, 2008).

Information from parents was also collected through the use of questionnaires.

### RESEARCH FINDINGS

All children in the study with a dual diagnosis of HFA

and ADHD had global sensory processing difficulties and global difficulties in adaptive skills. This is in contrast to the group with ADHD only, as less than 50% of this group had significant sensory processing difficulties or significant adaptive difficulties. Differences in sensory processing and deficits in adaptive skills are therefore more likely to occur when a child has a co-occurring diagnosis of both HFA and ADHD.

The group with a dual diagnosis of HFA and ADHD had a higher prevalence of deficits in motor skills, particularly gross motor skills, than the group with ADHD only. Although not all children with a dual diagnosis have motor skill difficulties, they are more likely to have motor deficits than children with ADHD only.

The study confirms that difficulties in sensory processing and motor skills will have a negative impact on independence in daily life skills. Children in the study who were sensory avoidant, sensory sensitive or had low registration were less independent in daily activities, including personal care tasks. Difficulties in visual and touch processing affected all aspects of adaptive skills, whereas auditory processing seemed to only affect conceptual skills (e.g., academic skills). Children who had higher scores in manual coordination, strength and agility were more competent and independent in daily tasks.

### IMPLICATIONS FOR PRACTICE

*(by the authors and reviewer)*

The high prevalence of sensory processing difficulties and adaptive skill deficits in children with HFA and ADHD suggests that it would be beneficial to always assess these skills in children with these diagnoses.

The presence of ADHD symptoms alongside HFA is likely to cause greater difficulties in motor and adaptive skills. Children with a dual diagnosis will therefore require more assistance to develop these skills.

## Children with Autism and Attention Difficulties: A Pilot Study of the Association between Sensory, Motor, and Adaptive Behaviours

Parents and professionals should be aware that children with sensory sensitivities, sensory avoidance and low registration will require more assistance in learning independence skills in daily activities. Sensory processing difficulties, especially visual and touch processing, should be addressed before expecting independence in these tasks.

Activities to improve strength, agility and manual dexterity should be incorporated in intervention in order to improve performance in daily activities, such as personal care tasks.

### FULL REFERENCE

Mattard-Labrecque, C., Amor, B.L. and Couture, M.M. (2013). Children with Autism and Attention Difficulties: A Pilot Study of the Association between Sensory, Motor, and Adaptive Behaviours. *Journal of the Canadian Academy of Child and Adolescent Psychiatry*, 22, p. 139-146.

## Sensory Correlates of Difficult Temperament Characteristics in Preschool Children with Autism

### RESEARCH AIMS

Temperament denotes behavioural style, or the manner in which a person interacts with their environment. Children with autism known to have sensory processing difficulties may exhibit difficult temperament characteristics such as high activity level, distractibility and withdrawal in response to their environment.

This study aimed to investigate (1) the frequency of co-occurring sensory processing dysfunction in preschool children with autism who had difficult temperament characteristics and (2) the relationship between sensory processing dysfunction and difficult temperament characteristics.

### RESEARCH METHODS

A total of 111 children aged 48–84 months – 67 children with autism and 44 age-matched typically developing children – participated in this study, which was conducted in Taiwan. Two questionnaires, the Sensory Profile and the Behaviour Style Questionnaire, were sent to and completed by the caregivers of the 111 participating children.

### RESEARCH FINDINGS

This study found that the children with autism displayed significantly more difficult temperament characteristics (such as high activity level, negative mood, high threshold of responsiveness) and were more withdrawn, less adaptable, less persistent and less distractable than typically developing children.

Additionally, of all the children with difficult temperament characteristics, 91.3% of the children with autism and 50% of the typically developing children were found to display co-occurring sensory processing dysfunction. However, of the children displaying easy temperament characteristics, the frequency of co-occurring sensory processing dysfunction was lower for both the children with autism (60%) and

typically developing children (0%). Furthermore, results indicate that sensory processing patterns were associated with different temperament characteristics. For example, children who sought excessive sensory input were more likely to show lower adaptability whereas children with less sensory seeking behaviours were more likely to be easily distracted; children with sensitivities to sensory stimuli were more likely to have higher intensities of reaction; and children who missed the sensory input needed for greater participation in activity were found to have a lower mood.

### IMPLICATIONS FOR PRACTICE

*(by the authors)*

- Modifying sensory stimulation from the environment can improve sensory processing function and therefore support children's participation in their daily activities.
- For children with sensory avoiding behaviours, teachers and care givers should make the necessary adjustments, such as limiting exposure to sensory stimuli and then gradually increasing sensory experiences to facilitate improved adaptation and functioning. However, care should be taken with children who have intense responses (such as disruptive behaviour or fight responses) to sensory experiences.
- Teachers and care givers should take every opportunity to understand the sensations sensory seeking children crave and incorporate the sensations into everyday activities.
- This study found that children who did not register meaningful sensory stimuli were more likely to experience low mood and less persistence in tasks. Individualised specific interventions, such as increasing the weight of objects, can stimulate sensory registration and may enhance mood and persistence with tasks.

### FULL REFERENCE

Chuang, I.C., Tseng, M.H., Lu, L. and Shieh, J.Y. (2012). Sensory Correlates of Difficult Temperament Characteristics in Preschool Children with Autism. *Research in Autism Spectrum Disorders*, 6, p. 988-995.

## Relationship Between Context and Sensory Processing in Children With Autism

### RESEARCH AIMS

This study aimed to establish if a child's context affects their behavioural responses to sensory input. In other words, this study examined the differences between school and home settings on a child's reactions to sensory information.

The researchers used the Sensory Profile (caregiver's report) and the Sensory Profile School Companion but chose to focus only on the Sensation Seeking and Sensation Avoiding quadrants. These two quadrants were selected as they represent active behaviours, which are therefore easier to observe by parents and teachers.

The authors stated two hypotheses:

1. When assessing children with autism, there would be a low relationship between scores on the Sensation Seeking quadrant at home and at school. It was hypothesised that children would show more sensation seeking behaviours at home than in school.
2. When assessing children with autism, there would be a high relationship between scores on the Sensation Avoiding quadrant at home and at school. It was hypothesised that the level of sensation avoiding behaviours would be the same in the home and school contexts.

### RESEARCH METHODS

The final sample included 49 children with autism, aged 3 years and 3 months to 11 years and 11 months. The following assessments were used:

- **The Sensory Profile (Dunn, 1999):** This was completed by the parents of the children included in the study. It is a 125-item questionnaire which provides statements regarding responses to sensory input. Caregivers use a 5-point Likert scale to score how frequently a behaviour occurs.
- **The Sensory Profile School Companion (Dunn, 2006):** This was completed by the teachers of the children included in the study. It is a 62-item questionnaire

which is designed to be used in conjunction with the Sensory Profile, and is therefore scored in the same way but the statements focus on sensory experiences in the school setting.

The scores on the Sensation Seeking and Sensation Avoiding quadrants were analysed and compared between the two assessments.

### RESEARCH FINDINGS

Scores on the Sensation Avoiding quadrant had a moderate to good correlation between home and school contexts, indicating that children with autism have a tendency to avoid sensory stimuli across both settings. A child who is easily overwhelmed by sensory input is likely to engage in avoiding behaviours at both home and school. Examples of such behaviours include covering ears in response to noises or avoiding eye contact.

This may vary of course, depending on the specific context. A child may live in a very quiet home environment and therefore exhibit few sensation avoiding behaviours, but in a noisy classroom the teacher may observe him engaging in more avoidant behaviours. In this example, responses will vary according to the specific context.

Scores on the Sensation Seeking quadrant had a fair correlation between home and school contexts. The authors explain that sensation seeking behaviours may be acceptable in the home environment and not viewed as a challenging behaviour, whereas in the classroom sensation seeking behaviours may be considered to be disruptive. For example, parents may enjoy hearing their child sing loudly at home, but in a classroom the teacher may view this as unacceptable. This would therefore explain why the correlation in this quadrant was lower. Additionally, the authors suggest that the child may maintain self-control during the restrictions of the school day but then seek increased sensation at home.

# RESEARCH PAPER

continued from overleaf..

## Relationship Between Context and Sensory Processing in Children With Autism

Significant correlations were also found between sensation avoiding in school and sensation seeking at home; and also between sensation seeking in school and sensation avoiding at home. Sensation avoiding and sensation seeking are both considered to be active self-regulation patterns in Dunn's Model of Sensory Processing (Dunn, 1997). These correlations suggest that the children are engaging in active strategies to control their own sensory input and to meet their sensory needs independently.

### IMPLICATIONS FOR PRACTICE

*(by the authors and reviewer)*

- The differing observations of parents and teachers shows the importance of obtaining information from both in order to gain a comprehensive picture of a child's sensory processing pattern.
- Children with autism appear to respond differently to sensory input depending on the context. Information should therefore be gathered from both home and school settings. Intervention strategies which are successful at home should be shared with the school and vice versa.
- Occupational therapists may find it beneficial to use both the Sensory Profile and the School Companion when assessing children with autism.
- As children spend a significant amount of their time in school, it is essential to assess sensory processing in that context. This will then assist in the development of appropriate intervention as part of an education context.
- Sensory processing is known to affect learning and academic achievement and education professionals therefore have a responsibility to address sensory needs in order to optimise engagement in the curriculum.
- Many children with autism engage in sensation avoiding behaviours at both home and school. Parents and professionals should therefore use strategies to minimise sensory input. This may include reducing noise and other input where possible, avoiding unpredictable sensory input, gradually introducing the child to sensory rich environments, providing calming resources and allowing calm breaks from sensory overwhelming environments and activities.
- Professionals should ask parents and teachers about times when the child attempts to avoid sensory experiences and then recommend appropriate intervention strategies. This is likely to decrease the child's anxiety and reduce the incidence of challenging behaviours.
- Sensation avoidance may explain some of the typically autistic behaviours, such as rigidity, adherence to routine and avoidance of new situations. The child's avoidance of sensory input may be contributing to these behaviours. Reducing the sensory demands in environments may assist the child in transitioning to new experiences and may encourage them to engage in a wider repertoire of activities.
- Teachers should be aware that some perceived challenging behaviours may in fact be the child's attempt to actively meet his own sensory needs. A child who is frequently getting out of his seat, humming to himself or fidgeting may be using these behaviours to provide sensory stimulation to the brain, in order to increase alertness and attention. Restricting these behaviours may negatively affect attention and engagement, and could result in more disruptive behaviours. If a child seems to require increased sensory input, he should have access to appropriate sensory activities for short intervals throughout the day. Examples include taking a short exercise programme, taking a message to another classroom, handing books out to classmates and provision of a fidget item.
- Parents may notice their child engaging in sensation seeking behaviours when the child comes home from school. The child should be allowed to engage in appropriate sensory rich activities at this time. Examples of activities which are appropriate for some children are trampolining, bouncing on a space hopper, running up and down stairs, going for a walk or assisting in

## Relationship Between Context and Sensory Processing in Children With Autism

household activities such as carrying shopping or mopping a floor.

### FULL REFERENCE

Brown, N. B. and Dunn, W. (2010). Relationship Between Context and Sensory Processing in Children with Autism. *The American Journal of Occupational Therapy*, 64, p. 474-483.

## Emotional and Behavioural Problems in Preschool Children with Autism: Relationship with Sensory Processing Dysfunction

### RESEARCH AIMS

1. To measure the rate at which sensory processing dysfunction co-occurs with emotional and behavioural difficulties in preschool children with autism.
2. To explore the relationship between sensory processing dysfunction and emotional and behavioural difficulties in preschool children with and without autism.

### RESEARCH METHODS

The study included 67 children with autism and 45 typically developing children, with an average age of 5 years and 4 months. Caregivers of each child completed the following assessments:

- Sensory Profile – Chinese version (SP-C, Tseng & Cheng, 2008): This questionnaire measures a child's responses to daily sensory experiences. Results are divided into four quadrants: Registration, Seeking, Sensitivity and Avoiding.
- Child Behaviour Checklist for ages 4-18 – Chinese version (CBCL-C, Huang, Chung & Wang, 1994): This checklist measures emotional (internalising) problems and behavioural (externalising) problems. Examples of internalising problems are withdrawal, anxiety and depression. Examples of externalising problems are disruptive and aggressive behaviours.

### RESEARCH FINDINGS

Overall, the study concluded that sensory processing dysfunction is more prevalent in preschool children with autism than in typically developing children. The study confirmed that sensory processing dysfunction is a key difficulty in autism. A relationship between sensory processing and emotional and behavioural difficulties was confirmed in children with and without autism.

The CBCL-C lists eight syndrome scales. This study found that 47.7% of the sample with autism had two or more of these syndromes compared to only 8.8% of the

typically developing sample. This supports the findings of other studies that children with autism are likely to have emotional and behavioural difficulties.

The results of the CBCL-C in this study showed that children with autism had more significant internalising problems than children without autism and greater severity in withdrawal and in difficulties associated with thought, attention and social aspects. There was no significant difference between the two groups in externalising problems.

The results of the SP-C indicated that the children with autism had a lower mean score (indicating definite sensory processing differences) in each of the quadrants than the children without autism. Further comparison showed that 77.6% of the group with autism scored in the “definite difference” range in at least one quadrant, whereas only 18.2% of the typically developing group had a quadrant score in the “definite difference” range. This suggests that most children with autism process sensory information in a different way from the typically developing population. Low registration was the most common sensory processing difficulty in preschool children with autism.

The scores on the CBCL-C were compared with the SP-C scores and a positive relationship was found in both groups. This means that children who have clinically significant emotional and behavioural difficulties also have definite differences in how they process sensory information, whether or not they have a diagnosis of autism. This indicates a causal link between sensory processing difficulties and emotional behavioural difficulties.

Children with and without autism who tend to be sensory avoiding are more likely to have internalising problems, and boys with autism are also more likely to experience internalising problems. Children with autism who are more sensory sensitive tend to have more externalising problems, whereas in children without autism, sensory seeking is a greater indicator of externalising problems.

## Emotional and Behavioural Problems in Preschool Children with Autism: Relationship with Sensory Processing Dysfunction

### IMPLICATIONS FOR PRACTICE

(by the authors and reviewer)

- Professionals working with children with emotional and behavioural difficulties should consider if the child has sensory processing dysfunction, as this is likely to be a contributory factor to emotional and behavioural difficulties. In particular, children with internalising problems, such as anxiety and social withdrawal, may benefit from assessment for sensory processing dysfunction.
- Children with autism presenting with high levels of anxiety and withdrawal may have an underlying pattern of sensory avoidance. Their dislike of sensory input (e.g., classroom noise, crowded environments, tactile materials) may cause them to withdraw from new experiences and to become anxious in unfamiliar scenarios. Reducing sensory input and gradually introducing new sensory experiences in a controlled way may reduce emotional difficulties.
- Children with autism who present with a sensory seeking pattern are likely to have externalising/behavioural difficulties, such as distractibility and agitation. Concentration is likely to improve if sensory

input is controlled and consistent, and calming deep pressure (e.g., through resistance activities or weighted items) is provided at regular intervals.

- Sensory stimulation in the school, home and other environments should be controlled as this will facilitate sensory processing for most children with autism and will subsequently reduce many of their emotional and behavioural difficulties. Factors to consider include controlling noise levels, reducing unexpected stimuli, limiting visual distractions and gradually exposing the child to new sensory experiences in a slow but progressive manner. The provision of deep pressure input may also reduce the emotional and behavioural difficulties frequently associated with sensory processing dysfunction and autism.

### FULL REFERENCE

Tseng, M. H., Fu, C. P., Cermak, S. A., Lu, L. and Shieh, J. Y. (2011). Emotional and Behavioural Problems in Preschool Children with Autism: Relationship with Sensory Processing Dysfunction. *Research in Autism Spectrum Disorders*, 5, p. 1441-1150.

## Sensory Features and Repetitive Behaviours in Children with Autism and Developmental Delays

### RESEARCH AIMS

The purpose of this experimental study was to examine the association between sensory processing difficulties and repetitive behaviours in children with autism and children with developmental delay. The processing difficulties hyper-responsiveness (over-reactivity to sensory stimuli), hypo-responsiveness (under-reactivity to sensory stimuli) and sensory seeking (craving/fascination with certain sensory stimuli) were investigated. The researchers also aimed to determine if the relationship between sensory difficulties and repetitive behaviours was influenced by developmental age.

### RESEARCH METHODS

There were two groups in the study: 67 children with autism and 42 children with developmental delay. The study used several standardised assessments to measure cognition, repetitive behaviour and sensory processing.

### RESEARCH FINDINGS

Overall, the researchers found that children with autism had significantly higher scores than children with developmental delay on sensory processing measures and in the repetitive behaviour measures (except for self-injury), indicating that children with autism had more difficulties in these areas.

Higher levels of hyper-responsiveness were correlated with higher levels of repetitive behaviours in both the autism and developmental delay group. Sensory seeking behaviours were significantly correlated with ritualistic/sameness behaviours. Overall the association between hyper-responsiveness and sensory seeking behaviour did not vary between children with autism and those with developmental delays.

The relationship between sensory processing and repetitive behaviours was not affected by developmental age.

### IMPLICATIONS FOR PRACTICE

*(by the authors)*

The researchers discussed the association between hyper-responsiveness and compulsive or ritualistic behaviours. In Obsessive Compulsive Disorder (OCD), which shares similarities with autism, anxiety has been found to have a major role in compulsive and ritualistic behaviours. Individuals with OCD engage in behaviours in an attempt to lower anxiety levels and to gain predictability and control. Therefore hypersensitivity in children with autism may result in anxiety, which could explain why they engage in compulsive/ritualistic behaviours.

Alternatively, the researchers suggested that hypersensitiveness may result in greater attention to detail, which may assist in “talents” in children with high functioning autism. To gain a greater understanding of the adaptive or maladaptive consequences of hypersensitivity, further research is required.

### FULL REFERENCE

Boyd, B. A., Baranek, G. T., Sideris, J., Poe, M. D., Watson, L. R., Patten, E., et al. (2010). Sensory Features and Repetitive Behaviours in Children with Autism and Developmental Delays. *Autism Research*, 3, p. 78–87.

## Sensory Processing Subtypes in Autism: Association with Adaptive Behaviour

### RESEARCH AIMS

1. To examine sensory processing patterns associated with autism.
2. To explore the relationship between sensory processing patterns and adaptive behaviours in children with autism.

N.B. Adaptive behaviours include independence skills and social competence.

### RESEARCH METHODS

There were 54 participants, aged 33-115 months, included in the study. The following assessments were used:

- Short Sensory Profile (SSP) (McIntosh et al., 1999). This questionnaire measures sensory processing in seven separate domains and provides a total score for sensory processing function.
- Vineland Adaptive Behaviour Scales (VABS) (Sparrow et al., 1984). This semi-structured interview assesses personal independence and social competence in five domains.

The SSP was completed by caregivers; information for the VABS was collected from participants' records.

### RESEARCH FINDINGS

Results from the Daily Living subdomain of the VABS were used to measure developmental level, and all participants' scores reflected low developmental level.

Total scores on the SSP indicated that 87% of participants had sensory processing dysfunction, which supports the view that the majority of children with autism experience sensory processing difficulties.

The main sensory processing difficulties were in the domains of auditory filtering and under-responsive/seeking sensation. This supports previous research findings and

reinforces that these tend to be the key areas of sensory processing difficulties experienced by children with autism. Interestingly, however, the two domains of auditory filtering and under-responsiveness/seeking sensation are often contradictory, as auditory filtering is generally an indicator of auditory over-responsiveness. This study therefore found that the two extremes of over-responsiveness and under-responsiveness to sensory input can often co-exist in children with autism.

The authors used cluster analysis to identify three sensory processing subtypes in children with autism:

1. **Sensory-based inattentive seeking:** This group had generally typical sensory processing but mild difficulties in under-responsive/seeking sensation and auditory filtering. This leads to inattention, distractibility and impulsivity.
2. **Sensory modulation with movement sensitivity:** This group had sensory processing difficulties in all domains and tended to fluctuate between the extremes of over-responsiveness and under-responsiveness. This was the only group to have movement sensitivity, low energy and weak muscle strength.
3. **Sensory modulation with taste/smell sensitivity:** This group also had sensory processing difficulties across most domains, but with extreme dysfunction in taste/smell sensitivity. They did not present with difficulties in movement sensitivity or low energy/weak.

These cluster patterns are different to other sensory modulation disorder classifications and indicate that children with autism may present with different sensory processing patterns than other groups of children.

The study found that the following three sensory domains are worthy of particular attention when working with children with autism:

- **Auditory filtering:** Many children with autism appear to respond less to noises, and in some instances show an absence of response to auditory stimuli.

# RESEARCH PAPER

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## Sensory Processing Subtypes in Autism: Association with Adaptive Behaviour

- **Taste/smell sensitivity:** Previous literature has suggested a link between taste/smell hypersensitivity in autism and food aversions, but the current study indicates that further research in this area is required.
- **Low energy/weak:** Children with difficulties in this domain tend to tire easily, and have limited muscle strength and poor core stability, leading to motor coordination deficits and dyspraxia. Other studies have identified these difficulties as prevalent in autism and associated with social communication deficits.

The study examined the link between sensory processing patterns and adaptive behaviours, and found that children with difficulties in the taste/smell domain had greater communication impairments, suggesting a link between these deficits. It also found that children with autism who have difficulties in the movement domain have better communication skills than children without movement difficulties.

Children in the study who presented with global sensory processing difficulties had a higher incidence of maladaptive behaviours than the children with milder sensory processing difficulties. In particular, significant difficulties in the sensory processing domains of taste/smell sensitivity, auditory filtering and movement sensitivity were positively associated with maladaptive behaviours.

### IMPLICATIONS FOR PRACTICE

*(by the authors and reviewer)*

- Sensory processing should be assessed in all children with autism due to the high prevalence of sensory processing dysfunction in this group.
- The majority of preschool children with autism are under-responsive to sensory input and therefore present with low registration and/or sensory seeking behaviours.
- This means that they often require increased amounts of sensory input, but in a controlled manner. Activities to increase arousal and meet their sensory needs should be used regularly throughout the day in order to optimise engagement, attention and interaction.
- Auditory filtering is again highlighted as a key area of difficulty for children with autism, and in many cases they are not responding adequately to auditory input. The use of visual strategies at home and in school will assist in gaining the child's attention and clarifying the information that is being communicated.
- Children with food aversions (leading to limited diets) should be assessed for taste/smell sensitivity. Strategies such as keeping kitchens and dining areas well ventilated and very gradually introducing new tastes and smells may help expand the child's diet.
- Significant sensory processing difficulties could be used as an indicator that a child is likely to have deficits in adaptive behaviours, i.e. independence skills and social competence. In particular, the domains of taste/smell sensitivity, auditory filtering and movement sensitivity could be useful predictors of maladaptive behaviours in autism.
- Sensory-based interventions to address issues such as auditory responsiveness, taste/smell sensitivity and motor coordination are likely to have a positive effect on independence skills and social communication, due to the association between sensory processing and adaptive behaviours.

### FULL REFERENCE

Lane, A. E., Young, R. L., Baker, A. E. Z. and Angley, M. T. (2010). Sensory Processing Subtypes in Autism: Association with Adaptive Behaviour. *Journal of Autism and Developmental Disorders*, 40, p. 112-122.

## The Everyday Routines of Families of Children with Autism: Examining the Impact of Sensory Processing Difficulties on the Family

### RESEARCH AIMS

The purpose of this qualitative study was to explore how sensory-related behaviours of children with autism affected family experiences and routines inside and outside the home.

### RESEARCH METHODS

In-depth semi-structured interviews were conducted with four parents of children with autism who had sensory processing difficulties. The children's sensory processing difficulties were measured by the Sensory Processing Measure Home Form (SPM; Parham et al., 2007) and the children were aged between 7 and 12 years. The interviews aimed to explore the meaning and impact of their child's sensory-related behaviours on family routines inside and outside the home. Three of the four families had at least one other child without a diagnosis of autism. During the interview parents were asked to describe typical family activities, a typical day, and family roles and routines.

### RESEARCH FINDINGS

Results from the Sensory Processing Measure found that all of the children fell into the "definite dysfunction" or "some problems" area in all seven categories: social participation, visual, hearing, tactile, proprioceptive, vestibular functioning and praxis.

During the semi-structured interviews six main themes emerged, which are discussed below.

#### **Flexibility**

Caregivers described feelings that the family had to be flexible at all times to accommodate the child's sensory needs. Activities could quickly change and activities that caused sensory difficulties for the child were completed when the child was not there.

#### **Familiar versus Unfamiliar Space**

Families reported that there were fewer difficulties with

sensory needs in familiar spaces such as the home. In such spaces predictability and routines were established to minimise sensory difficulties. However, in unfamiliar spaces it was difficult to predict and modulate sensory information and this could result in the child running away or engaging in challenging behaviours. The families reported that this limited the types of places they went to as a family, meaning sensory processing difficulties affected the families' ability to socialise with the community or other families.

#### **Difficulty Completing Family Activities**

Families perceived they were not able to complete family activities in the way other families without children with autism are.

- **Inside the home**

Morning and bedtime routines were perceived to be most difficult in the home. Morning routine was especially found to be stressful due to time restraints to get ready for work or school. Meal times were also reported to be stressful due to the child's sensory needs. Some children ate a very restrictive diet due to sensory sensitivities, while another child could not sit long enough for the family to enjoy a meal together. This resulted in stress for the children and caregivers and an inability to enjoy a meal together.

- **Outside the home**

Several activities outside the home were found to be difficult. This led to parents restricting family outings in some settings that were likely to present too much sensory stimulation. Steps were also taken to reduce risk of sensory overload when participating in an activity. For example, one family when attending a sporting activity brought the child after the teams were introduced due to the excessive noise. Another issue highlighted was the difficulty in finding appropriate childcare when the parents wished to spend time alone.

- **Impact on Siblings**

Parents noted that the child with autism sometimes monopolised attention, resulting in siblings receiving less attention and consequently engaging in more

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## The Everyday Routines of Families of Children with Autism: Examining the Impact of Sensory Processing Difficulties on the Family

independent tasks. This led to a feeling of guilt for the parents. To address this, one family completed family activities separately, meaning that one parent would be with the child without autism and one parent would go with the child with autism. There was an understanding by all the parents that the child with autism had to come first due to the nature of their difficulties. On occasions this was noticed by siblings.

### The Need for Constant Monitoring

Parents noted they felt the need to constantly monitor the environment and evaluate the impact of the sensory stimulation on the child. This meant parents were rarely able to take their attention off the child as they were on guard constantly to try and anticipate when difficulties would arise in case their child would damage property or disrupt others around them. Pre-planning to enable time to prepare the child was necessary. Specific difficulties were highlighted such as waiting in line, fluorescent lights and crowded spaces. In the home, where sensory stimulus is more predictable, the level of surveillance could be reduced.

### Strategies Developed to Improve Participation for the Family

The study found that although the families faced many challenges they made considerable effort to participate in as many activities as possible. Each family developed strategies to manage sensory difficulties arising during activities. All participants highlighted the need to develop a routine, including at weekends, to provide predictability for the child with autism. Other strategies depended on the activity being completed. For example, one family gave the child a role to complete, such as pushing a grocery trolley in a supermarket or giving the child a chew toy distracter after swimming. Such strategies enabled increased participation in activities.

When choosing activities, families tried to engage in activities that the child enjoyed and that did not over-stimulate the child. They also carefully adapted the

environment to ensure the child received the sensory stimulation they needed without being overwhelmed.

## IMPLICATIONS FOR PRACTICE

*(by the authors and reviewer)*

- There is a need for professionals to consider family routines, activities, coping strategies and the child's sensory processing when working with families affected by autism.
- Parents need more practical advice with regard to developing strategies to make it easier for the family to engage in activities. The role of occupational therapists in this area was highlighted as they could provide specific strategies to target sensory difficulties.
- Parents require support and advice in how to facilitate shared activities between the child with autism and their siblings.

## FULL REFERENCE

Schaaf, R. C., Toth-Cohen, S., Johnson, S. L., Outten, G., and Benevides, T. W. (2011). The Everyday Routines of Families of Children with Autism: Examining the Impact of Sensory Processing Difficulties on the Family. *Autism*, 15(3), p. 373-389.

## Sensory-Based Interventions in the General Education Classroom: A Critical Appraisal of the Topic

### RESEARCH AIMS

Current best practice education and allied health guidelines recommend the provision of therapy services to facilitate the academic performance of students with learning difficulties. For some children, certain sensory experiences may negatively affect their ability to attend, function and perform in the classroom.

This study reviewed the current literature regarding the effectiveness of sensory-based interventions in the general education classroom for children with and without a developmental diagnosis for improving attention, function and performance.

### RESEARCH METHODS

After performing a systematic literature search of electronic databases and applying inclusion criteria, 13 articles were identified for critical appraisal. All included articles were peer reviewed; published between 1990 and 2009; focused on children with and without developmental disabilities in mainstream elementary/preschool classrooms; and investigated the effectiveness of sensory-based interventions.

### RESEARCH FINDINGS

A variety of sensory-based activities and techniques were employed by the 13 included studies.

- “Active sitting” (facilitated by sitting on a moveable surface) and yoga, both known to encourage vestibular sensory feedback, were found to improve focus, listening and alertness in the classroom.
- Auditory stimulus in the form of calming music was found to improve arithmetic performance and on-task behaviour when compared to no music for 31 elementary school children.
- Tactile stimulation provided by a sensory toy and deep pressure, proprioceptive input from isometric exercises, and oral sensorimotor input from chewing gum or toys

can reduce off-task and aggressive behaviour in children with and without a developmental diagnosis.

### IMPLICATIONS FOR PRACTICE

*(by the authors)*

- Individualised sensory strategies should be employed within mainstream education settings to maximise the learning potential of students.
- Sensory strategies should improve the student’s ability to attend, stay on task, and general academic performance.
- Occupational therapists should collaborate with school staff and parents to assist and advise on appropriate sensory-based strategies to facilitate an appropriate environment to maximise learning potential.

### FULL REFERENCE

Worthen, E. (2010). *Sensory-Based Interventions in the General Education Classroom: A Critical Appraisal of the Topic. Journal of Occupational Therapy, Schools & Early Intervention, 3(1), p. 76-94.*

## Sensory Processing, Physiological Stress and Sleep Behaviours in Children With and Without Autism Spectrum Disorders

### RESEARCH AIMS

Sleep is a vital function for all living creatures. During childhood, the activity of sleeping is particularly important for brain development and maturation. Children with autism often experience sleep problems, such as night waking or difficulty getting to sleep, which are associated with an overall increase in the severity of autism symptoms.

It has been suggested that some sleep problems are due to sensory sensitivities. Both sleep and sensory modulation (the physiological and behavioural response to sensory stimuli) have been linked to overall arousal and release of the stress hormone cortisol. High levels of cortisol occur in response to stress.

The purpose of this study was to examine the relationship between the physiological responses to sensory stimuli and sleep quality in children with and without autism spectrum disorder.

### RESEARCH METHODS

Fifty-five children aged 6-12 years with an IQ of 70 or higher participated in the study. Twenty-seven children had a diagnosis of autism spectrum disorder and 28 were typically developing children.

Parents and caregivers completed the Sensory Profile questionnaire and questions from the Child Behaviour Check List that related to sleep quality, duration and behaviour. Patterns of salivary cortisol were collected in the morning, afternoon and night at home, and at five-minute intervals from 0-30 minutes after each child underwent periods of physiological stress through a Sensory Challenge Protocol in the laboratory.

Additionally, electrodermal activity and reactivity to sensory stimuli were assessed using non-invasive electrodes attached to the right hand of each child. Measurements were taken prior to, during and after the Sensory Challenge Protocol.

### RESEARCH FINDINGS

Overall the children with autism were reported to have a higher frequency of problem sleep behaviours and had significantly greater dysfunction across all quadrants of the Sensory Profile when compared to the results of the typically developing children. However, for the typically developing group, a significant relationship between sensory modulation and sleep behaviour was found for all quadrants of the Sensory Profile (Low Registration; Sensation Seeking; Sensory Sensitivity; and Sensation Avoiding), whereas the relationship between sensory modulation and sleep behaviour was only significant for one quadrant of the Sensory Profile for children with autism (Sensation Avoiding).

Irrespective of diagnosis, poor sleepers demonstrated higher levels of cortisol in the afternoon, a greater magnitude of electrodermal activity and reactivity to sensory stimuli, and a tendency toward higher cortisol levels 25 to 30 minutes following a sensory challenge compared to good sleepers. Children who were identified as poor sleepers demonstrated higher than average magnitudes of response to tone, smell and visual stimuli.

### IMPLICATIONS FOR PRACTICE

*(by the authors and reviewer)*

If a child has sleep problems, it may be important to consider the relationship between sleep behaviour and sensory modulation. Sensory strategies may improve sleep behaviour for children experiencing sleep problems. Examples may include:

- Reducing sensory input throughout the day to reduce anxiety, which may be affecting sleep patterns.
- Introducing an effective sleep hygiene routine before bed, e.g., provision of less stimulating activities, deep pressure input, reducing sensory stimulation in the bedroom.
- Addressing general sensory modulation difficulties to ensure children are emotionally regulated.

## Sensory Processing, Physiological Stress and Sleep Behaviours in Children With and Without Autism Spectrum Disorders

### FULL REFERENCE

Reynolds, S., Lane, S. and Thacker, L. (2012). Sensory Processing, Physiological Stress and Sleep Behaviours in Children With and Without Autism Spectrum Disorders. *Occupation, Participation & Health*, 32(1), p. 246- 257.



## CONCLUSION

The articles included in this Bulletin confirm the findings of previous research and the personal accounts of people with autism, highlighting that sensory processing difficulties are highly prevalent in autism but that there is significant variability amongst individuals. As Amy Laurent stressed in her interview, children and young people with autism may be hyper-reactive or hypo-reactive to sensory input and their responses will fluctuate according to the individual, the context and the activity.

Professionals and caregivers therefore need to adopt an individualised approach to meet the unique sensory

needs of each child and young person. Sensory-based interventions cannot be prescriptive, and it is essential that we are flexible in our intervention and able to tailor strategies to individual need.

Many children and young people with autism cannot regulate their own responses to sensory input, and so it is the responsibility of professionals and caregivers to make adaptations to the environment and activities in order to reduce anxiety or increase alertness. Qualified professionals, can advise on appropriate strategies that will then optimise opportunities for learning, play and interaction.

# NOTES

## YOUR OPINION

The Centre trusts that you have found this Research Bulletin informative. It would be appreciated if you would take a few minutes to provide the Centre with feedback in relation to this bulletin by clicking on the survey link below.

» **Survey for  
Sensory Processing**





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