



CENTRE FOR AUTISM
MIDDLETOWN

Sensory Processing Volume 2



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INTRODUCTION

This is the twenty sixth Research Bulletin produced by Middletown Centre for Autism and it provides summaries of fourteen articles spanning from 2014-2017.

The Bulletin commences with an interview with Professor Kelly Mahler.

Professor Kelly Mahler is a parent, occupational therapist, author, speaker and Adjunct Professor of Occupational Therapy. She earned an MS in Occupational Therapy, as well as a Post-Professional Pediatric Certificate from Misericordia University, Dallas, PA. As an occupational therapist and autism consultant she supports school-aged individuals and young adults with autism.

Kelly is co-founder of Destination Friendship, an organisation providing fun opportunities targeted at developing friendship skills in young people with autism. She is also actively involved in multiple research projects pertaining to interoception. Kelly has presented numerous seminars and workshops at the international and national levels.

Kelly has authored many books including:

- *Interoception: The Eighth Sensory System*
- *The Comprehensive Assessment of Interoceptive Awareness*
- *Sensory Issues and High Functioning Autism (with Myles and Robbins)* - winner of National Parenting Publications Bronze Medal
- *Destination Friendship: Developing Social Skills for Individuals with Autism Spectrum Disorders or Other Social Challenges (with Benton, Hollis, and Womer)*
- *Hygiene and Related Behaviors for Children and Adolescents with Autism Spectrum and Related Disorders* - winner of Mom's Choice Awards Gold Medal.

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.

AN INTERVIEW WITH PROFESSOR KELLY MAHLER

1. A young person with autism's sensory experience of the world can have a profound effect on their life. As professionals how can we help to solve these difficulties within the classroom/school environment?

I believe one of the best solutions that we can use as professionals is to proactively provide a sensory friendly school environment. Learn about each young person and his or her unique sensory needs. Try to consider these sensory needs throughout the school day and implement modifications that will maximise sensory comfort. For example, if you know a student is very sensitive to sounds, keep this in mind within the classroom by reducing any background noises, using a teaching approach that is low and slow, and providing advanced notice if any loud noises or activities are planned for the day (e.g. fire drills, assemblies, class party, etc). Additionally, when the student is calm, work together to create a plan, outlining steps the student can follow when the sensory environment become 'too much'. Keep in mind that the young person may not always recognise the feeling of sensory overwhelm, so account for this in the plan by adding in a secret signal that the student wants the teacher to use.

2. Why do a young person's responses to particular sensory experiences fluctuate from one day to the next?

As with all of us, the ability to tolerate sensory experiences fluctuates with a variety of factors including our levels of stress, how much we slept the night before or how predictable the situation is at hand. A young person with autism is no different. When a young person is stressed, sleep deprived or in an unpredictable situation, the ability to tolerate sensory experiences goes down.

3. In your opinion, what are the most accessible interventions supporting children and young people with sensory processing difficulties?

With the advances in technology, and having information at our fingertips, many interventions are fairly accessible. Most people, including a young person with sensory processing difficulties can virtually find countless techniques to use to modify the sensory environment and maximise comfort.

4. What is stimming and why do many young people with autism engage in stimming?

Stimming, which is short for self-stimulatory behaviour, is usually a repetitive behaviour of some form like flapping hands, body rocking, spinning a string round and round, jumping up and down, pacing back and forth, or making repetitive vocalisations. Autistic people report that stimming is very soothing and calming (in fact, sometimes it is the only strategy that helps them feel calm in an otherwise overwhelming environment).

5. Should stimming be encouraged or prevented in school?

Encouraged. As long as the stimming is safe and does not put a student at risk of injury. In most cases, stimming can be one of the most powerful methods that a student can use to get them ready and engaged in the learning process. I always find it strange when I see behavioural programmes designed to reduce the frequency of (safe) stimming. In other words, these behaviour programmes are designed to reduce the frequency of the individual using a calming strategy! That does not make much sense.

6. Could you explain the eighth sense 'interoception', and what impact having difficulties with interoception might have on a young person in school?

Interoception is a sensory system that allows us to sense or feel our internal body signals. These signals often come from body areas that many times we can't see, but we can still feel them. For example, we are able to feel our stomach growl, our heart speed, our throat grows dry and our muscles tense because of interoception. These signals are important to our emotional experience. When we clearly feel the signals from our body, they become clues as to what emotion we are experiencing. For example, when you feel your heart race, your stomach flutter and your muscles shake you know you are scared. Or when you feel your muscles tighten, your breathing grows shallow and your voice grumble you know you are frustrated. Or when you feel your eyes grow heavy, your muscles are sluggish, and your brain is foggy, you know you are tired. Interoception is the foundation of this body-emotion connection.

7. How are anxiety, emotional regulation difficulties and sensory differences linked?

You have to notice and understand exactly how you feel in order to manage it effectively. When we are able to clearly notice body signals, and connect the body signal to the corresponding emotion, this urges us into action. Interoception serves as our motivation to seek out comfort in a timely manner. For example, if you notice a pounding heart, fast brain and shaky muscles and know these body signals mean you are anxious, you are urged to do something to restore the comfort in your body (e.g. go for a walk). When a person has interoception difficulty, it can result in an unclear body-emotion experience. Challenges in figuring out how you feel, can lead to great difficulty managing your emotions. Cheyanne, a young person with autism shared, “I would not realise I was anxious until I was in a full meltdown, hiding in a corner or under a table. I didn’t notice the anxious feelings building in my body.” Max, another young person with autism shared, “Teachers at my school would get upset with me because I didn’t use my ‘emotion tools’ when I was anxious. The problem was that I never noticed the need to use my ‘emotion tools’ – I never noticed that I was anxious until it was way too late.”

8. How can sensory knowledge and strategies improve anxiety/mental health/wellbeing, for individuals with autism?

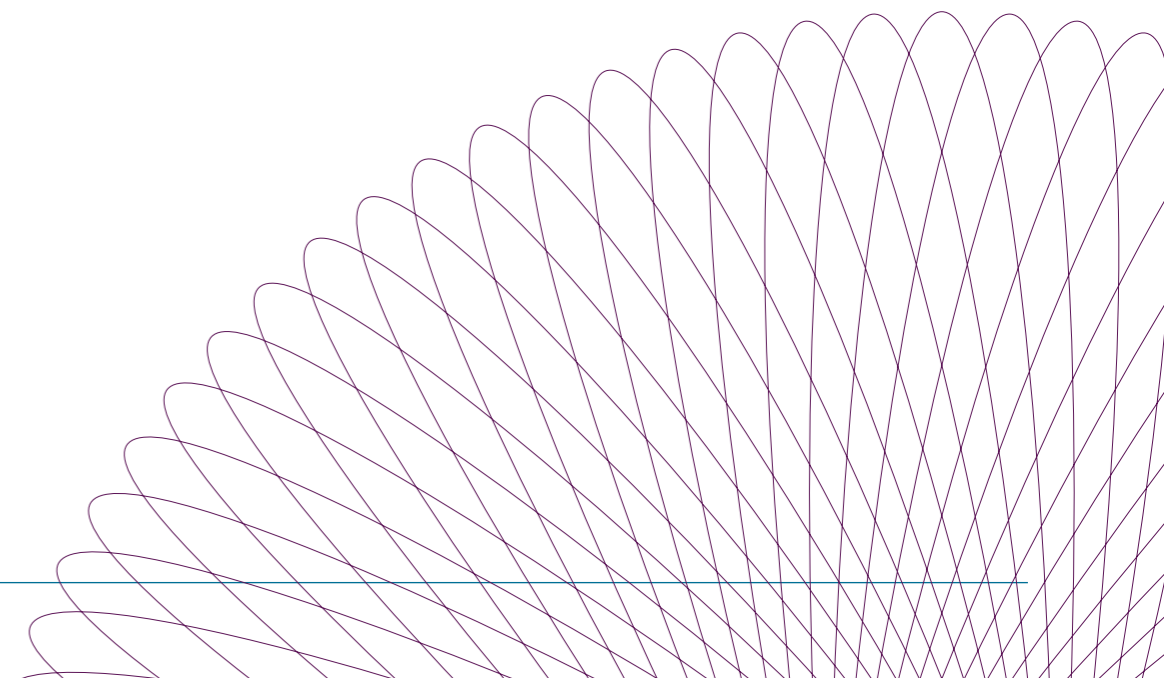
In terms of interoception, becoming more aware of your body and emotions can have a drastic effect on mental health and wellbeing. It gives a person more power to manage the way they feel. Exploring and understanding sensory needs in general can also have a profound effect on mental health and allow a person to communicate needs to others and seek out strategies for reducing sensory discomfort.

9. Top tips for improving/regulating a young person’s connection with their sense of interoception?

To improve interoception, we need to improve the ability to notice and understand internal body signals, thus building body-emotion connections. Many of the interventions that my colleagues and I have developed are influenced by mindfulness, which is currently the only evidenced-based technique for improving interoception. However, because mindfulness is extremely abstract for many young people, including children with autism, we took mindfulness-based strategies and made them very concrete, systematic and visual. We have an Interoception Curriculum coming out in October 2018 that will include these strategies as well as a step-by-step guide to improving interoception. For free information about interoception, check out www.mahlerautism.com or join our Facebook Group Interoception: The Eighth Sensory System.

10. Some young people with sensory processing difficulties experience difficulties with hygiene. What general advice would you give families for improving personal hygiene skills?

Improving personal hygiene is largely trial and error, exploring a variety of ways to adapt hygiene tasks to make them as sensory comfortable as possible. Use input from the young person whenever possible. One of my young female clients just went to the local store with her father to find a brand of shampoo she would be willing to use. They sat in the shampoo aisle for an hour and smelled each one until they found one she would try. You have to be willing to be flexible and creative to adapt the hygiene for the young person. However, it is also important to teach the ‘whys’ behind good hygiene, provide the logical reasons why good hygiene is so important.



MEAL TIME BEHAVIOUR DIFFICULTIES BUT NOT NUTRITIONAL DEFICIENCIES CORRELATE WITH SENSORY PROCESSING IN CHILDREN WITH AUTISM SPECTRUM DISORDER

BACKGROUND

In addition to atypical behaviours at meal time, specific dietary habits and preferences are recognised as behavioural criteria for the diagnosis of children with autism. Due to atypical behaviours at mealtimes there are concerns around the possibilities that this may be the cause of nutritional deficiencies.

There are many studies that support the presence of feeding difficulties in children with autism (food refusal, PICA disorder, limited variety of foods, food preparation preferences, rejecting/preference for food; oral motor difficulties). Regarding nutritional difficulties there are many case study reports of children with autism experiencing a range of medical difficulties (scurvy, rickets, vitamin A deficiencies). In addition to nutritional deficiencies, research has also indicated that some children with autism may have a preposition to be overweight.

Behaviours related to meals have also been linked to sensory processing difficulties (sensitivities to textures, smells, colours, taste of food or different behaviours around mealtimes that may be linked to senses) in children with autism, resulting in heightened anxiety in relation to nutritional consequences which in turn results in more stress at mealtimes.

The authors in this study highlighted that some of these prior findings may be confounded by household preferences.

RESEARCH AIMS

To offset the household confounder this study aimed to explore the feeding difficulties of children with autism compared to their siblings who live in the same household and as well as with other typically developing children. Another aim of this study was to evaluate the associations between mealtimes behaviour, nutritional deficiencies and sensory profile in children with autism.

RESEARCH METHOD

A total of fifty children with autism, aged three to six years, were compared in a case control study to their typically developing (TD) siblings (aged between three and 12 years) and a TD control group, matched by age and gender.

Exclusion criteria was applied for participation amongst all groups whereby children were not included in the sample if they used food supplements, had a metabolic disease such as diabetes mellitus or celiac disease or followed a gluten-free or casein-free diet.

Measures used

Questionnaires - the Autism Screening Questionnaire was used to screen children with autism.

Weight, height and body mass index (BMI) was reported by parents with comparative measures using the Wirkd Health Organisation AnthroPlus software between each of the three groups in the study.

Demographic variables were collected using a self-administered questionnaire.

Nutritional consumption was obtained by parents using a self-administered semi-quantified food diary to record the quantity of food consumed in real time. Parents were instructed to complete two weekdays and one weekend day using a food guide developed by the Department of Nutrition of Public Health Services in the Israeli Ministry of Health. A registered dietitian reviewed the diet records immediately after data collection with nutrient consumption calculated using a specific dietary programme.

Behavioural problems during lunchtime - BAMBI questionnaire consisting of 18 items scored on a 5-point Likert scale was used to measure the frequency of mealtime behaviour problems unique to children with autism. The questionnaire is defined by a 3-factor structure: limited variety, food refusal and features of autism.

Sensory profile - this questionnaire was completed only by the autism group. The Sensory Profile Caregiver Questionnaire was completed only by the autism group. The questionnaire is a 125 item questionnaire, used among 3-10 year olds. The questions in this questionnaire are scored on a 5-point Likert scale, and may ask parents if their children behave in certain ways to sensory stimuli. Results from this measure are analysed in several ways:

1. Nine factor groupings characterising children by their responsiveness to sensory input, sensory seeking, emotional reactive, low endurance/tone, oral sensory sensitivity, inattention/distractibility, poor registration, sensory sensitivity, sedentary and fine motor/perceptual.
2. Three sections quantify the ability to respond to sensory processing, modulation, behavioural and emotional responses.
3. Quadrants measure the degree to which children miss, obtain, detect or are bothered by sensory input.

FINDINGS

Results from this study indicated that mealtime behaviour difficulties were significantly more prevalent in the group of children with autism compared to their siblings and the TD control group. These differences were associated with a range of sensory regulation difficulties as opposed to nutritional deficiencies, with household preferences having limited effect on food aversion scores of children with autism.

With regard to whether children who experience more difficulties during mealtime would display more nutrient deficiencies, results indicated a significant correlation for “features of autism” and the nutrient deficiencies. Findings further indicated that difficulties around mealtimes greatly influence the life of families of children with autism. Significant differences between the BAMBI results over the SP factors, sections and quadrants indicate that there are greater challenges for children with autism who express non-typical sensory processing at meal time.

IMPLICATIONS FOR PRACTICE

(by the authors)

Understanding that part of the difficulties children with autism display during meal time may be due to sensory issues is an important factor in building appropriate treatment and intervention for the child and their family.

The lack of differences between nutritional deficiencies over the SP factors, sections and quadrants from this study further indicated that children who are at nutritional risk are not necessarily those who display unusual reactions to sensory stimuli.

The authors also posit that children with autism who are less picky or whose parents might notice less atypical behaviours at mealtime, may have nutritional deficiencies, so it is also important that these children are also evaluated. Furthermore, taking into consideration the increased nutritional risk and the lack of predictive tools which are adequate to assess for risk, it is evident that these children will benefit from a comprehensive assessment. This should include a nutritional assessment in addition to an appraisal of sensory aversions and preferences.

Full Reference

Shmaya, Y., Eilat-Adar, S., Leitner, Y., Reif, S. and Gabis, L. V. (2017). Meal Time Behaviour Difficulties but not Nutritional Deficiencies Correlate with Sensory Processing in Children with Autism Spectrum Disorder. *Research in Developmental Disabilities*, 66, p. 27-33.



AUDITORY PROCESSING AND SENSORY BEHAVIOURS IN CHILDREN WITH AUTISM SPECTRUM DISORDERS AS REVEALED BY MISMATCH NEGATIVITY

BACKGROUND

Problems in auditory processing are a commonly reported sensory processing difficulty amongst children with autism. Examples of atypical responses to auditory stimuli may include the child with autism placing their hands over their ears or having a preoccupation with a specific noise within the environment. Whilst much research has considered the differences between speech and non-speech stimuli, limited attention has been directed towards the influence of semantic content of the stimuli employing a mismatch negativity (MMN) task.

RESEARCH AIMS

The current study aimed to examine whether children with high functioning autism were impaired in auditory discrimination of speech sounds using a MMN paradigm using words and pseudowords.

RESEARCH METHODS

Eleven boys with an autism spectrum disorder aged 11-16 years were matched for verbal and nonverbal IQ with eleven typically developing boys to participate in a MMN model. Children were recruited through local mainstream schools. Parents provided confirmation that their children did not have any hearing problems or any psychopathological or neurological disorders.

Clinical and behavioural data was collected from all children using the Adolescent/Adult Sensory Profile Questionnaire, the Edinburgh Handedness Questionnaire, nonverbal IQ based on the Ravens Matrices and verbal IQ using the British Picture Vocabulary Scale.

After psychometric testing the children participated in a mismatch negativity (MMN) task. During this task children were situated in a video-controlled, electrically shielded and sound proofed space. Stimuli was delivered via headphones, whilst watching a silent movie of their choice; they were instructed to ignore any incoming acoustic stimuli. During this activity, two refreshments breaks were provided. Electrical brain activity was recorded throughout the experiment. Overall the experiment lasted 30 minutes.

FINDINGS

Results from this study indicated that children with autism displayed significantly reduced MMN responses to speech like stimuli (i.e. both words and pseudowords) in the frontal regions of the brain, compared to typically developing children. This effect was more pronounced between groups across the meaningful stimuli as children with autism displayed reduced activation in both the frontal and central regions of their brains for words. Differences for pseudowords were however only identified in the frontal regions of the brain. These findings correlated with previous studies which suggest that children with autism have an altered functional connectivity, prominently in the frontal cortex and circuits lining frontal areas to other brain systems.

In relation to whether auditory sensory processing is relevant to the way words are processed compared to pseudowords it was found that auditory responsiveness was the most common and pervasive form of sensory behaviour amongst children with autism compared to the neurotypical group.

Furthermore, to identify whether auditory sensory processing was a moderator of the differences in the way words and pseudowords were processed, findings revealed that as sensory sensitivity scores increased for children with autism, the lower their amplitude for words, with sensory sensitivity appearing to be the strongest sensory moderator of this effect.

Furthermore, auditory sensory scores collated from the Adolescence Sensory Profile indicated that children with autism recorded significantly higher behaviours to auditory stimuli than typically developing (TD) children across three of the sensory quadrants (Low Registration, Sensation Seeking, Sensation Sensitivity, and Sensation Avoidance).

IMPLICATIONS FOR PRACTICE

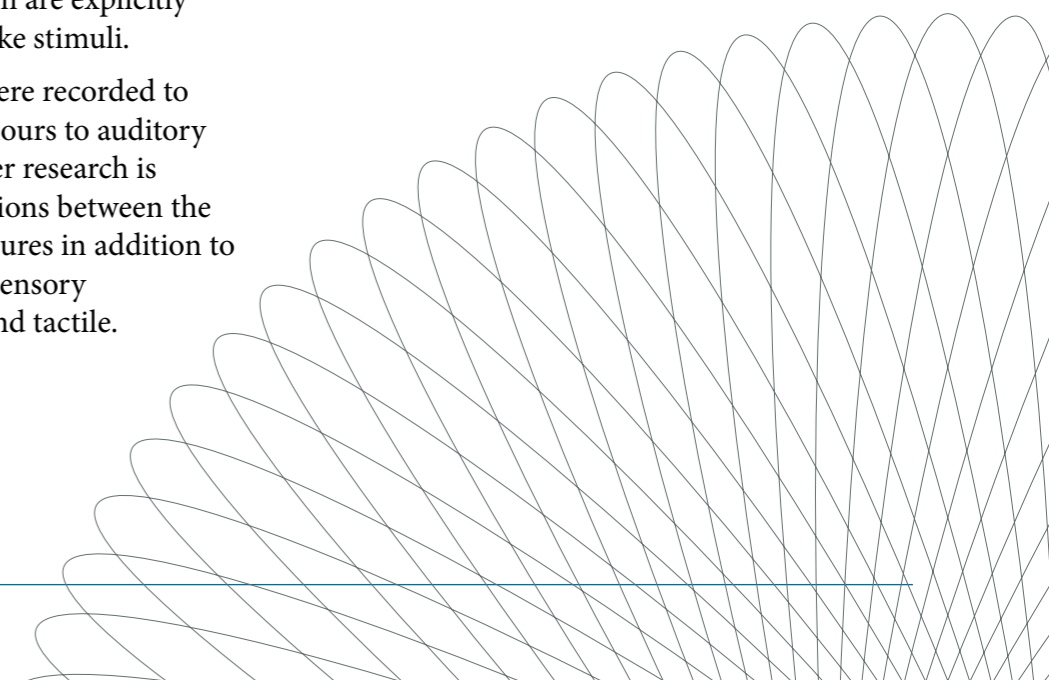
(by the authors)

Although this study has indicated that sensory behaviours may underlie differences in auditory perception of speech-like stimuli in children with autism, the authors have highlighted that results from this study should not be generalised to situations when meaningful stimuli is mixed with meaningless noise which occurs within most social situations, nor should comparisons be made when children with autism are explicitly requested to attend to speech-like stimuli.

Also, as children with autism were recorded to have significantly higher behaviours to auditory stimuli than TD children further research is required to address the interactions between the different auditory sensory measures in addition to bearing in mind the impact of sensory commonalities such as vision and tactile.

Full Reference

Ludlow, A., Mohr, B., Whitmore, A., Garagnani, M., Pulvermüller, F. and Gutierrez, R. (2014). Auditory Processing and Sensory Behaviours in Children with Autism Spectrum Disorders as revealed by Mismatch Negativity. *Brain and Cognition*, 86, p. 55-63.



BRIEF REPORT: ASSESSMENT OF EARLY SENSORY PROCESSING IN INFANTS AT HIGH-RISK OF AUTISM SPECTRUM DISORDER

BACKGROUND

Following a systematic review of the literature, it is acknowledged that atypical sensory responses are frequently reported in children with ASD in comparison to typically developing children, although by itself, these sensory symptoms do not differentiate ASD from other disabilities. These sensory symptoms could be informative in the early detection of ASD as the sensory modulation and regulation behaviours of toddlers with ASD has been reported as significantly different to those without ASD.

The Infant/Toddler Sensory Profile (ITSP) is the measurement framework used to evaluate toddlers' behavioural responses to sensory stimuli as observed and reported by parents. In a previous study, Mulligan and White (2012), used the ITSP to compare 13 high-risk (HR) infants (they had an older sibling with ASD), against normative ITSP data. The results showed that the infants had less sensory-seeking behaviours. As this study was conducted on infants before they were diagnosed and did not follow through once the diagnostic outcome of those infants was determined, it was unclear from the study whether the differences found were related to ASD.

RESEARCH AIMS

The aim of this study was to compare 24-month ITSP scores among three groups based on their diagnostic outcomes at three years. The groups were (a) a HR group who were later diagnosed with ASD (HR-ASD), (b) a HR group who were not later diagnosed (HR-N) and (c) a low-risk group of infants with no first-degree family history of ASD (LR). It was hypothesised that there would be significant differences among the three groups with the parents of the HR-ASD group reporting the highest number of sensory differences.

RESEARCH METHODS

The ITSP was administered at 24 months to assess a range of sensory inputs as described by parents. It assesses sensory processing across five areas: auditory, visual, tactile, vestibular and oral. The ITSP also assesses the child's reaction to a sensory experience within four quadrants: low registration, sensory seeking, sensory sensitivity and sensation avoidance. Diagnostic assessment at three years, using the Autism Diagnostic Observation Schedule (ADOS) and the Autism Diagnostic Interview (ADI-R), was conducted by a psychometrist, psychologist or developmental paediatrician trained to research reliability, who was not aware of any previous study assessments. A total of 91 participants gave complete data, 31 LR and 60 HR (15 HR-ASD; 45 HR-N).

RESEARCH FINDINGS

The results showed significant differences regarding auditory processing, with the HR-ASD group mean score being significantly higher than the HR-N and LR groups. There were no differences detected in the scores for visual, vestibular, tactile or oral sensory processing. In the quadrant scores, there was a significant group difference obtained for low registration (e.g. does not notice sensory stimuli), where again the mean HR-ASD score was significantly higher than the other two groups. This is not specific to a certain type of sensory domain but rather indicates the overall behaviours of the toddlers to a range of sensory inputs. There was also a non-significant trend that showed that the HR-ASD would engage in sensory seeking behaviour (e.g. seeking out a sensory stimulating environment).

IMPLICATIONS FOR PRACTICE (by the author)

Clinicians:

Although the hypothesis was only partially supported by the findings, the identification of sensory differences in terms of auditory processing and low registration to all types of sensory domains, could be potential risk markers of ASD amongst HR toddlers. The ITSP did not identify differences in other sensory areas. But they are sometimes reported to clinicians in young children with suspected ASD. Direct clinical observation and/or objective laboratory-based sensory measures could be used in conjunction with the ITSP to provide multiple perspectives for identifying ASD in young children. The authors recommend exploring the link between temperament and sensory processing to identify differences in HR infants for ASD.

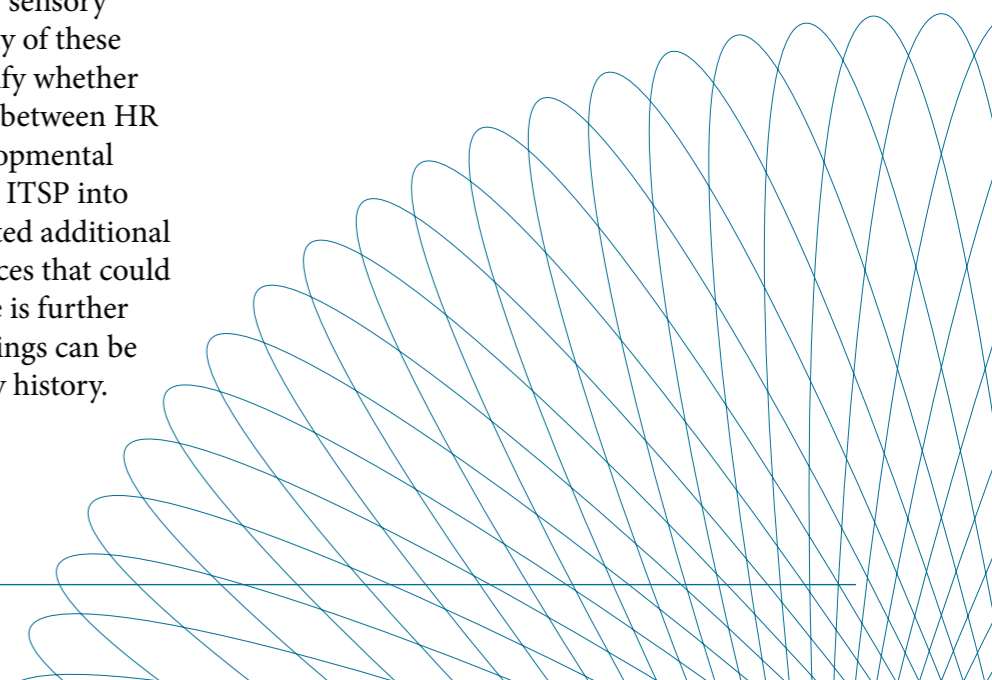
Researchers:

Although the sample size was larger than in previous reports it was still relatively small. Future studies should be larger and could include examining sensory profiles for children with ASD using symptom levels and functional abilities as the basis for understanding whether sensory differences correlate with the severity of these dimensions. It is important to identify whether sensory processing differences exist between HR infants and infants with other developmental disabilities to increase the use of the ITSP into other areas. This study has contributed additional information on the sensory differences that could forecast ASD in an HR cohort, there is further need to examine whether these findings can be generalised to children with a family history.

Due to the HR parents all being second time parents, it could be assumed that they would be more aware of their child's development given their experiences and so their responses may be more reliable than first time parents.

Full Reference

Germani, T., Zwaigenbaum, L., Bryson, S., Brian, J., Smith, I., Roberts, W., Szatmari, P., Roncadin, C., Sacrey, L. A. R., Garon, N. and Vaillancourt, T. (2014). Brief Report: Assessment of Early Sensory Processing in Infants at High-Risk of Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 44, p. 3264-3270.



THE RELATIONSHIP BETWEEN SENSORY PROCESSING AND ANXIETY ON CARS SCALE IN AUTISM SPECTRUM DISORDER

BACKGROUND

Challenges with sensory processing have always been associated with autism spectrum disorders (ASD) but it is only since DSM-5 (2013) that sensory problems were classified as a crucial symptom.

RESEARCH AIMS

The aim of this study was to determine the connection between functional areas related to sensory processing and anxiety in conjunction with the scale of autism in the adolescents and adults with ASD. A unique feature of this study was that it included the population of adolescence and adults (15-35 years of age) who had a severe form of autism spectrum disorder.

RESEARCH METHOD

The study was conducted on 48 participants selected from an initial 63 potential subjects. The results were generated on a sample of 42 subjects.

Those examined were both male and female adolescents and adults, aged 15-35 with severe forms of ASD and with an intellectual disability, from Belgrade. The research was conducted at branch centres of the Day Care Centre for Children and Adolescents with Developmental Disorders, Belgrade.

The Childhood Autism Rating Scale (CARS) was used to assess the severity of the participants' autistic disorder. From this assessment, the degree and severity of the autistic disorder could be compared to the functional areas of sensory interests and anxiety. The CARS assessment was performed by direct observation of subjects. In the assessment the following areas were evaluated: social, emotional, communication skills, repetitive behaviour, play, organisational behaviour, every day behaviour and sensory interests.

RESEARCH FINDINGS

The CARS results were processed on the sample of 42 participants, of whom 32 were male and 10 were female. The average age of those selected was 23.81, with the youngest being 16 and the oldest 35. The level of intellectual ability ranged from mild to profound mental retardation. The mean score of the scale, which determines the degree of the autistic disorder, indicated that the degree of autistic disorder in the participants was severe. Broken down into gender, the female participants had higher mean scores than the male participants.

The results showed that there was a statistically significant positive correlation between the degree of autistic disorder as measured on the CARS scale and the functional areas of unusual sensory interest, such as visual perception, auditory perception and near distance responsiveness. Also, there was a significant positive correlation between the total score and levels of anxiety. In addition, there was also a strong correlation between the items regarding sensory perception and the level of anxiety. By establishing a correlation between the level of intellectual functioning and total CARS score, a correlation was found between intellectual functioning and the items which evaluated visual perception. There was no correlation found between intellectual functioning and the items related to auditory perception or near distance responsiveness.

Once the data was processed, the results indicated that there was a correlation between the severity of the autistic disorder, measured using the CARS score, and the functional areas of sensory interests. Furthermore, a strong correlation was confirmed between the levels of anxiety and unusual sensory interests. A significant finding was that there was no correlation identified between age and the total CARS score or the

items related to levels of anxiety. The results demonstrated that in each age group the occurrence of anxiety disorder related to ASD was higher than in the general population.

The results of the study indicated that there is a link between visual perception and the level of intellectual functioning as well as establishing the relationship between the severity of the autistic disorder and the level of intellectual functioning. The relationship between the degree of ASD and visual perception was stronger than other relations of sensory processing, whilst there was no connection identified between the intellectual level of functioning and auditory perception or near distance responsiveness. These results differentiate visual perception disorder to be a particularly significant symptom in ASD.

IMPLICATIONS FOR PRACTICE (by the author)

There has not been a neurobiological basis established yet to explain why sensory integration disorders affect individuals with ASD but there are several theories to the cause of the sensory deficits.

In the neurotypical population stimulating the pattern of sensory processing improved the array of the individual's reactions and using multisensory methods could improve sensory function in the ASD population. Currently the treatment of sensory integration is mostly based on the subjective evaluation of occupational therapists, which although practical, fails to make strong empirical conclusions.

Further research around sensory symptoms related to ASD could potentially indicate, in a more wide-ranging way, the nature and psychopathology of this disorder and lead to new methods of effective treatment. The results from this study could be an incentive for further research in this area to help get a better insight

into the difficulties people with ASD have with sensory disorders, the final goal being to adapt the approach and treatment to help individuals achieve better self-regulation and increase their level of adaptation and range of activities that could help them socialise better into society.

Full Reference

Novakovic, N., Pejovic Milovancevic, M., Dukic Dejanovic, S., Paunovic, N., Jordanov, P. and Vukovic, M. (2015). The Relationship between Sensory Processing and Anxiety on CARS Scale in Autism Spectrum Disorder. *Psihijatrija Danas-Psychiatry Today*, 47(2), p. 139-150.

SENSORY OVER-RESPONSIVITY AND SOCIAL COGNITION IN ASD: EFFECTS OF AVERSIVE SENSORY STIMULI AND ATTENTIONAL MODULATION ON NEURAL RESPONSES TO SOCIAL CUES

BACKGROUND

Sensory over-responsivity (SOR) presents as extreme sensitivity to stimuli such as touch or auditory input and is particularly common in autism spectrum disorders (ASD) (Ben-Sasson et al, 2008). Research has shown SOR is associated with higher impairment in social and adaptive behaviour. These studies suggest individuals over-attend to extraneous sensory information rather than social information. To date no studies have directly tested the effect of a sensory distracter on the brain's ability to process social information.

RESEARCH AIM

This study used functional magnetic resonance imaging (fMRI) to examine brain activity when processing social information in individuals with and without autism.

RESEARCH METHOD

Participants included 15 high-functioning individuals with ASD and 16 age- and IQ-matched typically-developing (TD) controls aged 9-17.6 years. During the task participants viewed 16 different scenarios; first they saw a picture with auditory narration followed by a picture accompanied by either a sincere or sarcastic remark. They were asked to respond whether the person meant what they said. The task was completed using a 2x2 design; with tactile sensory distracter present or not present, and with and without instructions directing their attention to relevant social cues.

Child sensory questionnaires were completed by parents; short sensory profile (SSP), sensory over-responsivity inventory (SensOR) and diagnostic and cognitive measures were administered at a clinical assessment.

FINDINGS

Sensory over-responsivity

As expected the ASD group was rated as having significantly more severe tactile SOR symptoms on both sensory measures.

Accuracy

Results indicated that tactile stimulus caused accuracy to decrease in the No Instruction condition, but to go up in the Instruction condition. Whereas in the TD group accuracy was consistent across groups other than decreasing for Tactile only in the Instruction condition.

fMRI results

No instruction, no tactile condition – both groups showed significant activation in bilateral primary auditory and visual cortices. The ASD group also had significant activation in the right inferior frontal gyrus. Between group comparisons indicated the ASD group had greater activation in right temporal gyrus, left lateral occipital cortex and bilateral IFG. TD group did not show increased activity in any areas compared to ASD group.

No instructions, tactile condition – tactile stimulus was added; this stimulation was associated with increased brain activity in the TD in comparison to a decrease in the ASD group in areas associated with social cognition and language processing.

Instructions, no tactile condition – participants were given explicit instruction to attend to the speaker's face and tone of voice. Both groups showed activation in bilateral occipital and temporal lobes, left and post central gyri and left IFG. The TD group also had activation in amygdala and hippocampus.

Instructions, tactile condition – when tactile stimulation was added both groups showed increases in right pre- and postcentral gyri, right auditory regions and insular/opercular regions. ASD group also showed increases in left opercular cortex and increases to medial prefrontal cortex which differed from TD group.

IMPLICATIONS FOR PRACTICE (by the authors)

- This study found that ASD participants were able to understand and differentiate sarcasm accurately which is consistent with previous studies. Greater brain activation patterns for the ASD group as depicted in the results section suggest more effortful processing to interpret the communicative intent in the case of sarcasm.
- When the sensory distracter was used the ASD participants showed decreased brain activity to areas including the frontotemporal language processing region in comparison to TD group which showed increased activity. This suggests the individuals with autism shifted attention away from the task towards the sensory stimulus, therefore they were unable to sustain effortful processing of social information during stimulation. In contrast to the TD group the ASD group presented a slight decrease in accuracy of the task when experiencing distraction of the sensory stimulation.
- Increased activity in bilateral supramarginal gyrus in response to the tactile stimulus suggests that ASD individuals with higher SOR pay more attention to the tactile stimulation. It is likely the addition of the stimulus made it more difficult for ASD individuals with high SOR to interpret the verbal statement, they may have compensated by paying attention to the visual clues to decide whether the narrator was sincere or sarcastic.

- Results indicate that when ASD individuals were directed to pay attention to facial expression and tone of voice the tactile stimulation no longer caused decreases in brain activation. This suggests explicit direction to social cues lessens the effect of the distracter.
- The implications of these findings suggest interventions could focus on reducing environmental distractions as much as possible during social exchanges which in turn reduces the effort required to maintain attention to relevant social cues. The study found that giving explicit instructions directing attention to relevant social cues helped to reduce effort for the individual with autism.
- Further research is required using a larger group sample to investigate the relationship between sensory and social symptoms with brain activity during social tasks.

Full Reference

Green, S. A., Hernandez, L. M., Bowman, H. C., Bookheimer, S. Y. and Dapretto, M. (2017). Sensory Over-Responsivity and Social Cognition in ASD: Effects of Aversive Sensory Stimuli and Attentional Modulation on Neural Responses to Social Cues. *Developmental Cognitive Neuroscience*, 29, p. 127-139.

SENSORY PROCESSING IN AUTISM SPECTRUM DISORDERS AND FRAGILE X SYNDROME – FROM THE CLINIC TO ANIMAL MODELS

BACKGROUND

Our brains are constantly flooded with sensory information that needs to be filtered, processed, categorised and appropriately responded to. People with autism or Fragile X Syndrome (FXS) are often over- or under-reactive to sensory stimulation, leading to a wide range of behavioural responses. This altered sensory processing may be caused by disrupted or atypical brain activity.

Difficulties with sensory processing usually fall into one of two categories:

- Over-reactive or hypersensitive: children who are overly sensitive, and often struggle with sleeping, dressing or any form of sensory input.
- Under-reactive or hyposensitive: children who under-react to stimuli that should otherwise cause them some discomfort, such as pain or heat.

Individuals with autism and individuals with FXS are known to have sensory processing difficulties. Several studies suggest the existence of similar pathophysiological and anatomical mechanisms in autism and FXS, particularly in the sensory processing domain.

Animal models provide an excellent opportunity to examine common mechanisms of sensory processing difficulties in order to develop specific therapeutics.

This review focussed on investigating individuals with autism or FXS or rodent models' response to auditory stimuli as this can be objectively and non-invasively measured.

Understanding how the brain processes and responds to sensory stimuli could offer hope for individually targeted, age-specific therapeutic approaches in the future.

RESEARCH AIMS

This review focussed on investigating experimental approaches that measure sensory processing in humans with autism and FXS, and in relevant rodent models. This study outlines robust evidence of disrupted sensory processing in individuals with autism and FXS, and in respective animal models, focusing on the auditory (hearing) sensory domain.

REVIEW METHOD

Little detail is provided about how the authors sourced the articles included. However, studies which investigated sensory processing related brain activity, (such as electroencephalographic measurement of event related potentials, neural oscillations and mismatch negativity, as well as habituation and pre-pulse inhibition of startle) in individuals with autism or FXS or animal models were included.

Articles reviewed

This comprehensive review details recent advances in understanding the sensory processing disruptions underpinning sensory features of autism and FXS, focusing on the auditory sensory domain. It also evaluates similarities and differences between auditory sensory processing deficits in autism and FXS to highlight aspects of their shared and distinct pathophysiology. Emerging evidence from rodent models is also explained, which sheds light on the possible neurobiological underpinnings of sensory deficits in autism, FXS and associated neurodevelopmental disorders.

RESEARCH FINDINGS

Sensory difficulties, particularly in the auditory domain, are consistently seen in individuals with autism and individuals with FXS.

Different event-related potentials and behavioural measures can be used in humans and animal models to assess sensory filtering.

Basic sensory processing brain circuitry may be easier to trace compared to brain circuits involved in social communication and cognitive aspects of autism. Brain circuitry involved in basic sensory processing may also be more conserved across humans and mice compared to circuits involved in cognitive and social communication.

IMPLICATIONS FOR PRACTICE (by the authors)

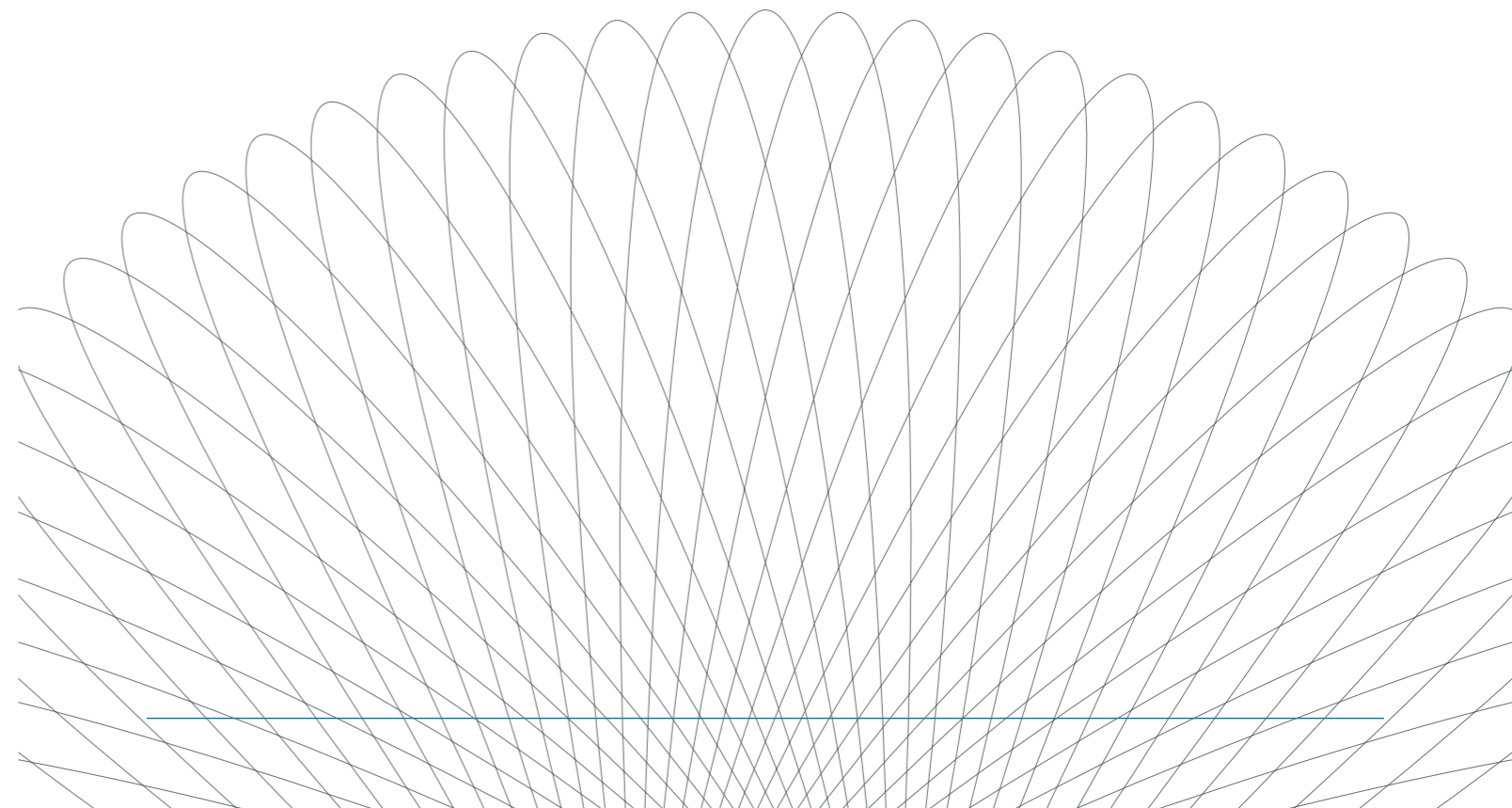
This study further evidences that responses to sensory stimuli happen at a sub-cortical level within the brain; and are often automatic and therefore very difficult for the individual experiencing sensory difficulties to control.

This study offers autism researchers a unique opportunity to understand the pathophysiology of autism and FXS at a brain circuit and cellular level by investigating sensory processing.

Future studies are required to investigate the auditory behaviours and brain circuits involved in individuals with autism and FXS.

Full Reference

Sinclair, D., Oranje, B., Razak, K., Siegel, S. and Schmid, S. (2017). Sensory Processing in Autism Spectrum Disorders and Fragile X Syndrome – From the Clinic to Animal Models. *Neuroscience and Behavioural Reviews*, 76, p. 235–253.



BEHAVIOURAL, PERCEPTUAL, AND NEURAL ALTERATIONS IN SENSORY AND MULTISENSORY FUNCTION IN AUTISM SPECTRUM DISORDER

BACKGROUND

Sensory difficulties within ASD are reported as one of the most significant symptoms, in up to 87% of cases), and yet it has taken up until recently (2013) to be included in the diagnostic measure (DSM-5) as a core symptom of ASD.

Social and cognitive symptoms of ASD have been the main focus, however, sensory processing difficulties have been identified as prevalent by those such as caregivers.

Information integration is a process which is necessary for the construction of durable perceptual representations. It is also arguably essential for constructing cognitive representations and abilities. Daily sensory information is presented in various forms which is processed through the senses. Essentially, the nervous system combines and synthesises the information so that it is understood as a complete whole. The information may need to be integrated or segregated depending on the source and whether it is related or unrelated. If the information cannot perceptually represent, and interpret the world, it will present great difficulties for communicating with and relating to the environment effectively.

Within the brain there are numerous regions specifically for combining and integrating multisensory information. Neuronal circuits and responses are key in the role of coding such information.

However, disruptions within these areas, particularly those that are multisensory, may be of importance when examining difficulties within ASD.

RESEARCH AIMS

The purpose of the current study is to investigate the importance of sensory processing and highlight the sensory features within ASD. It also aims to emphasise current knowledge and demonstrate how sensory processing fits within modern contemporary models. The research also examines differences within neural processing of those with ASD and those without ASD focusing on sensory and social communication. The study investigates deficits within multisensory integration as a core characteristic of ASD and the importance of multisensory processing in building both cognitive and perceptual representations.

RESEARCH FINDINGS

The review focuses on studies within four main areas of ASD. These include:

1. A typical sensory processing in ASD.
2. Theories of altered sensory and cognitive functioning in ASD.
3. Evidence for alterations in neural processing relevant to sensory function in ASD.
4. Plasticity and Remediation Therapies in ASD.

The review makes for an interesting read, as it deliberately concentrates on examining ASD primarily from a sensory dysfunction framework. It dissects current knowledge and theories on ASD to emphasise how relevant sensory brain regions are for functionality and how they can impact so greatly on the empirical evidence of current studies. The research directs us to question modern knowledge. Findings suggest that the information surrounding sensory dysfunction within ASD is both inadequately recognised and characterised. The review highlights the need for expansion of measuring numerous facets functioning within the same children to identify and characterise

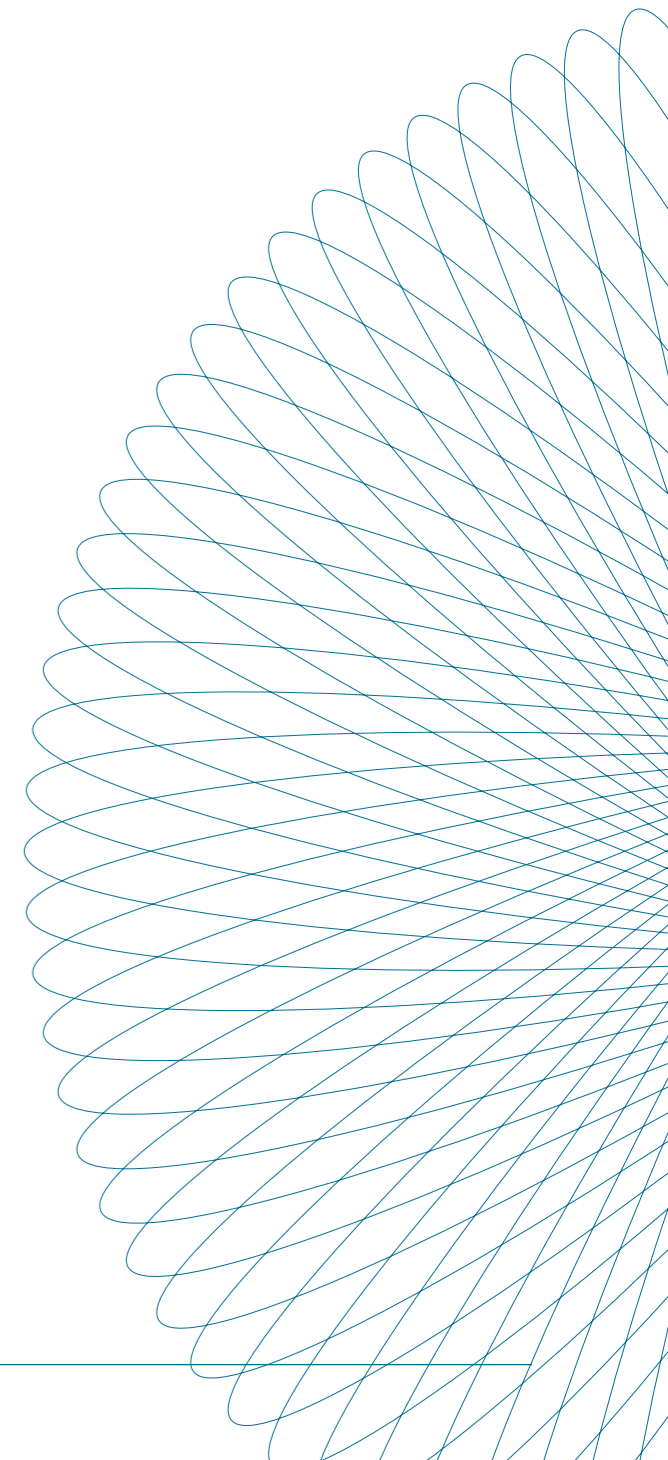
sensory-specific changes. The study also stresses the importance of applying a more dimensional approach to enhance knowledge and understanding of the neurobiology and pathophysiology of autism.

IMPLICATIONS FOR PRACTICE (by the authors)

- Further studies are much needed to enhance our understanding of the neurobiological building blocks of ASD.
- There is a greater need for empirical identification of both sensory function and dysfunction in ASD.
- Measuring numerous facets of sensory function could highlight sensory specific changes for each individual with ASD.
- Complete identification and characterisation of each change within the senses could lead to the possibility of determining the specificity of the changes which are relevant and necessary for sensory integration throughout all of the sensory systems.
- Neuroimaging based research which although is timely and expensive, could detect correlations between sensory function and cognitive performance.
- The revelation of establishing the relationships linking brain function, connectivity and genetic diversity could be a key to understanding ASD.
- The authors of the review also suggest more work should be carried out to examine shared characteristics of ASD with neuropsychiatric conditions, focussing on shared deficit areas.

Full Reference

Baum, S. H., Stevenson, R. A. and Wallace, M. T. (2015). Behavioural, Perceptual, and Neural Alterations in Sensory and Multisensory Function in Autism Spectrum Disorder. *Progress in Neurobiology*, 134, p. 140-60.



SENSORY PROCESSING IN CHILDREN WITH AUTISM SPECTRUM DISORDER: RELATIONSHIP WITH NON-VERBAL IQ, AUTISM SEVERITY AND ATTENTION DEFICIT/HYPERACTIVITY DISORDER SYMPTOMATOLOGY

BACKGROUND

Historically it has been reported that sensory processing impairments are highly prevalent in children with ASD. According to sensory integration theory, the processing and integration of sensory inputs strongly affect development. Sensory processing impairments involve a neurological dysfunction that may affect behavioural responses to sensory input. Sensory issues can affect the successful performance of adaptive responses and therefore have an impact on one's ability to engage in daily activities. Sensory functions are also related to praxis, which is the ability to plan and organise movements in order to carry out unfamiliar motor tasks. Difficulties with poor motor planning may limit the ability for one to expand play or engage with peers.

RESEARCH AIMS

The purpose of this study was to analyse the relationship between sensory processing, social participation and praxis impairments as well as some characteristics of the children such as non-verbal IQ, severity of ASD symptoms, and the number of ADHD symptoms, across home and school environments in a selection of children with ASD. In addition, sensory processing, praxis and social participation was measured in relation to functional performance during daily activities.

RESEARCH METHODS

Participants

Forty one children with a clinical diagnosis of ASD participated in the study along with their parents and teachers. The children were aged between 5 and 8 years old. The children all had non-verbal IQ ranging from 75 to 135 on the Raven's Coloured Progressive Matrices Test.

Procedures

Non-verbal IQ was evaluated by the school psychologist in a distraction free environment. Parents and teachers provided the psychologist with an interview to provide demographic information and information about the severity of autism.

Measures

The authors used the following measures:

1. Raven's Coloured Progressive Matrices Test (RCPM). This is a non-verbal test, which measures the ability to solve problems without relying on previous knowledge. It was used to obtain the non-verbal IQ score of each child in the study.
2. Gilliam Autism Rating Scale, Second Edition. This is a screening scale that helps to identify the severity of autism. The scale consists of 42 items that measure three domains associated with ASD: stereotyped behaviour, communication, and social interactions. The higher the value obtained on the global index, the greater the probability of autism.
3. The Sensory Processing Measure (SPM). The SPM is an integrated system of rating scales that assess sensory processing issues, social participation and praxis in children aged 5-12 years old.
4. Behavioural rating scale of inattention and hyperactivity/impulsivity for parents and teachers from the DSM-IV-TR. Parents and teachers filled in a questionnaire asking about the presence of ADHD symptoms in the child, both inattention and hyperactivity/impulsivity behaviours.
5. Questionnaires developed by the authors. Parents were asked a variety of questions about their child's gender, age, educational level etc. Teachers answered a socio-demographic questionnaire about their gender, age, number of years teaching experience etc.

RESEARCH FINDINGS

Regarding IQ, the authors did not find a relationship between non-verbal IQ and the presence of sensory issues or social participation or praxis deficits.

Regarding the severity of ASD symptoms, the authors found that the higher the dysfunctions on the sensory processing measure, the higher severity of autism symptoms across both environments.

Regarding the relationship between ADHD symptoms and sensory processing, social participation and praxis characteristics, the authors reported that in the home environment, both the inattentive and hyperactivity/impulsivity showed the higher the dysfunction on the sensory processing measure, the higher the number of ADHD symptoms. This had greater weight at home than in the classroom environment.

Regarding the relationship between ADHD symptoms and sensory processing characteristics, specifically touch and hearing, the authors reported that the hearing score was the only variable that had a marginally significant percentage in the inattentive score in the main classroom setting.

IMPLICATIONS FOR PRACTICE (by the authors)

The authors have suggested that because of the possible relationship between sensory processing and ADHD symptoms, especially inattention, that attention difficulties could be secondary to sensory problems in children with ASD. They hypothesised that if this were the case then it would be advisable to first apply intervention measures aimed at reducing sensory difficulties in order to improve attention. Simplifying classroom acoustics, minimising verbal instructions by using visual strategies and presenting verbal information at a reduced pace may help with attention.

Recommendations for future research

Future research should aim to analyse the relationship between sensory processing and the performance of attention (visual and auditory attention).

Future research should also consider other variables that can influence sensory processing in children with ASD such as parental stress, personality characteristics, the educational style used and differences in gender.

Full Reference

Sanz-Cervera, P., Pastor-Cerezuela, G., Maria-Inmaculada Fernández-Andrés, M. I. and Tárraga-Minguez, R. (2015). Sensory Processing in Children with Autism Spectrum Disorder: Relationship with Non-Verbal IQ, Autism Severity and Attention Deficit/Hyperactivity Disorder Symptomatology. *Research in Developmental Disabilities*, 45-46, p. 188-201.

SENSORY REACTIVITY, EMPATHISING AND SYSTEMISING IN AUTISM SPECTRUM CONDITIONS AND SENSORY PROCESSING DISORDER

BACKGROUND

Sensory processing refers to the way the brain receives, processes and responds to the continuous stream of sensory information from the world around us. The successful completion of every activity in life (e.g. washing, dressing, eating, having a conversation etc.), requires accurate sensory processing. Individuals with autism often report unusual sensory processing symptoms such as heightened sensitivity to touch or noise.

Although the DSM-5 added sensory processing difficulties as a criterion for autism, there is a group of children who display similar sensory difficulties but do not have autism; children with sensory processing disorder (SPD). Many defining symptoms between both groups of children are similar, (e.g. an apparent disinterest in peers), as such, diagnostic confusion exists.

RESEARCH AIMS

To aid diagnosis between children with autism and children with SPD, this study aimed to test whether children with autism and SPD can be differentiated on sensory symptoms and/or cognitive styles in empathy and systemising.

- Empathy is the ability to identify and understand the thoughts and feelings of others and to respond to these with appropriate emotions.
- Systemising refers to how strongly, easily and quickly a person is affected by other people's feelings.

RESEARCH METHODS

The study included 210 participants: 68 parents of children with autism, 79 parents of children with SPD and 63 parents of typically developing children. The Sensory Processing Scale Inventory was used to measure sensory symptoms, the Autism Spectrum Quotient (AQ) to measure autistic traits, and the Empathy Quotient (EQ) and Systemising Quotient (SQ) to measure cognitive styles. Parents completed all four questionnaires on line.

RESEARCH FINDINGS

This study found that in general:

- Typically developing children had no heightened sensory symptoms and average levels of parent reported empathy and systemising.
- Children with higher empathy scores had fewer sensory symptoms.
- Children with autism and children with SPD, showed significantly more sensory symptoms than typically developing children.
- Children with autism showed lower empathy and higher systemising compared to the SPD group.
- Children with SPD showed empathy and systemising skills within average levels.
- There was also a trend for lower empathy scores on the SPD group, with children with SPD scoring marginally lower than TD children on the EQ ($p=0.06$).

Together, this suggests that sensory symptoms alone may not be adequate to differentiate between children with autism and children with SPD but that cognitive style measures (such as empathy and systemising) could be used for differential diagnosis.

IMPLICATIONS FOR PRACTICE (by the authors)

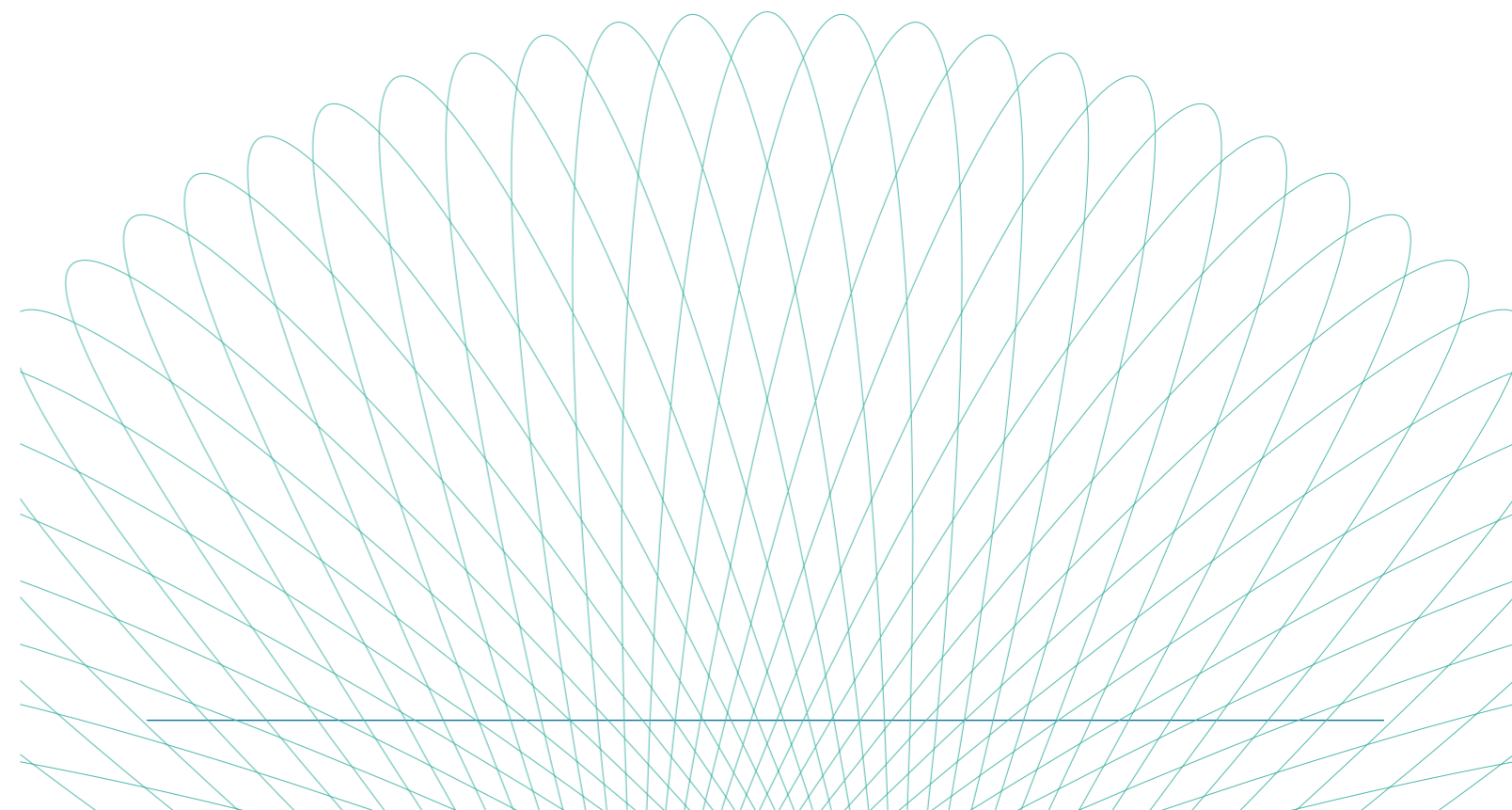
Given that children with higher empathy scores had fewer sensory symptoms, this study emphasises that children with autism and children with SPD, having higher sensory symptoms and lower empathy scores may have challenges with empathising with others; therefore, may have difficulty relating to peers and establishing friendships.

Understanding how sensory difficulties can contribute to atypical or challenging behavioural, social and emotional responses is important. This study further evidences the association between sensory processing and social skills.

Children with autism and sensory difficulties may benefit from additional support and education focusing on empathy related topics such as understanding emotions, emotional regulation and friendship skills.

Full Reference

Tavassoli, T., Miller, L., Schoen, S., Brout, J., Sullivan, J. and Baron-Cohen, S. (2017). Sensory Reactivity, Empathising and Systemising in Autism Spectrum Conditions and Sensory Processing Disorder. *Developmental Cognitive Neuroscience*, 29, p. 72-77.



THE DESIGN AND IMPLEMENTATION OF A CBT-BASED INTERVENTION FOR SENSORY PROCESSING DIFFICULTIES IN ADOLESCENTS ON THE AUTISM SPECTRUM

BACKGROUND

Many individuals with autism experience unusual reactions to sensory input which now form part of the diagnostic criteria for autism. These features are common and often have a significant impact on individuals and their families. Previous studies have been based on measurement of sensory experience ignoring the role of cognition. They have produced few validated interventions to remedy adverse sensory experiences felt by individuals with autism.

RESEARCH AIM

This study explores the feasibility of an eight week CBT-based, group intervention for self-regulation of sensory processing difficulties. This differs from previous research studies which are largely based on applying knowledge of neurological sensory sensitivities to measurement of sensory experiences and resulting interventions as it includes the role of cognition.

RESEARCH METHOD

Seven male adolescents with autism aged 11-16 years from one mainstream secondary school participated. Inclusion and exclusion criteria stipulated participants must have an independent clinical autism diagnosis, sensory issues as reported by school, functional hearing and vision, an IQ of 70 or above and not taking psychotropic medications.

Measures of sensory reactivity, anxiety and repetitive behaviours were taken at baseline, post-intervention and at follow-up eight weeks post programme including Adolescent/Adult Sensory Profile (AASP), Short Sensory Profile (SSP), Repetitive Behaviour Questionnaire (RBQ), Spence Children's Anxiety Scale-Parent (SCAS-P). Researchers also conducted semi-structured interviews and focus groups. Intervention consisted of eight weekly group

sessions during school hours lasting 45 minutes. Session content included typical elements of CBT interventions with some adaptations from existing CBT programmes for individuals with autism.

FINDINGS

Adolescents' perceptions of the intervention

Participants reported positive experiences of the programme. Five themes were identified from focus group discussions; raised awareness of sensory experiences, new-found self-expression, motivation for using coping strategies, generalisation of learning and improvements to the programme. Within these themes adolescents reported increased awareness of the relationship between thoughts, feelings and behaviours, new vocabulary acquisition and had the opportunity to experience a supportive group dynamic. They self-report using coping strategies acquired in the programme to relieve stress, avoid conflict and self-motivate across new situations.

Parents' perceptions of the intervention

Five themes were identified from parents' responses; challenges to parental involvement, importance of open communication with parents, positive post intervention changes, importance of group dynamics and improvements in future support and delivery. Parents reported it to be difficult to obtain direct information on session content from adolescents and were positive about the facilitators' ability to aid communication and understanding on a weekly basis. They reported observing their young person to use new coping tools and having a "safe space to think".

Qualitative analysis

All seven adolescents completed the programme, total attendance rate was 92.8%. Each adolescent completed between 10-25 sensory pictures in total. All took part in post-intervention focus groups (adolescents) and interviews (parents).

Quantitative analysis

Analyses indicated no significant change in scores over the three -time points on the primary outcome variables (SSP and AASP). There was also no significant change between pre-intervention and follow-up for the secondary outcomes variables (SCAS-P and RBQ). Repeated-measures ANCOVA analyses showed no significant effect for both the AASP score and SSP. However, effect sizes as estimated by partial eta squared are moderate-to-large. Analyses of secondary measures (RBQ and SCAS-P) also showed no significant effect. Researchers surprisingly identified an increase in parent-reported anxiety and repetitive behaviours based on means from SCAS-P and RBQ.

IMPLICATIONS FOR PRACTICE (by the authors)

- In terms of feasibility, results indicate this study successfully achieved its aim, which was to increase adolescents' awareness of their sensory experiences and how it may differ to others. It increased participants' expressive language in relation to sensory difficulties and equipped them with new coping strategies.
- High attendance rates and student engagement in the programme demonstrates its feasibility to be successfully incorporated within the complex environment of a mainstream secondary school. This fits with initiatives to increase mental health support in schools.

- The intervention was positively evaluated by participants, results show increased ability to self-regulate and modify behaviour. However, consideration would need to be given to increased participant anxiety related to the intervention.
- Future research is required by means of randomised trials with larger samples of adolescents to further test the efficacy of this eight week CBT-Sensory based programme.

Full Reference

Edgington, L., Hill, V. and Pellicano, E. (2016). The Design and Implementation of a CBT-Based Intervention for Sensory Processing Difficulties in Adolescents on the Autism Spectrum. *Research in Developmental Disabilities*, 59, p. 221-233.

A SYSTEMATIC REVIEW OF SENSORY BASED AUTISM SUBTYPES

BACKGROUND

Children with autism often present with sensory processing difficulties. Sensory processing abilities vary considerably in children with autism. Parent report measures have long identified that as a group, children with autism have significant differences in all or many sensory domains compared to neurotypical children.

Sensory-based subtypes or categories have been proposed as a means to better understand the unique sensory qualities in children with autism. Having distinct subtypes could help clinicians prioritise interventions and deliver more targeted therapeutic strategies.

RESEARCH AIMS

The purpose of this systematic review is to synthesise information about sensory-based subtypes that have been reported in the literature for children with autism.

REVIEW METHODS

PRISMA guidelines informed this review process. Included articles were published in the last 12 years, specific to children with autism between the ages of 2–18 years old. The authors of this study performed a systematic literature search using a range of electronic databases. Search terms were designed to answer the following research question:

What sensory-based subtypes have been used to classify children with autism?

A total of 361 articles were identified through the initial database searches. After removal of duplicates and application on inclusion criteria, eight articles were selected for review. Across the eight articles, 1643 children with autism were included in this review. On average 83.6% (range 79.9–91%) of the subjects were male and the overall age range of the subjects included across studies was five months to 12 years.

Articles Reviewed

Seven of the eight eligible articles were rated as meeting evidence criteria of a level IV and one study met criteria for a level III.

The results from the systematic review suggest that only a limited number of studies have examined sensory-based subtypes within this population and that the focus of this work has been on aspects of sensory modulation as opposed to the more inclusive factors associated with sensory processing disorder (i.e. the studies do not include measures of praxis or sensory discrimination).

Most of the reviewed studies based their sensory based subtypes on results of parent report measures (Sensory Profile instruments or Sensory Experiences Questionnaire), however one used a semi-structured play-based observational assessment rather than parent rating (The Sensory Processing Assessment).

The subtypes categorised within the measures are as follows:

- The Sensory Profile instruments: Seven groups (tactile, taste/smell, movement, under-responsive/seeking, auditory, low energy/weak, visual/auditory) and overall sensory responsivity. The full Sensory Profile score expands the characterisation of sensory responsivity patterns into nine factor groupings (responsivity, seeking, emotional reactivity, low endurance/tone, oral sensitivity, inattention/distractibility, registration, sensitivity, sedentary, fine motor).
- The Sensory Experiences Questionnaire: Four sensory factors (hyper-responsivity, hypo-responsivity, sensory interests and repetitive/seeking behaviours, and enhanced perception).
- The Sensory Processing Assessment: Uses observations of child responses rather than strictly parent rating scales.

RESEARCH FINDINGS

The literature consists of a small number of descriptive studies with little consensus on subtypes.

Findings indicate that sensory-based subtypes in children with autism were developed using primarily parent-report instruments that assess differences in sensory responsivity.

Several different subtyping schemes were presented, suggesting between three to five subtypes as an appropriate fit to encompass the different patterns of sensory responsivity seen in children with autism.

Several studies suggest that a subgroup of this population has typical sensory functioning, and a subgroup exists with significant, global sensory differences. Mixed results were found for those children who fall in between, who have specific versus global differences in responsivity (i.e. hyper- or hypo-responsivity or sensory seeking), or within specific sensory domains.

IMPLICATIONS FOR PRACTICE (by the authors)

Clinicians should be aware that there is a subset of children with autism who appear to have typical sensory modulation abilities; for this subtype, professionals should explore alternatives that may better support other causes of atypical behaviour as sensory modulation may not be a casual factor.

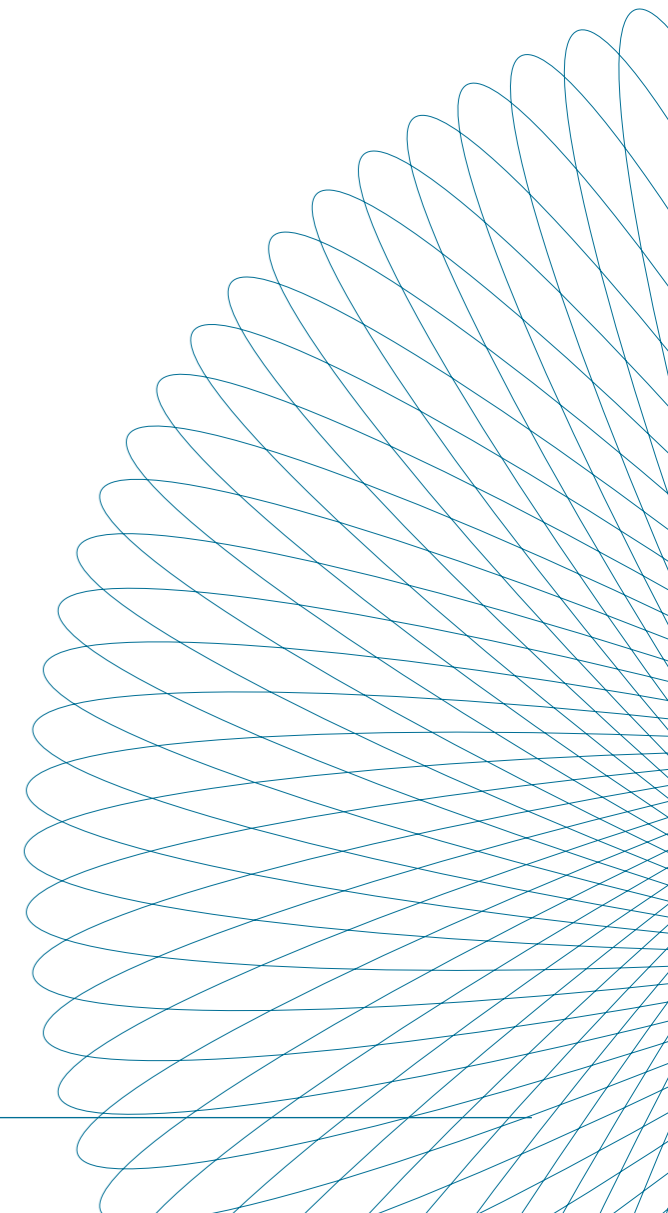
More global sensory processing deficits may greatly impact functioning in other performance areas, and occupational therapists will play a critical role in supporting these needs.

Aspects of sensory modulation, such as hypo- or hyper-responsivity may have a direct link to an individual's ability to successfully complete everyday activities such as washing, dressing, writing etc.

Further research is required to define sensory based subtypes that could provide a logical mechanism for assigning children to treatment groups for research studies or selecting appropriate intervention techniques.

Full Reference

DeBoth, K. and Reynolds, S. (2017). A Systematic Review of Sensory-Based Subtypes. *Research in Autism Spectrum Disorders*, 36, p. 44-56.



THE INTERPLAY BETWEEN SENSORY PROCESSING ABNORMALITIES, INTOLERANCE OF UNCERTAINTY, ANXIETY AND RESTRICTED AND REPETITIVE BEHAVIOURS IN AUTISM SPECTRUM DISORDER

BACKGROUND

Sensory processing difficulties are a recognised challenge for children and young people diagnosed with autism. These difficulties can impact on the individual's experience of the sensory world, leading to sensory under responsiveness, sensory over responsiveness and sensory seeking behaviour. These can often occur within the same sensory system demonstrating the complexity of the sensory systems and the need for further research in this area. It has been suggested that the experience of anxiety and what is called intolerance of uncertainty may influence sensory related behaviours e.g. restricted and repetitive activities. Understanding the role of anxiety and intolerance of uncertainty and their relationship with the experience of sensory difficulties and any behaviours related to this will be useful in developing supportive strategies for children and young people with autism.

RESEARCH AIMS

The aim of this research was to examine the relationship between sensory processing difficulties and repetitive behaviours and to examine the impact, if any, of intolerance of uncertainty and anxiety in children and young people with autism.

RESEARCH METHODS

The sample was 53 children with autism aged 8-16years comprising 47 boys and six girls.

The parents of the children completed a screening measure for autism and a range of measures relating to the child's sensory difficulties, anxiety, intolerance of uncertainty and restrictive and repetitive behaviours. The results of these were subject to statistical analysis in order to determine any relationships or correlations.

RESEARCH FINDINGS

The research findings indicate that the child's sensory responding i.e. under responding and over responding had an impact on restrictive and repetitive behaviours. The children who were reported by their parents as presenting with under responding to sensory input generally presented with both insistence on sameness, restrictive repetitive behaviours and motor restrictive repetitive behaviours. The children who were identified by their parents as presenting with over responding to sensory input generally presented with insistence on sameness, restrictive repetitive behaviours. In all cases the presentation of restrictive repetitive behaviours was also influenced by the child's anxiety levels and the child's ability to tolerate uncertainty. In all cases intolerance of uncertainty drove up both anxiety and restrictive and repetitive behaviours.

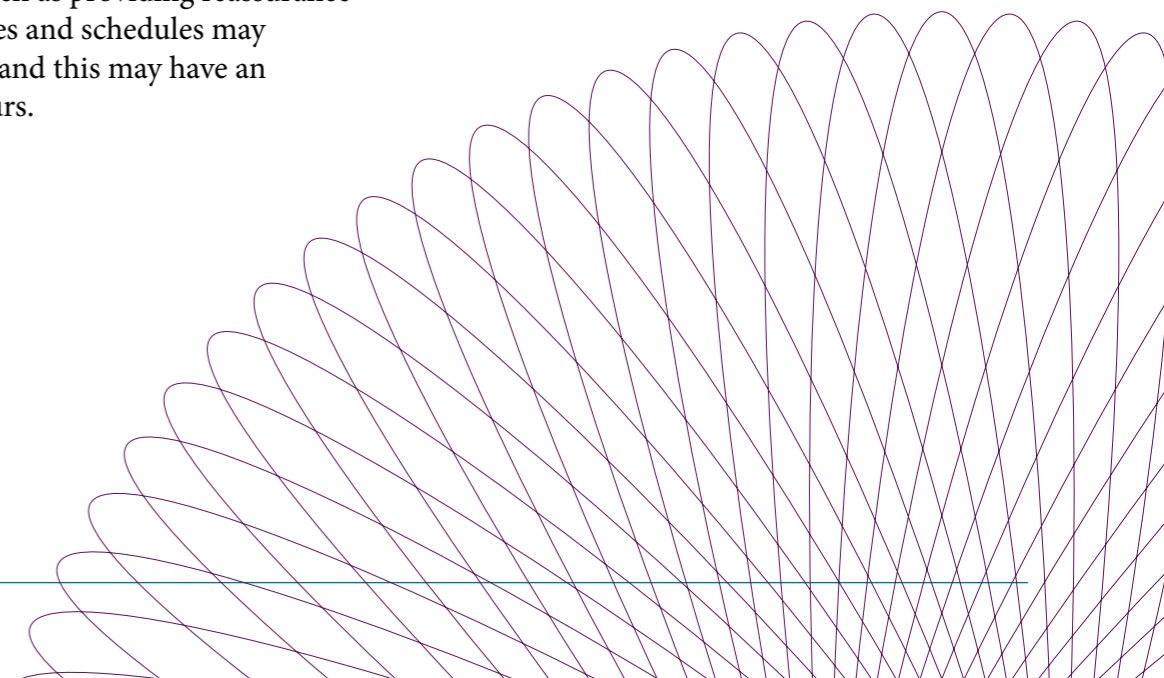
IMPLICATIONS FOR PRACTICE (by the authors)

The researchers acknowledge that this research was based on a small sample size and that it is the first research to address the role of intolerance of uncertainty on sensory experiences and restrictive and repetitive behaviours. The impact of intolerance of uncertainty on the children led to a range of implications for practice detailed by the researchers. These were:

- There is a need for further research into intolerance of uncertainty in autism and in autism and anxiety
- Heightened levels of intolerance of uncertainty led to more restrictive and repetitive behaviours so interventions that address intolerance of uncertainty may lead to a reduction in restrictive and repetitive behaviours.
- Practitioners should teach behavioural and cognitive strategies that build resilience to uncertainty.
- Increased restrictive and repetitive behaviours may indicate increased levels of anxiety and intolerance of uncertainty.
- Simple strategies such as providing reassurance and visual timetables and schedules may reduce uncertainty and this may have an impact on behaviours.

Full Reference

Wigham, S., Rodgers, J., South, M., McConachie, H. and Freeston, M. (2015). The Interplay between Sensory Processing Abnormalities, Intolerance of Uncertainty, Anxiety and Restricted and Repetitive Behaviours in Autism Spectrum Disorder. *Journal of Autism and Developmental Disorders*, 45, p. 943–952.



ASSESSING SENSORY PROCESSING DYSFUNCTION IN ADULTS AND ADOLESCENTS WITH AUTISM SPECTRUM DISORDER: A SCOPING REVIEW

BACKGROUND

Sensory Processing is known to be associated with and part of the current diagnostic criteria for ASD. Little research has been conducted into assessing sensory processing difficulties in both adolescents and adults with ASD. Evidence suggests that sensory symptoms are significant in adolescents and adults with ASD.

RESEARCH AIMS

The primary aim of this study was to identify approaches that have been used to measure sensory processing within current literature. The research also aimed to both describe and compare best practice guidelines that could possibly be integrated into future evidence-based practice. The review aspired to be informative in sensory processing assessment techniques which are recognised and consistent internationally and interdisciplinary across the lifespan of those with ASD.

RESEARCH METHODS

The review considered scientific databases and grey literature ranging from January 1987 to May 2017. The authors identified that the most effective methodology for analysing such complex information qualitatively and quantitatively was through the implementation of a scoping review. This was carried out using a two-phase approach which included a comprehensive search of the empirical literature available, followed by a systematic search of the grey literature.

During the first phase (Empirical Research) the authors ascertained relevant studies which included 'ASD', 'sensory processing', and 'methods' or 'tools' to 'assess sensory processing'. Detailed eligibility criterion was applied outlining those articles to be included and excluded within the review. The reviewers also employed article screening and data extraction processes to focus their study.

The second phase (Grey Literature search) identified studies that were relevant, directing their research around clinical guidelines of all ASD organisations which are national associations as well as regulatory bodies within varying countries including the United States of America, Canada, the United Kingdom, Australia and New Zealand. A screening process and data extraction was also applied to phase two of the study. Furthermore, a data synthesis of both empirical and clinical studies was employed.

Utilising such an approach the authors identified 4769 articles and a total of 12 clinical guidelines.

RESEARCH FINDINGS

Following the intensive screening process, 66 relevant articles were discovered and reviewed for this study. Assessment approaches were pinpointed as relevant. These included: Self- and Proxy-Report Questionnaires, Psychophysical Assessment, Direct Behavioural Observation, Qualitative Interview Techniques, and Neuroimaging/EEG.

This was the first review to systematically identify instruments to assess sensory processing in adolescents and adults demonstrating a range of options other than the AASP.

Self and proxy report measures

It was found that the most predominant assessments currently in use are Self- or Proxy-report measures (71.1%). Eleven were found in the scoping review, mostly within cross-sectional studies focusing on sensory processing in ASD.

Reviewers highlight the strengths of this method outlining the ease of implementing such assessments, the vast amount of information that can be collected promptly and how the individual doesn't necessarily need to be present as they can easily be done online or over the telephone.

Qualitative interviews

Research identified this method as favourable in its flexibility in structure and ease for collecting information. It can be individualised, therefore client specific which again is highly significant for ASD. They found that clients were more inclined to share more information through this methodology. Although they also bring their attention to the skill of the clinician and how this can have an impact on the result, it is very time consuming for the professional conducting the interview and there needs to be a strong theoretical understanding and knowledge surrounding sensory processing in adults with ASD.

Psychophysical methods

Interestingly it was discussed that this method was currently not within any of the reviewed clinical guidelines. The authors state that this method could provide vital baseline sensory information which could potentially improve clinical decisions.

Direct behavioural observation

Research demonstrated a gap within the literature which currently exists around behavioural observation. Most of the research surrounding observable behaviours and sensory processing difficulties employed a functional behaviour assessment (FBA). The authors found that this was a limited assessment tool for measuring sensory processing difficulties.

Neuroimaging

Although this measure is costly and difficult to obtain the research ascertains the potential strength of this method for advancing knowledge around sensory processing particularly if combined with various other methods.

IMPLICATIONS FOR PRACTICE (by the Authors)

- Outline the need for a variety of assessment approaches that combine both measures and techniques.
- Assessments are required that are specifically designed for adolescents and adults with ASD, particularly accounting for the prevalence of concurrent IDD.
- Identified a need for more research particularly advising a systematic review around results of questionnaires, compared to psychometric properties.
- More research would be recommended as the current collection of assessments for sensory profile are limited.
- Clinical practice could be improved through the addition of newly established questionnaires such as SR-AS as add-ons for current assessments.
- Clinical guidelines that are both international and interdisciplinary could bridge the gap in sensory processing research. The authors suggest doing this through an expert conference specifically for sensory processing.
- Clinical education should be implanted in sensory processing knowledge.

Full Reference

DuBois, D., Lymer, E., Gibson, B. E., Desarkar, P. and Nalder, E. (2017). Assessing Sensory Processing Dysfunction in Adults and Adolescents with Autism Spectrum Disorder: A Scoping Review. *Brain Sciences*, 7 (8), p. 108-131.

THE IMPACT OF ATYPICAL SENSORY PROCESSING ON SOCIAL IMPAIRMENTS IN AUTISM SPECTRUM DISORDER

BACKGROUND

Prior research focusing on sensory processing and autism has found that up to 95% of parents of children with autism report some atypical sensory behaviour in their child. Sensory processing difficulties are reported across all ages and levels of symptom severity. Previous research also identified that sensory processing difficulties adversely affect both daily functioning and academic performance. The behavioural, neurophysiological and anecdotal evidence of sensory impairment as a prevalent characteristic feature of autism is acknowledged in the DSM-5.

Sensory receptors are stimulated by environmental stimuli and sensory information is relayed to the brain to create a subjective neural representation. This process is known as perception. Sensation and perception are inter-related constructs however a breakdown of sensation results in a lack of perception, and similarly, without perception the activation of a sensory receptor is meaningless. An additional concept in this process, is attention. An individual may sense and perceive a stimulus but fail to attend to it in an expected way, therefore it can be difficult to disentangle these constructs to identify whether sensory, perceptual, or attentional deficit is underlying a given response.

Prior research often focuses on the sensory and social features of autism independently, however new theoretical and empirical evidence suggests a stronger relationship between the two than previously thought.

RESEARCH AIM

The relationship between sensory and social processing can occur at many hierarchical levels and atypical behavioural outcome can reflect a breakdown at any point within the hierarchy.

The aim of this review was to examine behavioural and neurobiological studies on social and sensory processing in autism across multiple modalities; vision, auditory, tactile, olfaction, gustation, and multisensory integration, with the purpose of exploring the relationship between sensory deficits and social functions in autism.

Theoretical models of autism and their implications for the relationship between sensory and social functioning were also discussed in this paper.

RESEARCH METHOD

In this review paper, behavioural and neurobiological studies relating to social and sensory processing in autism were examined. More specifically, authors investigated the possible mechanisms by which atypical sensory processing across the five basic senses could manifest in social deficit characteristics of autism. Furthermore, the authors reviewed existing hypotheses which attempted to integrate these features as well as reviewing evidence from neuroimaging studies which highlighted differences in sensory and social representations often observed in autism. In addition, three theoretical models of autism were outlined and implications for the relationship between sensory and social functioning were addressed.

RESEARCH FINDINGS

Vision

Differences in vision is one of the earliest markers of autism; atypical visual processing has been widely documented in individuals with autism. Perception of social cues is crucial in social development and interpersonal interactions as it drives visual attention patterns. The authors outline how atypical visual processing spanning gaze processing, face processing and biological motion processing can have cascading deleterious effects on subsequent social functioning.

Auditory

Hearing is an important aspect of successful social-communication interactions. Abnormal auditory processing, which is consistently reported in autism, stems from atypical sensation, altered perception, and lack of preferential attention to auditory stimuli. The review found that oversensitivity to speech and prosody results in individuals being unable to filter out background noise, attend to speech and other relevant social cues thus impacting negatively on decoding and reciprocity in social exchanges.

Tactile

Touch is important for developing social bonding. The review found that individuals with autism display abnormal detection of tactile stimuli as well as a lack of habituation to tactile stimuli. According to the authors these irregularities in touch and tactile perception may be associated with broad levels of social dysfunction in autism but that future research on the importance of tactile perception in orienting and self-regulation as well its impact on other social domains is needed.

Olfaction and Gustation

The authors found that despite there being limited research on olfaction and gustation in autism, eating behaviour and sensitivity to smell are common concerns for individuals with autism. Overall there is evidence of atypical responses to both however, future studies to examine the relationship between them and social functioning is needed.

Multisensory integration

The integration of multisensory stimuli is essential for social functioning and complex social interactions. The integration of senses provides more information than the separate components, thus creating predictability which influences how an individual interacts socially. Even if the perception of each individual sense is intact, the integration of senses into a perceptual whole may fail thus impacting on social functioning. The review details how language development, emotion recognition, imitation and developmental considerations of impairments in multisensory integration in autism impacts on social functioning.

IMPLICATIONS FOR PRACTICE

(by the author)

Sensory characteristics across autism are varied, with features ranging from intact, enhanced to impaired. Dysregulated sensory processing is considered universal in autism.

According to the authors, this paper consolidated the evidence emerging from behaviour, neuroscience, and other modalities of research on sensory and social processing in autism and identified their inter-relationship in autism.

Atypical sensory processing in autism can impact on the individual's ability to attend to social stimuli, decode intentions, engage in social reciprocity, and adhere to social norms of behaviour. Atypical sensory processing can also impact on the individual's ability to engage and obtain an accurate assessment and consequently access intervention and therapy.

As sensory issues can differ across individuals with autism, they play a key role in social and communicative difficulties in autism. Future research should give consideration to sensory needs when designing intervention plans for children with autism.

There are several cognitive and neurobiological mechanisms through which sensory processing abnormalities might either cause or exacerbate many of the social impairments seen in autism. The authors found that altered sensory processing and sensory integration in autism affect language, communication, emotion, response to reward, and interpersonal functioning in individuals with autism.

It is important that practitioners continue to build models of autism that incorporate both the social and sensory domains of autism. This acknowledges that the two core domains of autism are interrelated therefore require intervention that targets both domains in conjunction.

Full Reference

Thye, M. D., Bednarz, H. C., Herringshaw, A. J., Sartin, E. B. and Kana R. K. (2017). The Impact of Atypical Sensory Processing on Social Impairments in Autism Spectrum Disorder. *Developmental Cognitive Neuroscience*, 29, p. 151-167.



CONCLUSION

This Bulletin provides summaries of fourteen articles addressing a range of issues involving sensory processing in autism. The articles address areas from childhood through to the assessment of sensory issues in older children and adults, which is an area that requires development.

For parents, people with autism and practitioners there are broad implications for practice to be taken from the summaries. Some of the more salient implications are:

- Sensory characteristics across autism are varied, with features ranging from intact, enhanced to impaired. Dysregulated sensory processing is considered universal in autism.
- Assessments are required that are specifically designed for adolescents and adults with ASD.
- Increased restrictive and repetitive behaviours may indicate increased levels of anxiety and intolerance of uncertainty.
- Children with autism and sensory difficulties may benefit from additional support and education focusing on empathy related topics such as understanding emotions, emotional regulation and friendship skills.
- CBT style training may increase adolescents' awareness of their sensory experiences and how it may differ to that of others.

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.

[Research Bulletin Feedback Sensory Processing \(Volume 2\)](#)



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