Relationship between directly observed sensory reactivity differences and classroom behaviors of autistic children

Brief Report: The relationship between directly observed sensory reactivity differences and classroom behaviours of autistic children.

H.Marcham & T.Tavassoli

School of Psychology and Clinical Language Sciences, University of Reading

Marcham, H., & Tavassoli, T. (2024). Brief Report—Relationship between directly observed sensory reactivity differences and classroom behaviors of autistic children. American Journal of Occupational Therapy, 78, 7803345010. https://doi.org/10.5014/ajot.2024.050345

Abstract

Importance: Sensory reactivity differences are a core feature of autism, however there is more to learn about the role they play in classroom learning.

Objective: Use direct observational measures to investigate if there is a link between sensory reactivity differences and classroom behaviours of autistic children.

Design: Correlational study.

Setting: Two Special Educational Needs schools.

Participants: Children with a clinical diagnosis of autism, aged 5 – 18 (*n*= 53).

Outcomes and Measures: Sensory reactivity differences were assessed via the Sensory Assessment for Neurodevelopmental Differences. Classroom behaviours were measured using the Behaviour Assessment for Children – second edition Student Observation System.

Results: Total sensory reactivity differences were correlated positively with behaviours that impede learning ($r = .31$, $p <.05$) and negatively with behaviours that facilitate learning ($r = -.38$, $p <.05$). Hyporeactivity differences were correlated positively with behaviours that impede learning ($r = .28$, $p <.05$) and negatively with behaviours that facilitate learning ($r = -.31$, $p < .05$). Hypereactivity and seeking differences were not significantly correlated with behaviour.

Conclusions and Relevance: Results suggest a link between sensory reactivity differences and classroom behaviours, highlighting a need for further research using observational measures in special educational settings.

What This Article Adds: Direct observational methods suggest hyporeactivity differences may be playing a bigger role in classroom behaviour than is suggested by previous literature. This has implications for tailoring support for hyporeactivity differences.

Introduction

Sensory reactivity differences are a core diagnostic criteria for Autism Spectrum Conditions (ASC; DSM-5, American Psychiatric Association 2013). Sensory reactivity differences are found across all sensory domains including tactile, visual and auditory domains (Dunn, 1997). Differences fall into three subtypes; hyperreactivity (a strong response to stimuli such as finding noise painful), hyporeactivity (an under responsiveness like not noticing the cold) and sensory seeking (fascination or need for a certain input; Ben-Sasson et al, 2009). All subtypes may be found within the same individual (MacLennan et al, 2022). Whilst autistic individuals describe finding enjoyment or comfort in some of their sensory reactivity differences (MacLennan et al, 2020) they may be challenging in a range of areas (Dellapiazza et al, 2018).

Autistic students are at higher risk for underachieving academically (Mallory & Keehn, 2021), there is increasing research looking into the role of sensory reactivity differences in this. A correlation between sensory reactivity differences and poorer academic performance has been demonstrated in autistic students in mainstream classrooms (Ashburner et al, 2008). Dunn (1997) theoretically demonstrates why sensory differences impact on behaviour and learning..Jones et al (2020) describes how teachers and parents see sensory differences causing distress, distraction and reducing classroom participation. They have also been shown to reduce attention (Mallory & Keehn, 2021).

Investigating the role of each sensory subtype in learning is vital as there is different support methods needed to aid with each. Utilising parent reports, Liss et al (2006) found a relationship between hyperreactivity and over focus of attention, and between hyporeactivity and lower adaptive functioning and communication skills. However, this link was with general adaptive functioning skills rather than classroom behaviour specifically. Ashburner et al. (2008) found autistic students with increased hyporeactivity and seeking differences (measured via Short Sensory Profile, SSP) were at increased risk of inattention to tasks in the classroom, a behaviour that impedes learning. Utilising parent and teacher report Green et al (2016) found sensory reactivity differences were linked to increased emotional, but not behavioural, challenges.

The limited previous literature in the field relies upon parent and teacher reports. Whilst these are important sources of information, they are vulnerable to recollection bias and parent-teacher discrepancies.(Jordan et al, 2019). More research is needed utilising direct observational methods. Furthermore, previous work focuses on students in mainstream schools and does not incorporate autistic students in special educational settings.

This work aims to investigate if there is a link between sensory reactivity differences and classroom behaviours of autistic children in special educational settings, utilizing objective direct observational measures.

Methods

Participants and Procedures

Fifty-three students aged 5-18 years (M= 10.53, 9 females 44 males) with a clinical diagnosis of autism participated. Participants were recruited from two special education schools, where all students have Education Health and Care Plans (EHCP) and require high levels of support, reflected in high staff to student ratios ranging from 1:1 to 1:3. Informed consent was gained from parents via electronic forms. Participants were unable to provide written or verbal consent, so were continuously monitored for signs of distress. If they appeared distressed, or school staff statedthey were displaying anxiety the assessment stopped. Research was conducted in participants usual classroom, with behaviour observations completed during a routine seated table work activity.

Measures

Sensory Assessment for Neurodevelopmental Differences (SAND)

The SAND comprises of a direct observation of an individual's response to sensory stimuli and accompanying parent interview (Siper et al, 2017). In line with study aims to utilize a direct observation method only the observational aspect of the SAND was used here. During the observation individuals' observable reactions to stimuli are scored, a verbal response is not required. therefore the tool is suitable for individuals with minimal spoken language..A structured observation using standardised manipulatives is completed. The observation lasts approximately 15 minutes. The SAND was designed specifically to capture autistic sensory reactivity differences. The SAND examines sensory hyperreactivity (adverse reaction to noisy toys or flashing lights), hyporeactivity (not noticing being touched by a cold pack or sudden unexpected noise) and seeking behaviour (looking very closely at a spinning wheel or bringing a toy close to their ear) across visual, tactile, and auditory domains. If a difference is observed a score of one is given, if not then it scores zero. A severity rating is given for each of the hyper, hypo and seeking categories within each domain. A score of one for mild differences and two for moderate/severe differences, e.g if a reaction is shown multiple times. Number of differences observed plus severity ratings are combined to give an overall score (out of 15) for each domain with total observed scores ranging from 0-45. Higher scores represent higher presence of sensory reactivity differences. The SAND has high internal consistency (Cronbach's α of 0.90) and strong inter-rater (above 0.8) and test-retest reliability (0.8, *p*<.001; Siper et al, 2017). Researchers were trained on the SAND by a previously confirmed reliable researcher.

Behaviour Assessment for Children – second edition Student Observation System (BASC-SOS)

The BASC-SOS (Reynolds & Kamphaus, 2004) assesses 13 "adaptive" behaviours that facilitate learning (e.g., following instruction, completing activity, interacting with staff) and 58 "problem" behaviours that impede learning (e.g., aggression, self-injury, inattention). For this study the BASC language has been changed to be less stigmatising, behaviours are referred to as behaviours that impede or facilitate learning. It is important to recognise that autistic students may learn in different ways to neurotypical students, however in the context of a routine table-based learning activity (during which the BASC was completed) the behaviours assessed would impede or facilitate task engagement. The BASC procedure entails watching the participant for 3 seconds followed by 27 seconds to record witnessed behaviours, repeated over a 15-minute period. Total number of each behaviour type observed was used as participants score. The BASC-SOS shows high internal consistency (0.8 with children, 0.9 with adolescents) and test-retest reliability (Reynolds & Kamphaus, 2004). Furthermore, it was designed specifically for use with children who are experiencing difficulties significant enough to impede academic progress and has been used previously in research with autistic students (Hodges et al, 2022).

Multiple researchers collected data across schools, all BASC and SAND procedures were followed.

Results

Data analysed using SPSS IBM 24. Alpha level of .05.

Kolmogorov-Smirnov test (Berger & Zhou, 2014) was used to test normality. Behaviours that facilitate learning variable was normally distributed, (D[53].09, p = .20). Behaviours that impede learning (D[53] = .13, p = <.05) as well as total number of sensory reactivity differences (D[53] = .13, p <.05), hyperreactivity differences (D[53]= .23, p = <.001), hyporeactivity differences (D[53] = .268, p = <.001) and seeking differences (D[53] = .15, p <.05) were not normally distributed, therefore nonparametric tests were used.

Pearson correlation (Freedman et al, 2007) showed age was correlated to behaviours that facilitate learning (r[51] = -.47, p = <.001). Non parametric Spearman's rank test (Zar, 2005) showed age was also correlated with seeking differences (r[51] = -.37, p <.05), but not with behaviours that impede learning (r[51] = .15, p = .28), total number of sensory reactivity differences (r[51] 1.17, p = .247), hyperreactivity differences (r[51] .17, p = .247) or hyporeactivity differences (r[51] .03, p = .844). Therefore, age was controlled for in analyses involving behaviours that facilitate learning and seeking differences variables.

Descriptive statistics in Table 1.

Table 1.

Descriptive statistics for SAND domains and BASC-SOS classroom behaviours.

	Minimum	Maximum	Mean (SD)
Classroom Behaviours			
Behaviours that facilitate learning	1.0	36.0	15.77 (8.39)
Behaviours that impede learning	3.0	33.0	15.06 (8.21)
Sensory Reactivity Differences			
Total number of sensory reactivity differences	2.0	17.0	10.70 (3.75)
Hyperreactivity differences	0.0	10.0	1.98 (2.37)
Hyporeactivity differences	0.0	8.0	2.20 (2.61)
Sensory seeking differences	0.0	14.0	6.51 (3.41)

	Behaviours that facilitate learning	Behaviours that impede learning
Total sensory differences	-.38*	.31*
Hyperreactivity	-.03	.10
Hyporeactivity	-.31*	.28*
Seeking	-.23	.20

Note: * correlation significant at .05 level (two-tailed)

Correlation results in Table 2.

Table 2.

Correlation Matrix

Scatterplot matrices of significant results provided in Appendix A.

Discussion

Sensory reactivity differences and autistic student's classroom behaviour were related. The more sensory reactivity differences displayed the more behaviours that impede learning and less behaviours that facilitate learning were observed. Our findings are consistent with previous research demonstrating that sensory differences impact negatively upon adaptive behaviour and attention and participation (Dellapiazza et al, 2018; Jones et al, 2020; Mallory & Keehn, 2021). This finding adds to the field as we addressed a limitation of previous literature by utilizing direct observational methods rather than teacher and parent report. We also included autistic students with high support needs in special educational settings who are underrepresented in research.

Hyporeactivity was the only sensory subtype independently linked to classroom behaviour. This is consistent with Liss et al (2006) parent report based work which found increased hyporeactivity was linked to general lower adaptive functioning. The relationship we found between hyporeactivity and reduced behaviours that facilitate learning is supported by previous research demonstrating that hyporeactivity impacts negatively upon key learning skills such as joint attention (Baranek et al, 2013) motor skills (Jasmin et al, 2009) and communication (Watson et al, 2011). Ashburner (2008) found that increased hyporeactivity/seeks sensation scores on the SSP were related to inattention and reduced academic achievement. Our use of the SAND measurement allowed for separation of hyporeactivity and sensory seeking differences, meaning their roles could be investigated separately. Our results suggest hyporeactivity differences could have been driving this link and sensory seeking may not have been significantly linked in Ashburner's work had it been a separate variable. The role of hyporeactivity differences may have been underreported in previous literature given its reliance on parent and teacher report as hyporeactivtity may be less noticeable.

Hyperreactivity and sensory seeking differences can be disabling for autistic students (Howe et al, 2016) therefore it is intriguing we found no significant link to classroom behaviours. Nevertheless we foundmoderate effect sizes for seeking differences and classroom behaviour which is supportive of previous literature (Jones et al 2020). Our finding may reflect the fact that teachers in special educational settings make various adaptions to classrooms to accommodate sensory needs, mainly for hyperreactivity and sensory seeking (Pillar et al, 2016) including lowering lighting or providing rocking chairs. Without direct assessment hyporeactivity differences may be harder for teachers to notice, so they are unaware there is a need for accommodations. Iincreased hyperreactive and seeking differences might be better supported as these differences are more overtly noticeable.

If hyporeactivity is playing a larger role in classroom engagement this has implications for teaching and classroom design. Current design guidance already consider sensory reactivity differences, with a focus on how to address sensory hyperreactivity (Tola et al, 2021). Hyporeactivity needs to be supported by enhancing stimuli of tasks so that it can reach the higher sensory registration levels of hyporeactive students (Dunn, 1997). There are also implications for designing classrooms that allow for increased saliency of learning cues and stimuli.

Limitations and Future Research

Data was collected at a single time point, therefore may not be representative of an individual's overall classroom behaviour, which may have impacted findings. We were unable to collect more information about participant characteristics, this is significant given there is literature linking sensory differences to communication ability (Dellapiazza et al, 2018) and lower cognitive ability (Zachor & Ben-Itzchak, 2014). The SAND is a novel tool for sensory assessment but is not yet widely used in research. The BASC-SOS categorises behaviours based on neurotypical students, therefore it's possible that behaviours may be inappropriately categorised for autistic students learning. Future research should measure variables multiple times and collect detailedparticipant demographic information.

Implications for practice

- Findings suggest if autistic students are showing increased behaviours that impede their learning or reduced behaviours that facilitate, they might benefit from a sensory assessment.
- Findings suggest more research is warranted into the role of hyporeactivity differences on classroom behaviours. Students who are particularly hyporeactive may be at increased risk for not engaging and need targeted support.

Conclusion

This study found a link between increased sensory reactivity differences and more behaviours that impede learning and fewer behaviours that facilitate learning when assessed using direct observations in special educational setting. Hyporeactivity correlated with both fewer behaviours that facilitate learning and increased behaviours that impede learning. This has implications for tailoring support to students with increased sensory differences, especially those with hyporeactivity.

Acknowledgments

The authors would like to thank all the autistic students and their schools for participating. The authors would like to thank past students who supported this study, specifically Brett Davies, Charlotte Daniels and Frankie Englezou. Last, we would like to thank the ESRC SeNSS doctoral program for funding this research.

References

American Psychiatric Association. (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Washington, DC.

Ashburner, J., Ziviani, J., & Rodger, S. (2008). Sensory processing and classroom emotional, behavioral, and educational outcomes in children with autism spectrum disorder. *American Journal of Occupational Therapy*, *62*(5), 564-573.

Baranek, G. T., Watson, L. R., Boyd, B. A., Poe, M. D., David, F. J., & McGuire, L. (2013). Hyporesponsiveness to social and nonsocial sensory stimuli in children with autism, children with developmental delays, and typically developing children. *Development and psychopathology*, *25*(2), 307-320.

Ben-Sasson, A., Hen, L., Fluss, R., Cermak, S. A., Engel-Yeger, B., & Gal, E. (2009). A meta-analysis of sensory modulation symptoms in individuals with autism spectrum disorders. *Journal of autism and developmental disorders*, *39*(1), 1-11.

Berger, V. W., & Zhou, Y. (2014). Kolmogorov–smirnov test: Overview. *Wiley statsref: Statistics reference online*.

Conover, W.J. (1999), “Practical Nonparametric Statistics (3rd Ed.). New York: *Wiley*, (p. 327-328).

Dellapiazza, F., Vernhet, C., Blanc, N., Miot, S., Schmidt, R., & Baghdadli, A. (2018). Links between sensory processing, adaptive behaviours, and attention in children with autism spectrum disorder: A systematic review. *Psychiatry Research*, *270*, 78-88.

Dunn, W. (1997). The impact of sensory processing abilities on the daily lives of young children and their families: A conceptual model. *Infants & Young Children, 9*(4), 23-35.

Freedman, D., Pisani, R., & Purves, R. (2007). Statistics (international student edition). *Pisani, R. Purves, 4th Edn. WW Norton & Company, New York*.

Green, D., Chandler, S., Charman, T., Simonoff, E., & Baird, G. (2016). Brief report: DSM-5 sensory behaviours in children with and without an autism spectrum disorder. *Journal of Autism and Developmental Disorders*, 46, 3597–3606.

Hodges, A., Cordier, R., Joosten, A., Bourke-Taylor, H., & Chen, Y. W. (2022). Evaluating the feasibility, fidelity, and preliminary effectiveness of a school-based intervention to improve the school participation and feelings of connectedness of elementary school students on the autism spectrum. *Plos one*, *17*(6),

Howe, F. E., & Stagg, S. D. (2016). How sensory experiences affect adolescents with an autistic spectrum condition within the classroom. *Journal of Autism and Developmental Disorders*, *46*(5), 1656-1668.

Jasmin, E., Couture, M., McKinley, P., Reid, G., Fombonne, E., & Gisel, E. (2009). Sensori-motor and daily living skills of preschool children with autism spectrum disorders. Journal of autism and developmental disorders, 39, 231-241.

Jones, E. K., Hanley, M., & Riby, D. M. (2020). Distraction, distress and diversity: Exploring the impact of sensory processing differences on learning and school life for pupils with autism spectrum disorders. *Research in autism spectrum disorders*, *72*, 101515.

Jordan, A. K., Thomeer, M. L., Lopata, C., Donnelly, J. P., Rodgers, J. D., & McDonald, C. A. (2019). Informant discrepancies in the assessment of adaptive behavior of children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *49*, 2024-2034.

Liss, M., Saulnier, C., Fein, D., & Kinsbourne, M. (2006). Sensory and attention abnormalities in autistic spectrum disorders. *Autism*, *10*(2), 155–172.

MacLennan, K., O'Brien, S., & Tavassoli, T. (2022). In our own words: The complex sensory experiences of autistic adults. *Journal of autism and developmental disorders*, *52*(7), 3061-3075.

MacLennan, K., Roach, L., & Tavassoli, T. (2020). The relationship between sensory reactivity differences and anxiety subtypes in autistic children. *Autism Research*, *13*(5), 785-795.

Mallory, C., & Keehn, B. (2021). Implications of sensory processing and attentional differences associated with autism in academic settings: An integrative review. *Frontiers in Psychiatry*, *12*, 695825.

Piller, A., & Pfeiffer, B. (2016). The sensory environment and participation of preschool children with autism spectrum disorder. *OTJR: occupation, participation and health*, *36*(3), 103-111.

Rabiner, D., Coie, J. D., & Conduct Problems Prevention Research Group. (2000). Early attention problems and children's reading achievement: A longitudinal investigation. *Journal of the American Academy of Child and Adolescent Psychiatry*, 39, 859–867.

Reynolds, C. R., & Kamphaus, R. W. (2004). *Behavior assessment system for children* (2nd ed.). Circle Pines: AGS.

Siper, P. M., Kolevzon, A., Wang, A. T., Buxbaum, J. D., & Tavassoli, T. (2017). A clinician-administered observation and corresponding caregiver interview capturing DSM-5 sensory reactivity symptoms in children with ASD. *Autism Research*, *10*(6), 1133-1140.

Tola, G., Talu, V., Congiu, T., Bain, P., & Lindert, J. (2021). Built environment design and people with autism spectrum disorder (ASD): A scoping review. *International journal of environmental research and public health*, *18*(6), 3203.

Watson, L. R., Patten, E., Baranek, G. T., Poe, M., Boyd, B. A., Freuler, A., & Lorenzi, J. (2011). Differential associations between sensory response patterns and language, social, and communication measures in children with autism or other developmental disabilities. *Journal of Speech, Language, and Hearing Research*, 54, 1562–1576.

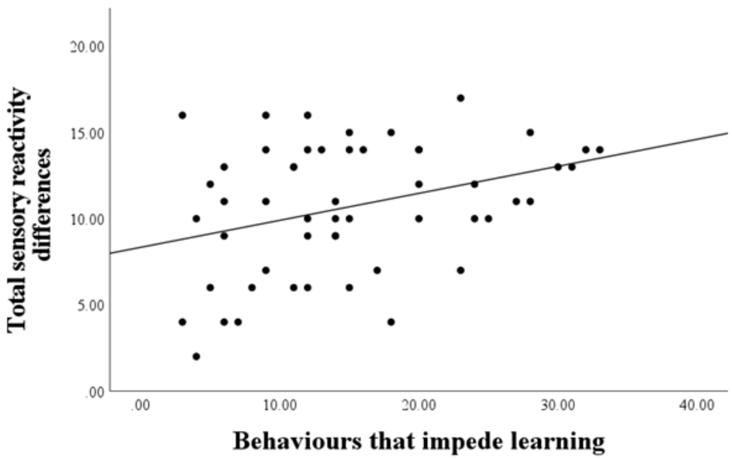
Zachor, D. A., & Ben-Itzchak, E. (2014). The relationship between clinical presentation and unusual sensory interests in autism spectrum disorders: A preliminary investigation. *Journal of autism and developmental disorders*, *44*(1), 229-23.

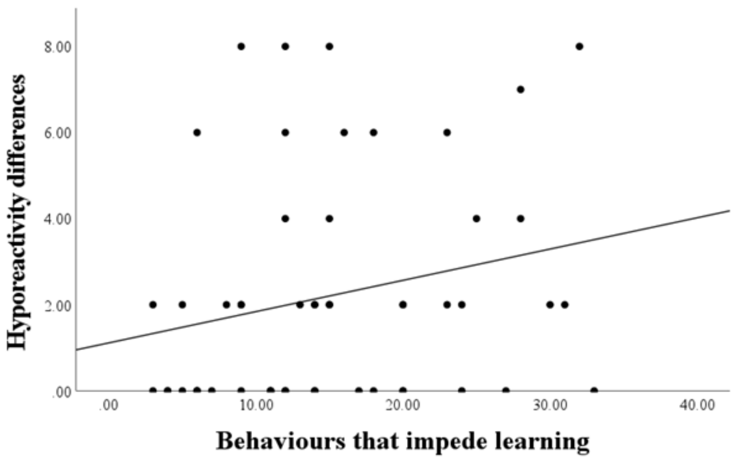
Zar, J. H. (2005). Spearman rank correlation. *Encyclopedia of Biostatistics*, *7*.

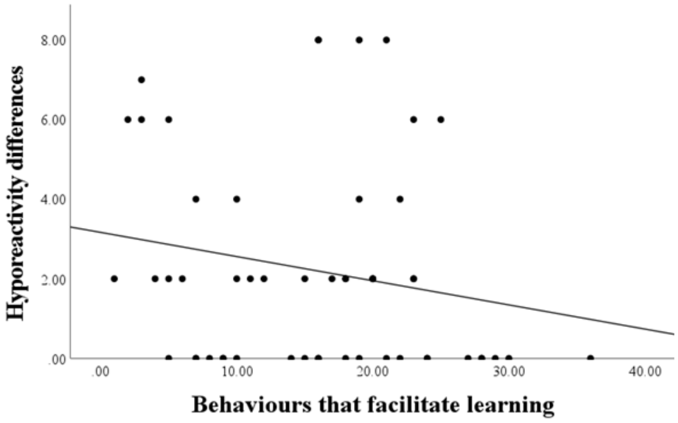
Appendix

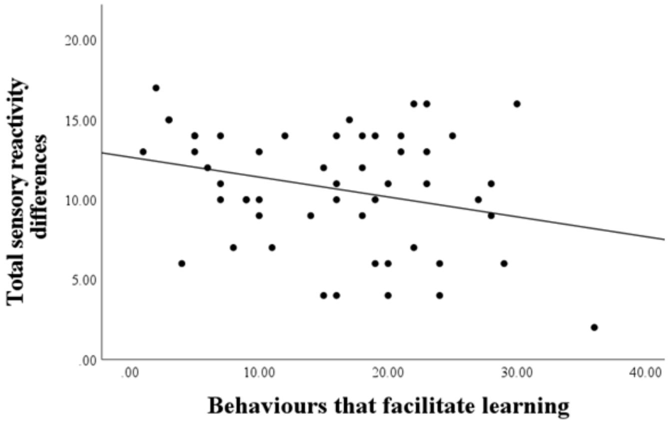
Appendix A

Scatter plots of significant results






Hyporeactivity differences
8.00
6.00
4.00
2.00
.00
.00
10.00
20.00
30.00
40.00
Behaviours that facilitate learning


Total sensory reactivity differences
20.00
15.00
10.00
5.00
.00
.00
10.00
20.00
30.00
40.00
Behaviours that facilitate learning