

# SENSORY PROCESSING ISSUES AND OCCUPATIONAL ENGAGEMENT AMONG CHILDREN WITH AUTISM SPECTRUM DISORDERS

**Selamat S<sup>1,2</sup>, A Rahman P<sup>1</sup>, and Psychouli P<sup>3</sup>.**

<sup>1</sup>Centre of Occupational Therapy Studies, Faculty of Health Sciences, Universiti Teknologi MARA Cawangan Selangor Kampus Puncak Alam, 42300 Bandar Puncak Alam, Selangor, Malaysia

<sup>2</sup>Pusat Genius Kurnia, Sentul, Wilayah Persekutuan Kuala Lumpur

<sup>3</sup>Occupational Therapy and Neurorehabilitation, Department of Health Sciences, European University Cyprus, 6 Diogenous Str., Egkomi 2404, Nicosia, Cyprus

## Correspondence:

Padma A. Rahman,  
Centre of Occupational Therapy Studies,  
Faculty of Health Sciences,  
Universiti Teknologi MARA Cawangan Selangor Kampus Puncak Alam,  
42300 Bandar Puncak Alam, Selangor, Malaysia  
Email: padma553@uitm.edu.my

## Abstract

Children with Autism Spectrum Disorder (ASD) experience sensory processing issues, affecting their daily behaviour and functional performance. Occupational engagement is viewed as activities a person participates in which involve occupational performance and environmental factors. This study aims to identify impaired sensory processing and occupational engagement, the relationship with demographic profile, and the relationship between impaired sensory processing and occupational engagement among children with ASD. A total of 169 children with ASD from a centre in Sentul were recruited. School Companion Sensory Profile and the Short Child Occupational Profile (SCOPE) were used as the outcome measurements in this study. The research finding yields those children with ASD appear to experience some degree of processing issues in “avoiding” sensory patterns and appear to have significant challenges in “communication and interaction skills” in their occupational engagement. Sensory processing issues and activity engagement are also found to be a minimal to moderate relationship with the demographic profiles of the children. The study also concludes that sensory processing and occupational engagement among children with ASD are interrelated. The correlation coefficients range from  $r = -0.20$  to  $r = -0.36$  indicating a fair to moderate correlation between sensory processing and occupational engagement. These sensory processing issues significantly impact children’s life, which can be seen through their level of engagement in daily life activities. Information on sensory processing issues and occupational engagement allows one to identify successful intervention strategies.

**Keywords:** Autism Spectrum Disorder, Occupational Engagement, Sensory Processing

## Introduction

The prevalence of ASD is increasing globally, with 1 in every 50 children diagnosed with ASD spectrum disorder (1). With the prevalence increasing throughout the years, there is a need to identify possible solutions and management to handle ASD cases. A previous study on sensory processing has identified an abnormal pattern of sensory processing among individuals with ASD. These patterns, including over-responsiveness and under-responsiveness (2) with ASD, commonly have difficulty in the interaction between a sensory system, including tactile, visual, auditory, olfactory, vestibular and proprioceptive systems (3).

Having sensory processing issues makes children’s life harder as they must cope and adapt well to sensory information around them. In Malaysia, children with

disabilities can access education in a special school and in the inclusion program in mainstream primary and secondary schools (4). However, some significant concerns arise as the student appears to have issues with academic skills, social and communication skills, behaviour and emotional support, attention skills, lack of self-esteem, lack of participation, and emotional instability (4). These issues have significant impacts on the sensory processing of the child as they appear to have a deficit in daily function and develop fear (5), difficulty socialising (6) and affect the child’s ability to learn (7).

The sensory processing issue is quite common among children with ASD, with 42% to 88% of children with ASD experiencing sensory processing disorder (8). Although sensory processing is not a diagnostic core characteristic

of ASD yet, sensory processing issue among children with ASD has been well described by many researchers (9, 10). The atypical response among children with sensory processing issues has been reported to occur across every sensory domain, which includes tactile, vestibular, auditory, and visual (11).

In the area of activity of daily living, some children with ASD have shown significant challenges in performing self-care activities like grooming, dressing, feeding, washing, and toileting (12). This is due to difficulties performing fine motor activities like buttoning or the feel of some clothing texture (13). Abnormal sensory-motor responses of tactile and auditory processing are the main cause of decrease independency levels and poor performance in the activity of daily living (14).

Children may have difficulty playing with peers due to a lack of engagement in sensory and motor play (6). This type of play is believed to promote the development of cognitive and social skills. When the child has been isolated socially from their peers, this may prevent the development of social relationships, which is essential for early social development (15). Moreover, some children may not cope well with daily routine demands in their home environment due to fear, anxiety, and discomfort that they experience (5).

The child may show significant distress in school engagement as the school environments contain physical and social demands that challenge the child's tolerance (16). Some children with sensory processing issues may experience difficulty tolerating environmental demands long before they enter school. This issue becomes more obvious once they enter a daycare or school environment (17). This sensory processing may remain into adulthood and appear to have a significant problem related to emotion and social difficulties (18).

Moreover, research has shown that sensory processing issues may affect the child's learning ability (7). This is due to the child's failure to be aware of crucial sensory input in their environment. Some may be overly sensitive toward the stimuli and withdraw from active participation in purposeful activities. The dysfunctional sensory processing makes it difficult for the child to learn in the school environment as the child may overlook important information needed to function well in school.

There is no published evidence on sensory processing issues and occupational engagement among children with ASD in Malaysia. Hence, this study aimed to identify impaired sensory processing and occupational engagement, the relationship with demographic profile and the relationship between impaired sensory processing and occupational engagement among children with ASD. This study also aimed to extend the result of the previous study by Brown et al. (19) with a large sample size in obtaining the result of the impact of sensory processing issues on occupational engagement.

## **Materials and Methods**

### **Design, procedure and the study sample**

This study focused on the children who received an early intervention at an autism centre in Sentul. The targeted samples were determined following the formula for accuracy of sample size as suggested by Krejcie & Morgan (20). A total of  $n = 169$  participants were recruited for the study. All samples for this study were clinically diagnosed by the paediatrician. The samples' aged range between 3 to 6 years old as, at this age, they are still developing their skills in daily life and early intervention is crucial. Occupational engagement is always conditional on environmental support, which includes physical and social dimensions (21). Thus, the samples recruited in this study received the same intervention program, used similar facilities and attended sessions weekly.

### **Measures**

The instruments used for this research are the School Companion Sensory Profile (22) and the Short Child Occupational Profile (SCOPE) (23). The Sensory Profile is the most used assessment to measure the sensory system in ASD cases. The School Companion Sensory Profile measures children from age three years old to 11 years old and the assessment requires teachers to use a 5-point Likert scale to assess a 62-item questionnaire regarding the child's responses to common sensory experiences in the school context (24). The reliability of the School Companion Sensory Profile has been described as adequate, with the correlations ranging from 0.83 to 0.95 (25). The test-retest reliability coefficients were 0.80 to 0.95, indicating good to excellent stability of scores from one teacher who assesses the child to another teacher assessing the same child. Thus, this indicates a suitable assessment for identifying sensory processing issues among children with ASD.

The Short Child Occupational Profile (SCOPE) is an assessment derived from the Model of Human Occupation (MOHO) (26). The SCOPE is also one of the occupation-focused and client-centred assessments (21). The use of client-centred and family-centred among pediatric therapists shows that the motivation and life circumstances are unique to every child and their family (27, 28). The SCOPE is used to measure children and youth from age 2 years old to 21 years old. Psychometric testing has been conducted on the SCOPE, indicating that SCOPE version 2.0 can provide valid interpretation in analysing pediatric clients' occupational participation and determining whether environmental factors influence participation (21). The client separation was 3.07, with a separation reliability of 0.90, indicating that the SCOPE domains of occupational participation reliably separated samples. Whereas the therapist's rater separation was 1.34 with a separation reliability of 0.64, indicating a significantly different level of severity or leniency during rating the samples using SCOPE (21).

### Procedures

The data was obtained by recruiting children in an intervention centre for ASD children located in Kuala Lumpur. The consent form was given in writing to the children's caregivers to obtain an agreement to participate in the study. The teachers and occupational therapists who work in the centre administered the research tools. A total of 12 therapists and eight teachers participated in this research as an assessor. The assessors were given a set of the School Companion Sensory Profile and SCOPE and were required to evaluate the children accordingly. The School Companion Sensory Profile is a commonly used assessment in the centre; thus, the assessors are familiar with the assessment. However, SCOPE is a new assessment in the centre, and training on administering the assessment was conducted one week before the data collection.

### Data analysis

The data were analysed using Statistical Package for the Social Sciences, SPSS software, version 23. The variables from demographic profiles obtained, such as gender, age, frequency, and duration of contact, were analysed descriptively. The result for numerical variables of study measure for the School Companion Sensory Profile and the SCOPE were described using mean value and standard deviation.

The normality testing was conducted using the Shapiro-Wilk statistic. A significant value, where ( $p$ ) was less than 0.05, indicates the distribution is not normal. Thus, the non-parametric test was conducted. While the relationship between sensory processing and occupational engagement was identified using Spearman's correlation.

### Results and Discussion

169 children participated in this study, with the majority or 57.4%, aged 5 years old. The majority, or 82.8% of them, are male. Most children, or 74.6%, come to the centre once a week, and the majority or 56.2% of them, receive intervention for 6 months. Table 1 shows the demographic data of participants.

**Table 1:** Demographic data of participants ( $n = 169$ )

Variables	$n$ (%)
<b>Child Gender</b>	
Male	140 (82.8)
Female	29 (17.2)
<b>Child age</b>	
3 years old	1 (.6)
4 years old	32 (18.9)
5 years old	97 (57.4)
6 years old	39 (23.1)
<b>Race</b>	
Malay	147 (87.0)
Chinese	13 (7.7)
India	5 (3.0)
Others	4 (2.4)

**Table 1:** Demographic data of participants ( $n = 169$ ) (continued)

Variables	$n$ (%)
<b>Frequency of Contact (day in a week)</b>	
1	126 (74.6)
2	38 (22.5)
3	3 (1.8)
4	2 (1.2)
<b>Duration of Contact (month)</b>	
2	44 (26.0)
4	9 (5.4)
6	95 (56.2)
8	19 (11.3)
10	0 (0)
12	2 (1.2)

### Impaired components in sensory processing and occupational engagement among children with ASD

Table 2 shows the distributions of scores in the School Companion Sensory Profile. The result of this study indicates that the most impaired sensory quadrant is the "avoiding" component (72.2%), which this component implies the degree to which the child is bothered by sensory input (24). For example, the child appears to hold hands over his ears to filter sound from the surrounding. Apart from that, most children also were observed to be a picky eater and avoid certain textures like clothing, light touch, and deep pressure. However, the result of this study contradicted the past studies as these authors identified that children with ASD appear to have significant difficulties in "seeking" sensory patterns (29, 30). The "seeking" pattern is when the child receives sensory input and enjoys it, i.e. the child craves certain foods, textures, smells or actively moves around. There were a considerable variety of atypical sensory responses among children with ASD (29). It is not possible to generalise about atypical sensory responses yet. The high frequency of these sensory pattern difficulties indicated that they should not be overlooked. Even though this finding reflects that sensory processing issues experienced by children are diverse, it may be helpful for an occupational therapist to measure ASD children intensively and holistically in measuring sensory impairment.

The current study shows that atypical sensory responses range from 50.3% to 70.2%, affecting various sensory patterns in the "quadrant", "school factor", and "section" in School Companion Sensory Profile. The finding was closer to the range reported in a review where the authors estimated the range of atypical responses in ASD children is between 30% to 100% suggesting the abnormality is identified at a young age of life (31). A previous study stated that 88.6% of children showed sensory processing difficulties (30) and demonstrated a very high percentage of atypical responses within quadrants, factors, and sections in the sensory Profile in the study (29). These findings hypothesised that children at preschool age demonstrate

more atypical sensory responses than typically developing children of the same age. Thus, these findings might be helpful in screening processes as an early prediction where sensory abnormality can be identified at a young age.

**Table 2:** Distribution of score in school companion sensory profile (*n* = 169)

Section	n (%)			Mean (SD)
	Performance Less Than Others	Typical Performance	Performance More Than Others	
<b>Quadrant</b>				
Registration	0 (.0)	61 (36.1)	108 (63.9)	1.64 (0.48)
Seeking	0 (.0)	94 (55.6)	75 (44.4)	1.44 (0.49)
Sensitivity	3 (1.8)	80 (47.3)	86 (50.9)	1.49 (0.54)
Avoiding	0 (.0)	47 (27.8)	122 (72.2)	1.72 (0.45)
<b>School Factor</b>				
School Factor 1	0 (.0)	58 (34.3)	111 (65.7)	1.66 (0.48)
School Factor 2	1 (.6)	128 (75.7)	40 (23.7)	1.23 (0.44)
School Factor 3	0 (.0)	50 (29.6)	119 (70.4)	1.70 (0.46)
School Factor 4	0 (.0)	60 (35.5)	109 (64.5)	1.64 (0.48)
<b>Section Raw Score</b>				
Auditory	7 (4.1)	51 (30.2)	111 (65.7)	1.62 (0.57)
Visual	12 (7.1)	72 (42.6)	85 (50.3)	1.43 (0.62)
Movement	0 (.0)	54 (32.0)	115 (68.0)	1.68 (0.47)
Touch	0 (.0)	50 (29.6)	119 (70.4)	1.70 (0.46)
Behavior	2 (1.2)	62 (36.7)	105 (62.1)	1.61 (0.51)

This study also identifies the most impaired occupational engagement among children with ASD using the SCOPE, as in Table 3. This study identified that “communication and interaction skills” are the most impaired component among children with ASD, where all components showed significant occupational impairment in the category of “non-verbal communication”, “conversation”, and “relationships”, with 36.7%, 35.5% and 37.3% respectively. This finding

was similar to a previous study where most children with ASD experience the most difficulties in the same domain (30). Analysis of the “communication and interaction skills” section in SCOPE indicates that many children showed some challenges in “non-verbal communication”, “conversation”, and “relationship” (30). These children exhibit minimal use of non-verbal communication during interaction which they may have trouble maintaining eye contact, rarely gives hugs, and display anger inappropriately (23). The children also may abruptly leave a conversation before it is over and consistently refuses to share toys with other friends during play. In another study, it is estimated that 30% of children with ASD remain minimally verbal (32). Some ASD children fail to acquire spoken language despite receiving intervention from an early age (33). These findings have shown that ASD children appear to have significant challenges in the area of communication, suggesting a holistic assessment and intervention in the area. The summary of the distribution score of SCOPE is illustrated in Table 3.

***The relationship between sensory processing issues and occupational engagement among children with ASD***

Table 4 shows the relationship between sensory processing issues and occupational engagement among children with ASD. Results indicated that there was a significant association between “quadrant” and “school factor” with volition, habituation, communication and interaction skills, process skills, motor skills, and environment. The correlation coefficients range from (*r* = -0.20) to (*r* = -0.36) indicating fair to moderate correlation between variables. The negative correlation indicates that one variable gets more prominent, and the other gets smaller. Thus, if sensory processing issues increase, the level of occupational engagement will be decreased.

The study’s finding suggests that the children’s sensory responses and engagement toward activities are interrelated. The child’s “volition”, in general, is used to explain the child’s motivation toward the occupation. Atypical sensory experiences, however, may impact child motivation at some point. Reduced motivation will reduce the number of life experiences (34) and affects child performance (30). Children’s responses to sensory stimuli can significantly impact their successful participation in daily life activities (19). Children with poor participation in sensory and motor play may have a reduced ability to play successfully with friends (6). A sensory impairment that causes children to fear, anxiety, or discomfort can influence engagement in daily routines (35). This also can impact engagement in school activities as school environments may contain physical and social stimuli that cause distress to children with ASD (16).

The “habituation” concept refers to the recurring patterns of occupation in daily life. These occupations can be referred to as activities of daily living that the child engages in all day. Some children with ASD have difficulty mastering self-care

**Table 3:** Distribution of score in short child occupational profile ( $n = 169$ )

Section	n (%)				Mean (SD)
	Restricts	Inhibits	Allows	Facilitate	
<b>Volition</b>					10.20 (3.17)
Exploration	16 (9.5)	68 (40.2)	58 (34.3)	27 (16.0)	
Expression of Enjoyment	15 (8.9)	67 (39.6)	60 (35.5)	27 (16.0)	
Preferences & Choices	28 (16.6)	48 (28.4)	60 (35.5)	33 (19.5)	
Response to Challenge	25 (14.8)	62 (36.7)	61 (36.1)	21 (12.4)	
<b>Habituation</b>					9.63 (3.22)
Daily Activities	32 (18.9)	55 (32.5)	63 (37.3)	19 (11.2)	
Response to Transition	29 (17.2)	62 (38.2)	63 (37.3)	15 (8.9)	
Routine	24 (14.2)	49 (29.0)	78 (46.2)	18 (10.7)	
Roles	36 (21.3)	59 (34.9)	60 (35.5)	14 (8.3)	
<b>Communication &amp; Interaction Skills</b>					9.03 (2.93)
Non-Verbal Communication	35 (20.7)	62 (36.7)	53 (31.4)	19 (11.2)	
Verbal/ Vocal expression	45 (26.6)	47 (27.8)	60 (35.5)	17 (10.1)	
Conversation	48 (28.4)	60 (35.5)	51 (30.2)	10 (5.9)	
Relationships	35 (20.7)	63 (37.3)	61 (36.1)	10 (5.9)	
<b>Process Skills</b>					9.31 (3.00)
Understand & Uses Objects	27 (16.0)	68 (40.2)	64 (37.9)	10 (5.9)	
Orientation to Environment	24 (14.2)	64 (37.9)	69 (40.8)	12 (7.1)	
Plan & Make Decisions	36 (21.3)	56 (33.1)	69 (40.8)	8 (4.7)	
Problem-Solving	36 (21.3)	55 (32.5)	73 (43.2)	5 (3.0)	
<b>Motor Skills</b>					11.75 (2.82)
Posture & Mobility	8 (4.7)	31 (18.3)	88 (52.1)	42 (24.9)	
Coordination	9 (5.3)	31 (18.3)	86 (50.9)	43 (25.4)	
Strength	8 (4.7)	35 (20.7)	81 (47.9)	45 (26.6)	
Energy/ Endurance	9 (5.3)	40 (23.7)	88 (52.1)	32 (18.9)	
<b>Environments</b>					14.02 (3.85)
Physical Space	9 (5.3)	46 (27.2)	62 (36.7)	52 (30.8)	
Physical Recourses	13 (7.7)	43 (25.4)	77 (45.6)	36 (21.3)	
Social Groups	11 (6.5)	57 (33.7)	57 (33.7)	44 (26.0)	
Occupational Demands	10 (5.9)	50 (29.6)	77 (45.6)	32 (18.9)	
Family Routine	12 (7.1)	52 (30.8)	76 (45.0)	29 (17.2)	

skills such as bathing, dressing, eating, and toileting (29). Atypical sensory responses may interfere with children's independence level of self-care skills (36). These studies are also associated with the result finding from this research, where most children have difficulties in "understanding and using objects" in the "process skills" section in SCOPE. The child may experience some difficulties using a spoon during feeding. Besides, occupational engagement in daily life requires sensory interaction; thus, hyperactivity, such as sensory sensitivity or avoidance, will interfere with occupational engagement in daily life (29).

The "communication and interaction skills" concept in SCOPE refers to how children convey intentions and needs

and interact with others. This may affect child abilities if they experience atypical sensory responses. Past studies have reported the relationship between sensory patterns and the emotional, social, and behavioural performance of children with ASD (37). Smith & Miller-Kuhaneck (38) explained that children with sensory processing issues also might be sensitive and respond negatively toward the auditory stimulus. Some of them may withdraw from functional activities. For example, the child may withdraw from social engagement as they do not enjoy playtime at the playground due to sensory sensitivity to movement. Besides, the child also may not respond when someone calls their name due to hyporesponsive to registration or auditory.

“Motor skills” refer to how children move their bodies or object when performing a specific task or occupation. Literature suggests that children with ASD appear to have some motor problems, where some children have difficulties with motor coordination (39), motor delay (40), motor planning (41), and imitation of body movement (42). These findings are associated with the study result as children demonstrate some difficulties in motor function.

The “environment” influences occupational engagement, where the opportunities and resources within the environment meet the children’s demands. For example, when the child loses self-control or throws a tantrum in class, where the class is a sensory-rich environment,

the child might easily control their emotion as they get distracted by other sensory stimuli. However, the child’s response might differ in a different context, such as at home or in public places. The previous study by Brown and Dunn (43) found a correlation between sensory responses at school and home on two variables of School Companion, which are “avoiding” and “seeking” identified a moderate correlation (respectively  $r = 0.59$  and  $r = 0.45$ ), suggesting that child response toward sensory experiences might be similar at home and school, however, some sensory response might differ. For example, if the child sings aloud at home, the parents might consider such behaviour acceptable. Still, the same behaviour might be considered disruptive when it happens at school.

**Table 4:** Correlation coefficient ( $r$ ) of Short Child Occupational Performance (SCOPE) and “Quadrant”, “School Factor”, and “Section Raw Score”

SCOPE Domain	School Companion Sensory Profile rating						
	Variable	Quadrant			School Factor		
		Median (IQR)	$r$	$p$ -value	Median (IQR)	$r$	$p$ -value
Volition	10.0 (5)	-0.25	0.00	10.0 (5)	-0.27	0.00	
Habituation	10.0 (4)	-0.35	0.00	10.0 (4)	-0.37	0.00	
Communication and Interaction Skills	9.0 (5)	-0.31	0.00	9.0 (5)	-0.32	0.00	
Process Skills	9.0 (5)	-0.35	0.00	9.0 (5)	-0.36	0.00	
Motor Skills	12.0 (4)	-0.21	0.00	12.0 (4)	-0.20	0.00	
Environment	14.0 (6)	-0.29	0.00	14.0 (6)	-0.35	0.00	

**Conclusion**

The research finding indicated that children with ASD appear to experience some sensory processing issues. These sensory processing issues significantly impact children’s life, which can be seen through engagement in daily life activities. The severe sensory processing issues indicate a minor occupational engagement of the children. This study illustrated that sensory responses significantly impact children engaged in activities. Even the impact of sensory processing issues and activity engagement in terms of demographic data such as age, gender, frequency, and duration of the intervention is minimal, yet, the finding is sufficient in intervention planning. In addition, having information on sensory processing issues and occupational engagement provides an opportunity to identify successful intervention strategies. Therefore, the service provider in early intervention plays the most significant role in delivering a holistic intervention that meets the children’s needs. The study findings also suggest that occupational therapists play an essential role in the rehabilitation process of evaluating ASD children at preschool age, where most children in this study presented with some impairment in sensory processing and their engagement in occupation. The occupational therapist needs to include a comprehensive evaluation focusing on children’s sensory

processing characteristics and a consideration of how these characteristics might influence occupational engagement. Thus, possible occupation and environment adjustments can be made.

**Competing Interest**

The authors declare that they have no competing interests.

**Ethical clearance**

Ethical approval was obtained from Research Ethics Committee, Universiti Teknologi MARA (Reference: 600-IRMI (5/1/6) and Genius Kurnia, Ministry of Education Malaysia (Reference: KURNIA 500-2/6/1 (21)

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