Title: Sensory processing and its relationship with children's daily life participation

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Sensory processing and its relationship with children's daily life participation

ABSTRACT

Aims: To investigate whether children with impairments in sensory processing (SP) had participation restrictions, and the relationship between Short Sensory Profile (SSP) scores and children's participation. **Methods:** The participants were parents of 64 children (mean age 8 years 1 month); 36 with potential impairments in regulating sensory input and filtering out unnecessary stimuli (29 boys, 7 girls) and 28 with typical SP abilities (25 boys, 3 girls). Parents' completed the SSP and Participation in Childhood Occupations Questionnaire (PICO-Q). The SSP score was used to categorize children as potential SP impairment group and typical SP ability group. **Results:** Children categorized as having potential SP impairments exhibited significantly lower participation levels and enjoyment than children categorized as having typical SP abilities. However, participation frequency between both groups was similar. Six out of the seven impairment types had small to moderate correlations with children's participation (Pearson's r coefficients=0.25−0.48, p<0.05). Multiple regression analyses indicated that only three impairment types (Underresponsive/Seeks Sensation, Low Energy/Weak, and Visual/Auditory Sensitivity) were significant predictors of PICO-Q participation domains. **Conclusions:** The results suggest that children with potential SP impairments have restrictions in the degree of participation and enjoyment. Three SP impairments types are related to specific participation domains, but they explain a small amount of variance or none in some participation domains. Other variables should be considered to identify determinants of children's participation.

KEYWORDS: Sensory processing, participation, children, occupational therapy, sensory profile.

Participation in everyday life offers children numerous opportunities to develop physical, cognitive and communication skills, to form social relationships, and to establish adaptive behaviours (Klaas, Kelly, Gorzkowski, Homko, & Vogel, 2009; Law et al., 2004). Facilitating children's participation has become a clinically important goal and outcome for healthcare and rehabilitation (King et al., 2003). Participation is defined as an individual's involvement in life situations in the International Classification and Functioning, Disability and Health (ICF) (World Health Organization, 2001). In the ICF, participation is conceptualized to be influenced by health conditions, body functions and structures, activities, personal and environmental factors. With the ICF framework, a range of potential factors impacting children's participation has been specified in several conceptual models (King et al., 2003; Palisano et al., 2011) and literature reviews (Bult, Verschuren, Jongmans, Lindeman, & Ketelaar, 2011; Majnemer et al., 2008) and include child factors (e.g., motor skills, adaptive behaviours, social-emotional function, or mastery motivation), family factors (e.g., activity orientation or family structure/relationship), and environmental factors (e.g., rehabilitation services, school setting/type/size, or policies).

Sensory processing (SP), a body function, has been hypothesized to influence children's adaptive behaviours, which in turn may interfere with their participation in life situations (Dunn, 2007; Parham & Mailloux, 2001). SP refers to the registration and modulation of a sensory stimulus and to the conscious experience related to the sensation (Humphry, 2002). It describes the ability to regulate and organize sensory input and filter out unnecessary stimuli and, therefore, is critical for execution of adaptive responses to situational demands (Miller, Anzalone, Lane, Cermak, & Osten, 2007).

Investigators have also described daily life participation of children with SP impairments (Bar-Shalita, Vatine, & Parush, 2008; Bar-Shalita, Yochman, Shapiro-Rihtman, Vatine, & Parush, 2009; Cosbey, Johnston, & Dunn, 2010; Engel-Yeger, 2008; Yochman, Alon-Beery, Sribman, & Parush, 2013); diverse results have been reported. Yochman et al.

(2013) found a significant difference (p<0.05) only in the degree of participation between children with and without SP impairments. In studies by Bar-Shalita et al. (2009) and Cosbey et al. (2010), children with SP impairments exhibited lower participation enjoyment than typically developing peers, but had similar degree or frequency of participation. Bar-Shalita et al. (2008) reported that children's participation profiles (including degree, enjoyment and frequency of participation) were significantly associated with their SP abilities to varying extents (Pearson's r correlations=0.22−0.72, p<0.05) and predicted whether the children had SP impairments (odds ratios=1.73−3.13). More studies are thus needed to compare participation between children with and without SP impairments, and a question not specifically explored is which type(s) of SP impairments are inversely related to children's participation.

The Short Sensory Profile (SSP) (Dunn, 1999) has been used to identify the presence of SP impairments in children. The SSP measures children's SP through caregivers' or parents' report on frequency with which maladaptive behaviours in relation to sensory stimuli occur. Development of the SSP was informed by Dunn's Model of Sensory Processing (Dunn, 1999, 2007), in which maladaptive reactions to sensory stimuli are classified into four patterns based on neurological threshold (e.g., low versus high) and behavioural responses (e.g., passive versus active). Children with a low neurological threshold are assumed to be over-sensitive to sensation and, therefore, either exhibit actively defensive behaviours such as hands over ears when faced with unpleasant stimuli (Sensory Sensitive), or tend to withdraw from noxious sensations quickly (Sensory Avoiding). Conversely, children with a high neurological threshold may fail to notice usual sensation, resulting in passive, apathetic, or delayed responses (Low Registration) or seek unusual amounts/types of sensory experience actively in order to maintain their optimal levels of arousal (Sensory Seeking). These patterns are applied to the SSP to form seven sections that are indicative of different types of SP impairments. Bar-Shalita et al. (2008, 2009) found small to high correlations between SSP

total scores and frequency (r=0.22), enjoyment (r=0.42), and level (r=0.72) of participation. Small to moderate correlations were found between SSP section scores and children's activity preference (Engel-Yeger, 2008; Engel-Yeger, Shani-Adir, & Kessel, 2011) and school functions (r=0.37−0.62) (Ashburner, Ziviani, & Rodger, 2008). However, there is a gap in knowledge of which types of SP impairments are related to children's participation.

The purpose of this study was to investigate whether specific types of SP impairments had stronger relationships with children's participation. Considering previous findings related to activity preference and school functions (Ashburner et al., 2008; Engel-Yeger, 2008; Engel-Yeger et al., 2011), we hypothesized that four types of SP impairments (e.g., movement sensitivity, underresponsive/seek sensation, auditory filtering, and auditory/visual sensitivity) are correlated small or moderately with children's participation such that higher impairment scores are associated with lower participation. We also anticipated that these four SP types would explain a small or moderate amount of variance in participation, given the multi-factorial nature of participation (Majnemer et al., 2008; Palisano et al., 2011). In addition, this study aimed to ascertain whether children with SP impairments had limited participation in daily life situations, compared to children without SP impairments.

METHODS

Participants

Children who attended a university-based paediatric occupational therapy clinic in Brisbane, Australia and their parents were invited to participate in this study as a convenience sample. The clinic provides occupational therapy assessments and individual/group therapy sessions to children aged 2−18 years, who may not have specific diagnoses but present with difficulties in daily life participation. Reasons for referral to the clinic included difficulty: a) engaging in academic tasks at school, b) participating in social situations, and c) managing self-care tasks. Children were selected for inclusion in this study if: a) they experienced

participation restrictions or life skill difficulties based on therapists' initial interview with child's parents and/or evaluation, b) did not have a specific disability/diagnosis, and c) their parents had a basic understanding of English in order to complete the questionnaires. This study obtained ethical approval from the Behavioural and Social Sciences Ethical Review Committee at University of Queensland. Parents willing to participate in the study provided informed written consent on behalf of their children.

A total of 72 children without known disabilities/diagnoses and their parents participated in the study, and 64 of them completed all the questionnaires. These children included 54 boys and 10 girls, consistent with the gender split of clinics' referrals in the previous studies (Bar-Shalita et al., 2008; Cosbey et al., 2010). Their mean age was 8 years 1 month, ranging from 3 years 11 months to 14 years 1 month. Based on the SSP total scores with cut-off values (detailed later), 28 (43.8%) children were classified as having typical SP performance, 14 (21.9%) as probable difference in SP, and 22 (34.4%) as having a definite difference in SP, compared to an established norm (Dunn, 1999).

Children were further categorized into two groups (potential SP impairment group and typical SP ability group). That is, 28 children (25 boys and 3 girls) whose SSP scores indicated typical SP performance comprised the typical SP ability group, whereas 36 children (29 boys and 7 girls) whose SSP scores indicated probable or definite difference in SP comprised the potential SP impairment group. By comparison using *chi*-square or *t*-test, there were no significant differences in gender ($p=0.34$) and age ($p=0.23$) between these two groups. It is also noted that the majority (85.7%) of the 28 children, although being classified in the typical SP ability group based on total scores, exhibited probable/definite SP issues in one or more SSP sections.

According to the power analysis performed by Bar-Shalita et al. (2008), a minimum of 24 children in each group is required to detect a difference of 12 points for a participation measure (within a 5% level of significance and 80% power). Thus, the sample was

adequately powered for subsequent *t*-tests. In addition, we performed a power analysis for multiple regression analyses using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009). Based on Bar-Shalita et al.'s study (2008), the SSP total scores were correlated with children's participation level (r=0.72), enjoyment (r=0.42), and frequency (r=0.22). Assuming the same power conditions and the inclusion of the seven SSP sections, 22−290 participants were required to obtain a significant multiple regression model, depending on which participation variable was the focus. The sample of 64 participants in this study achieved the minimum but not the maximum requirement.

Measures

Short Sensory Profile (SSP)

The SSP (Dunn, 1999), an abbreviated version of the Sensory Profile, is a parent- or caregiver-report questionnaire designed to measure children's SP in daily life and to screen for those with SP impairments. It is comprised of 38 items, derived from the 125 items in the full version that presented with the highest discrimination for atypical SP patterns. These 38 items are divided into seven sections including: *Tactile Sensitivity* (e.g., touch experiences, seven items), *Taste/Smell Sensitivity* (e.g., taste and smell experiences, four items), *Movement Sensitivity* (e.g., movement experiences, three items), *Underresponsive/Seeks Sensation* (e.g., level of noticing sensory events, seven items), *Auditory Filtering* (e.g., ability to use and screen out sounds, six items), *Low Energy/Weak* (e.g., ability to use muscles to move, six items), and *Visual/Auditory Sensitivity* (e.g., response to sounds and sights, five items). Each item is scored on a five-point Likert scale (1=always, 2=frequently, 3=occasionally, 4=seldom, and 5=never) to rate how often a child demonstrates particular sensory-related behaviours. Because the SSP items are negatively worded, lower scores indicate more atypical SP patterns (Dunn, 1999).

In each of the seven sections, the total score is the sum of scores for all items. The section total scores have been used to indicate different types of SP impairments (Ashburner

et al., 2008; Engel-Yeger, 2008; Engel-Yeger et al., 2011; Rogers, Hepburn, & Wehner, 2003). According to the SSP manual (Dunn, 1999), the total scores for each of the seven sections can be summed to indicate a SSP total score. The SSP total score provides an indication and classification of a child's SP ability as *typical performance* (scores=155−190), *probable difference* (scores=142−154), and *definite difference* (scores=38−141). These classifications were derived from norms established in the United States (Dunn, 1999). Children classified probable or definite difference are considered as having potential SP impairments in regulating sensory input for execution of adaptive behaviours (Dunn, 1999). Such threefold classification is also available for each section.

Internal consistency of the SSP sections were found as acceptable (Cronbach's α coefficients=0.69−0.93) (Dunn, 1999). As for internal validity, intercorrelations between SSP total and section scores varied from 0.25 to 0.76 (p<0.01) (Dunn, 1999). The factor structures underlying the SSP have been confirmed (Dunn, 1999; Engel-Yeger, 2010). Several studies demonstrated good discriminant validity of the SSP sections in identifying children with and without SP impairments (Bar-Shalita et al., 2008; Dunn, 1999; Engel-Yeger, 2008; Engel-Yeger et al., 2011).

Participation in Childhood Occupations Questionnaire (PICO-Q)

The PICO-Q (Bar-Shalita et al., 2009) is a parent-report questionnaire that measures children's participation in daily occupations and routines at home, at school, and in the community. It comprises of 22 items that can be divided into four participation domains including: Daily Care (e.g., eating meals or washing, eight items), Academic Activities (e.g., doing homework or following school regulations, six items), Play and Leisure (e.g., attending extra-curricular activities or parties, six items), and Habits and Routines (e.g., being flexible during transitions or routine changes, two items). All items are rated on three dimensions: a) participation level (i.e., children's degree of participation in the activities), b) degree of enjoyment, and c) frequency of participation. The first two dimensions are measured on a

seven-point Likert scale (ranging from low to high), while the third dimension is measured on a four-point scale (1=less than once a month, 2=once a month, 3=once a week, and 4=everyday). For each dimension, total scores are calculated by summing item scores for the four domains. Bar-Shalita et al. (2009) recommends calculating the dimension score for each of the four participation domains. The dimension score for a domain provides a more in-depth indication of children's participation in each specific life area.

Bar-Shalita et al. (2009) has reported that the PICO-Q exhibited good internal consistency of items (α=0.86−0.89) for each dimension of participation (level, enjoyment, and frequency). Acceptable test-retest reliability for the three dimension scales (r=0.69−0.86, $p\leq$0.01) was also found. Furthermore, the content validity of the PICO-Q has been established based on the review of theoretical and clinical literature, interviews with two mothers, and expert examinations (Bar-Shalita et al., 2009). Discriminant validity was evident in the comparison between children with and without SP impairments, where significant group differences were found in some or all dimensions of participation across the four PICO-Q domains (Bar-Shalita et al., 2008; Bar-Shalita et al., 2009).

Procedure

The parents of each child referred for assessment/intervention between 2010 and 2011 were sent an invitation explaining the research purpose and procedure, with a consent form, prior to the child's occupational therapy appointment. The PICO-Q was included in the mail out. The completed consent form and PICO-Q (if the parents consented to research participation) were returned upon arrival to the assessment appointment. During the appointment, the parent was asked to complete the SSP. In addition, medical and demographic information about the child and the parent was obtained through the assessment interview and referral notes.

Data Analysis

Analyses were performed with the Statistical Package for Social Sciences (SPSS) Version 21.0, using a 0.05 level of significance for all statistical tests. To compare mean PICO-Q

scores of children with potential SP impairments and children with typical SP abilities, independent *t*-tests were computed. To investigate relationships between the SSP section scores and PICO-Q domain scores, Pearson's *r* correlations and multiple regression analyses were used. Multiple regression analyses were used to explore which types of SP impairments explained the most variance for each dimension of participation within each of the four participation domains (Daily Care, Academic Activities, Play and Leisure, and Habits and Routines). In each multiple regression model, the seven SSP section scores (i.e., the types of SP impairments) were the independent variables, while the dimension score of the PICO-Q domain was the dependent variable (total of 12 multiple regression analyses). Due to four multiple regression analyses being undertaken for each participation dimension, Bonferroni corrections (Bland & Altman, 1995) were applied to adjust *p* values to 0.0125 (0.05/4) for identification of significant regression models.

RESULTS

Mean scores on the PICO-Q of children with potential SP impairments and typical SP abilities are presented in Table 1. Children with potential SP impairments had significantly lower participation levels (for the total scale and all domains) and enjoyment (for the total scale and all but not Daily Care domain) than children with typical SP abilities. There was no significant difference in participation frequency for any domains or total scale score between the two groups.

Insert Table 1 about here

Table 2 presents the correlations between the children's types of SP impairments and PICO-Q domain scores. Most types of SP impairments had small to moderate correlations with one or more PICO-Q domains. These included the four types (i.e., Movement Sensitivity,

Underresponsive/Seeks Sensation, Low Energy/Weak, and Visual/Auditory Sensitivity) that were hypothesized to be positively correlated with children's participation. Taste/Smell Sensitivity scores were not correlated with any PICO-Q scores and, therefore, this type of SP impairment was not considered as an independent variable in subsequent multiple regression analyses.

Insert Table 2 about here

Twelve multiple regression analyses were performed to explore whether SP impairment scores were predictive of participation dimension (level, enjoyment, and frequency) scores for each of the four participation domains (Daily Care, Academic Activities, Play and Leisure, and Habits and Routines). Tables 3−5 report the results of these regression analyses, and the main findings are summarized.

For the level of participation dimension, SP impairment scores explained 18.8% of the variance in Daily Care domain scores ($F_{6,57}$=3.42, p=0.006) (Table 3). The amount of explained variance was considered of small magnitude. Underresponsive/Seeks Sensation (β=0.54) was identified as the only significant predictor for the Daily Care domain.

Insert Table 3 about here

For the participation enjoyment dimension, SP impairments scores explained 17.6% of the variance in Play and Leisure domain scores ($F_{6,57}$=3.25, p=0.008) and 23.8% of the variance in Habits and Routines domain scores ($F_{6,57}$=4.27, p=0.001) (Table 4). The magnitude of explained variance was small. Low Energy/Weak (β=0.36) was the only significant predictor for the Play and Leisure domain; no predictor was identified for the Habits and Routines domain.

Insert Table 4 about here

For the participation frequency dimension, SP impairment scores explained 17.9% of the variance in Academic Activities domain scores ($F_{6,57}$=3.29, p=0.008) which was of a small magnitude (Table 5). Underresponsive/Seeks Sensation (β=-0.44) and Visual/Auditory Sensitivity (β=0.43) were two significant predictors for this domain. Movement Sensitivity was not a significant predictor in any of the regression models.

Insert Table 5 about here

DISCUSSION

Children with probable or definite SP impairments had significantly lower participation levels and enjoyment of participation than children with typical SP abilities. This finding is consistent with previous studies (Bar-Shalita et al., 2008; Bar-Shalita et al., 2009; Baranek et al., 2002; Reynolds, Bendixen, Lawrence, & Lane, 2011). All but one type (Taste/Smell Sensitivity) of SP impairment had a small to moderate correlation with children's participation scores. Furthermore, three SP types (Underresponsive/Seeks Sensation, Low Energy/Weak, and Visual/Auditory Sensitivity) explained a small magnitude of variance in specific participation domains/dimensions. Underresponsive/Seeks Sensation scores were a significant predictor of level of participation dimension scores for the Daily Care domain; Low Energy/Weak scores were a significant predictor of enjoyment dimension scores for the Play and Leisure domain; and Underresponsive/Seeks Sensation and Visual/Auditory Sensitivity scores predicted frequency dimension scores for the Academic Activities domain. Except for Movement Sensitivity, the results generally support our hypotheses on the types of

SP impairments relating with children's participation and the magnitude of explained variance.

In contrast to the findings by Bar-Shalita et al. (2008) and Hilton et al. (2008), in our study, children with probable or definite SP impairments did not differ in frequency of participation compared with children with typical SP abilities. We used the same participation measure (i.e., the PICO-Q) as Bar-Shalita et al. (2008). This difference may be attributable to dissimilar participant characteristics among the studies. For instance, our study recruited children who were referred to the clinic due to specific participation issues. They were classified as having either typical SP ability or potential SP impairment group (which included children with probable or definite difference in SP). Conversely Bar-Shalita et al.'s study (2008) included children with typical development and children whose SSP scores were classified as 'definite' difference in SP. Furthermore, the PICO-Q includes items representing typical, everyday activities (e.g., showering or organizing school objects); thus, frequency of engagement may not be affected in children whose SSP scores were classified as having 'probable' differences in SP.

To date there has been little known about which types of SP impairments have stronger relationship with children's participation. We found that Taste/Smell Sensitivity scores did not correlate significantly to any participation domain scores in the combination sample of children with and without potential SP impairments. It could be assumed that this type of SP impairment is most likely to affect children's eating or nutrition selection, which relates to only a sub-area of self-care. Contrarily it is out of our expectation that Movement Sensitivity scores were not a predictor of any participation domain scores, although this SP type correlated with children's participation level and enjoyment for the Play and Leisure domain. Children with sensitivity in movements may feel insecure and uncomfortable when engaging in activities that include unpredictable movements (e.g., roughhousing) or require both feet leave the ground (e.g., standing on a balance beam) (Dunn, 1997, 2007). It is noted

that activities involving such kind of movements are not common in children's everyday lives. This may explain that Movement Sensitivity had a less impact on children's participation than other SP impairment types.

Low Energy/Weak scores were the only significant predictor, small and positively relating with children's participation enjoyment scores of play/leisure activities. This implies that children with higher energy have more enjoyment of play/leisure activities (Dunn, 1997, 2007). A possible explanation is that having appropriate energy levels, alertness and endurance may enable children engaging in play/leisure activities for a longer time to develop a greater sense of enjoyment. However, this SP type explained only small amount of variance in children's participation enjoyment. This suggests that other factors such as children's mastery motivation (Majnemer et al., 2008) or environmental supportiveness (Bronson & Bundy, 2001) be taken into account to explain children's enjoymernt during participation in play/leisure activities.

Underresponsive/Seeks Sensation is a sensory modulation issue whereby the child has a high neurological threshold for noticing sensory events, but may respond in two different behavioural ways (passively, resulting in low registration; or actively, resulting in sensory seeking behaviours) (Dunn, 2007). This type of SP impairment was found to be the only one positively small predictor to the degree of children's daily care participation in this study. This is not surprising as children who can, for instance, sit still without seeking movement stimulation or actively react to a notice that their hands or face are messy may have higher levels of engagement in daily care activities (e.g., dressing themselves before school or washing face and hands after a meal). However Underresponsive/Seeks Sensation scores did not explain children's daily care participation scores to a large extent, and simultaneous considerations of other factors such as hand skills (Chien, Brown, McDonald, & Yu, 2014) or prosocial behaviours (Tseng, Chen, Shieh, Lu, & Huang, 2011) is recommended.

Both Underresponsive/Seeks Sensation and Visual/Auditory Sensitivity scores were found to be predictors explaining only a small amount of variance in children's frequency scores of engagement in academic activities, but with different directions of interpretation. As expected, Visual/Auditory Sensitivity had a positive relationship as academic activities usually involve considerable visual and auditory input and children's difficulty processing this input is likely to limit academic participation (Ashburner et al., 2008). However, the negative relationship between Underresponsive/Seeks Sensation scores and participation frequency scores in academic activities is somewhat unexpected (that is, increased sensory seeking or low registration relates to increased frequency of academic activities). From a statistical viewpoint, this may be resulted from a Type I error due to the small sample size or the number of regression analyses being undertaken in the study. From a clinical perspective, we speculated that frequency of engagement in academic activities may be difficult to accurately detect for children with underresponsive behaviours, as these behaviours in the classroom can be misinterpreted as quietly engaging in schoolwork without being disruptive. Furthermore, it is possible that children with mild sensory seeking behaviours engage more readily with academic tasks due to their search for stimulation in their environment.

It is also worth noting that, although Underresponsive/Seeks Sensation and Visual/Auditory Sensitivity scores were significant predictors of children's participation frequency scores in academic activities, they explained only a small amount of variance. This is similar to aforementioned findings in explaining participation enjoyment in play/leisure and degree in daily care. Moreover, no types of SP impairments were identified as significant predictors of Habits and Routines domains. It is therefore suggested that other child factors (e.g., preference or motivation) or environmental factors (e.g., parenting styles) may be more important determinants of Play and Leisure, Academic Activities, and Habits and Routines domains, and their inclusion in future research is warranted.

This study has limitations that must be considered. First, the inclusion of children with and without potential SP impairments from a paediatric clinic means that this study cannot be generalizable to groups of children with SP impairments who have never been referred to clinical services. Second, the sample size of this study is modest. Particularly in the multiple regression analyses, the number of the participants was insufficient for the models of participation enjoyment and frequency and is potential threats to the validity of our findings. The inflation of Type I error rate may also occur due to the number of regression analyses undertaken in this study. Further research should involve a larger sample of children with SP impairments to determine the relationship between SP and participation and whether SP explains a large amount of variance. Third, this study obtained children's SP impairments and participation through parent report and was therefore unable to reflect the insights or actual performance directly from children. It is suggested that child-report participation measures and/or therapist-administered SP tools be used in future research.

CONCLUSIONS

This study provides evidence that participation restrictions are experienced by children who have scores on the SSP indicating a probable or definite SP impairment, particularly in the level of participation and enjoyment. All types of SP impairments except for Taste/Smell Sensitivity had a small to moderate correlation with children's participation. Three SP types (Underresponsive/Seeks Sensation, Low Energy/Weak, and Visual/Auditory Sensitivity) explained a small but significant amount of variance in specific domains/dimensions of the PICO-Q. These findings have potential implications for clinicians, suggesting a need to screen for children with SP impairments and understand different types of SP impairments that children may have. Because SP explains a small amount of variance or none in some participation domains, other variables should be included in multivariate analyses to identify determinants of children's participation.

Declaration of Interest

The authors report no declarations of interest.

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TABLE 1. Between Group Comparison of Participation in Childhood Occupations Questionnaire scores

Participation dimensions	Domains	Potential SP difficulty group† (n=36) Mean	Potential SP difficulty group† (n=36) SD	Typical SP ability group (n=28) Mean	Typical SP ability group (n=28) SD	*t*	p
Level of participation	Total score	108.6	20.5	121.6	16.0	-2.768	0.007*
	Daily Care	41.5	8.5	45.6	6.7	-2.115	0.038*
	Academic Activities	21.3	5.6	24.3	5.6	-2.144	0.036*
	Play and Leisure	36.2	9.0	41.1	4.5	-2.627	0.011*
	Habits and Routines	8.6	3.3	10.6	2.4	-2.741	0.008*
Enjoyment of participation	Total score	106.4	16.3	118.8	16.4	-3.016	0.004*
	Daily Care	39.4	7.4	42.2	7.6	-1.496	0.140
	Academic Activities	20.2	5.3	23.9	6.0	-2.632	0.011*
	Play and Leisure	38.6	7.6	42.4	4.1	-2.380	0.020*
	Habits and Routines	8.2	3.3	10.3	2.3	-2.906	0.005*
Frequency of participation	Total score	68.5	7.2	70.9	5.4	-1.516	0.135
	Daily Care	24.2	2.4	23.8	2.6	-0.561	0.577
	Academic Activities	17.4	3.0	18.4	1.8	-1.630	0.108
	Play and Leisure	20.2	3.6	21.8	2.7	-1.943	0.060
	Habits and Routines	6.6	1.3	6.9	1.1	-0.674	0.503

* $p < 0.05$

† The potential SP difficulty group included children who were classified as probable or definite difference based on classification of Short Sensory Profile total scores.

Abbreviations: SP, sensory processing; SD, standard deviation.

TABLE 2. Pearson's *r* correlations between Short Sensory Profile section scores and Participation in Childhood Occupations Questionnaire domain scores

	Short Sensory Profile						
Participation in Childhood Occupations Questionnaire	Tactile Sensitivity	Taste/Smell Sensitivity	Movement Sensitivity	Underresponsive/ Seeks Sensation	Auditory Filtering	Low Energy/ Weak	Visual/Auditory Sensitivity
Level of participation							
Daily care	0.22	0.24	0.06	0.47*	0.25	0.07	0.09
Academic activities	0.25*	0.10	0.20	0.27*	0.28*	0.42*	0.21
Play and leisure	0.19	0.04	0.26*	0.21	0.28*	0.42*	0.25
Habits and routines	0.41*	0.18	0.16	0.33*	0.40*	0.29*	0.35*
Enjoyment of participation							
Daily care	0.25	0.24	0.12	0.39*	0.19	0.72	0.13
Academic activities	0.22	0.02	0.22	0.18	0.32*	0.34*	0.17
Play and leisure	0.15	-0.11	0.31*	0.17	0.26*	0.48*	0.36*
Habits and routines	0.45*	0.24	0.23	0.40*	0.44*	0.25*	0.39*
Frequency of participation							
Daily care	-0.06	0.02	0.08	0.01	-0.17	0.02	0.07
Academic activities	-0.02	0.04	0.18	-0.14	0.15	0.22	0.30*
Play and leisure	0.20	-0.07	0.22	0.09	0.16	0.31*	0.34*
Habits and routines	0.12	0.14	0.08	0.03	0.12	-0.08	0.10

* $p < 0.05$

TABLE 3. Multiple regression results for the level of participation dimension of the Participation in Childhood Occupations Questionnaire

Level of participation dimension	B	SE B	β	R^2 (adj.)
Daily Care domain				0.188†
Tactile Sensitivity	0.21	0.25	0.12	
Movement Sensitivity	-0.32	0.38	-0.11	
Underresponsive/Seeks Sensation	0.62	0.16	0.54*	
Auditory Filtering	0.03	0.20	0.02	
Low Energy/Weak	0.03	0.19	0.02	
Visual/Auditory Sensitivity	-0.37	0.28	-0.21	
Academic Activities domain				0.132
Tactile Sensitivity	0.11	0.18	0.09	
Movement Sensitivity	-0.11	0.29	-0.05	
Underresponsive/Seeks Sensation	0.15	0.12	0.19	
Auditory Filtering	0.01	0.15	0.01	
Low Energy/Weak	0.38	0.14	0.45	
Visual/Auditory Sensitivity	-0.22	0.21	-0.17	
Play and Leisure domain				0.039
Tactile Sensitivity	-0.22	0.31	-0.11	
Movement Sensitivity	-0.53	0.47	-0.16	
Underresponsive/Seeks Sensation	0.12	0.20	0.09	
Auditory Filtering	<0.01	0.24	<0.01	
Low Energy/Weak	0.42	0.23	0.32	
Visual/Auditory Sensitivity	0.23	0.34	0.11	
Habits and Routines domain				0.156
Tactile Sensitivity	0.16	0.10	0.24	
Movement Sensitivity	<0.01	0.15	<0.01	
Underresponsive/Seeks Sensation	0.05	0.06	0.11	
Auditory Filtering	0.07	0.08	0.15	
Low Energy/Weak	0.01	0.08	0.02	
Visual/Auditory Sensitivity	0.08	0.11	0.11	

† Bonferroni corrections were applied giving a p value of 0.0125 (0.05/4) for identification of significant regression models.

* $p<0.05$

Abbreviations: B, unstandardized coefficient; SE B, unstandardized coefficient standard error; β**,** Beta coefficient; and R^2 (adj), Adjusted R Square value.

TABLE 4. Multiple regression results for the enjoyment dimension of the Participation in Childhood Occupations Questionnaire

Enjoyment dimension	B	SE B	β	R^2 (adj.)
Daily Care domain				0.088
Tactile Sensitivity	0.28	0.25	0.16	
Movement Sensitivity	<0.00	0.38	<0.00	
Underresponsive/Seeks Sensation	0.42	0.16	0.39	
Auditory Filtering	-0.04	0.20	-0.03	
Low Energy/Weak	-0.06	0.19	-0.06	
Visual/Auditory Sensitivity	-0.12	0.28	-0.07	
Academic Activities domain				0.074
Tactile Sensitivity	0.07	0.19	0.05	
Movement Sensitivity	0.17	0.30	0.08	
Underresponsive/Seeks Sensation	<0.00	0.13	<0.00	
Auditory Filtering	0.21	0.15	0.23	
Low Energy/Weak	0.21	0.15	0.25	
Visual/Auditory Sensitivity	-0.18	0.22	-0.14	
Play and Leisure domain				0.176†
Tactile Sensitivity	-0.15	0.21	-0.10	
Movement Sensitivity	0.31	0.32	0.14	
Underresponsive/Seeks Sensation	-0.03	0.14	-0.03	
Auditory Filtering	0.04	0.16	0.04	
Low Energy/Weak	0.34	0.16	0.36*	
Visual/Auditory Sensitivity	0.22	0.23	0.15	
Habits and Routines domain				0.238†
Tactile Sensitivity	0.18	0.09	0.26	
Movement Sensitivity	0.12	0.14	0.11	
Underresponsive/Seeks Sensation	0.05	0.06	0.12	
Auditory Filtering	0.10	0.07	0.21	
Low Energy/Weak	-0.07	0.07	-0.16	
Visual/Auditory Sensitivity	0.12	0.10	0.18	

† Bonferroni corrections were applied giving a *p* value of 0.0125 (0.05/4) for identification of significant regression models.

* $p<0.05$

Abbreviations: B, unstandardized coefficient; SE B, unstandardized coefficient standard error; β**,** Beta coefficient; and R^2 (adj), Adjusted R Square value.

TABLE 5. Multiple regression results for the frequency dimension of the Participation in Childhood Occupations Questionnaire

Frequency dimension	B	SE B	β	R^2 (adj.)
Daily Care domain				<0.001
Tactile Sensitivity	-0.02	0.09	-0.04	
Movement Sensitivity	0.05	0.13	0.06	
Underresponsive/Seeks Sensation	0.03	0.06	0.08	
Auditory Filtering	-0.12	0.07	-0.32	
Low Energy/Weak	0.01	0.07	0.04	
Visual/Auditory Sensitivity	0.10	0.10	0.18	
Academic Activities domain				0.179†
Tactile Sensitivity	-0.11	0.08	-0.19	
Movement Sensitivity	2.23	0.12	0.25	
Underresponsive/Seeks Sensation	-0.16	0.05	-0.44*	
Auditory Filtering	0.09	0.06	0.22	
Low Energy/Weak	-0.02	0.06	-0.05	
Visual/Auditory Sensitivity	0.24	0.09	0.43*	
Play and Leisure domain				0.065
Tactile Sensitivity	0.05	0.11	0.06	
Movement Sensitivity	0.15	0.17	0.13	
Underresponsive/Seeks Sensation	-0.05	0.07	-0.10	
Auditory Filtering	-0.03	0.09	-0.06	
Low Energy/Weak	0.06	0.08	0.12	
Visual/Auditory Sensitivity	0.21	0.12	0.29	
Habits and Routines domain				0.001
Tactile Sensitivity	0.02	0.04	0.08	
Movement Sensitivity	0.09	0.07	0.19	
Underresponsive/Seeks Sensation	-0.03	0.03	-0.14	
Auditory Filtering	0.04	0.03	0.21	
Low Energy/Weak	-0.07	0.03	-0.38	
Visual/Auditory Sensitivity	0.06	0.05	0.20	

† Bonferroni corrections were applied giving a *p* value of 0.0125 (0.05/4) for identification of significant regression models.

* $p<0.05$

Abbreviations: B, unstandardized coefficient; SE B, unstandardized coefficient standard error; β**,** Beta coefficient; and R^2 (adj), Adjusted R Square value.