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Reliability of the participation and sensory environment questionnaire: Community scales

Beth Pfeiffer[a], Aimee Piller[b,*], Katherine Bevans[a], Chengshi Shiu[c]

[a] Department of Rehabilitation Sciences, Temple University 1101 W Montgomery Ave, 3rd Floor, Philadelphia, PA 19122
[b] Piller Child Development, LLC, PO Box 50218, Phoenix, AZ 85076
[c] School of Nursing, Yale University, 400 West Campus Dr, Orange, CT 06477

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ABSTRACT

Background: The Participation and Sensory Environment Questionnaire (P–SEQ): Community Scales is a parent report questionnaire designed to examine the impact of the sensory environment on participation within community activities for children with autism spectrum disorder (ASD).
Methods: This study used a cross sectional quantitative design to establish the reliability and discriminate validity of the P–SEQ: Community Scales.
Results: This study established the initial reliability of the questionnaire including internal consistency of 0.98 test-retest reliability of 0.76. The P–SEQ: Community Scales demonstrated significant differences in item distribution for children without ASD as compared to those with ASD, an essential aspect of construct validity.
Conclusions: The results of this study indicate that the questionnaire is a reliable tool that can be used to assess the impact of sensory environment's impact on participation in community activities. Identified barriers can be modified to support participation in community tasks.

1. Introduction

Children with autism spectrum disorder (ASD) frequently have difficulties in the area of communication, social skills, restrictive behaviors, and differences in sensory processing (American Psychiatric Association [APA], 2013). Sensory processing difficulties range from hypo reactivity to hyper reactivity and fall under the diagnostic criteria of *Restrictive and Stereotypic Behaviors* in the Diagnostic and Statistical Manual of Mental Disorders 5th edition (APA, 2013). Hypo reactivity to sensory input means that a child requires more stimuli or more intense stimuli to register and respond. On the contrary, hyper reactivity is described when a child reacts more intensely to sensory stimuli and responds to limited sensory stimuli that does not typically cause a response in others. Sensory processing difficulties are comprised of atypical responses to sensory stimuli that may result in impairments in function (Miller, Nielsen, Schoen, & Brett-Green, 2009). Unusual response to sensory stimuli includes a lack of awareness of stimuli, such as touch, aversive response to stimuli such as sound, and excessive seeking of sensory stimuli such as repetitively touching or looking at objects (APA, 2013). Sensory processing difficulties are documented as present in 69%–93% of persons with ASD (Baranek, David, Poe, Stone, & Watson, 2006; Klintwall et al., 2011; Leekam, Nieto, Libby, Wing, & Gould, 2007).

Sensory processing differences can impact participation of children with ASD (Little, Sideris, Ausderau, & Baranek, 2014; Reynolds, Bendixen, Lawrence, & Lane, 2011). As a result, quality of life for children with ASD and their families is affected

* Corresponding author at: Piller Child Development, LLC, PO Box 50218, Phoenix, AZ 85076. Tel.: (480) 398-4280; fax: (480) 398-4281.
E-mail address: aimee.piller@pillerchilddevelopment.com (A. Piller).

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(Hochhauser & Engel-Yeger, 2010; Reynolds et al., 2011; Schaaf, Toth-Cohen, Johnson, Outten, & Benevides, 2011). Participation in community activities such as attending school, attending religious services, and organized activities is significantly less for children with ASD as compared to other populations of children (Lee, Harrington, Louie, & Newschaffer, 2008). Parents of children with ASD identified community participation as a major area of concern in the quality of life of their children and family (Pfeiffer, Piller, Giazzoni-Fialko, & Chainani, 2016). Poor regulation of behaviors is associated with decreased participation in community activities or the need for altering participation in community activities (Schaaf et al., 2011) and sensory processing difficulties are associated with maladaptive behaviors (Lane, Young, Baker, & Angley, 2009).

Children with disabilities, such as ASD, have limited participation in many settings. Barriers, both societal and physical barriers, exist in the environment that limits participation for children with disabilities, including ASD (Rosenberg, Ratzon, Jarus, & Bart, 2012; Schneidert, Hurst, Miller, & Ustun, 2003). Children with disabilities identify limits to participation as attitudinal barriers from peers and adults. In addition, the quality of services available limits participation for children with disabilities (Kramer, Olsen, Mermelstein, Balcells, & Liljenquist, 2012). Participation is impacted more in the community setting than in the home and school setting for children with disabilities (Hwang et al., 2015). The family is an important consideration when examining a child's participation. For children, participation occurs most extensively within the context of the family (Raghavendra, 2013). Families of children with ASD frequently modify their activities and routines based upon the needs of the child with ASD. On the other hand, families may simply avoid activities due to the complex needs of the child (Schaaf et al., 2011). Specifically, within the community setting, young children with ASD demonstrate decreased participation. The limits in participation are brought on by both the family choices and the child's choices to not participate in activities (LaVesser & Berg, 2011). Children and families respond to participation restrictions through an interactional relationship in which parents provide supports to facilitate participation (Pfeiffer et al., 2017).

The goal of interventions for children with ASD is to increase participation (Noonan, Kopec, Noreau, Singer, & Dvorak, 2009), which indicates that environmental factors that limit participation (Rosenberg et al., 2012) must be considered. For children with ASD, these factors may include sensory components within the environment. Parents of preschool children with ASD identified sensory components of the environment as influencing participation (Pfeiffer et al., 2017). In addition, preschool teachers identified that sensory aspects of the environment impacted participation of children in the school setting, but that the impact was unique to the child based upon his or her sensory processing patterns (Piller & Pfeiffer, 2016).

Frequently, sensory responses are considered from the perspective of the person, and not from the perspective of the sensory aspects that exist within the environment. However, identifying sensory related environmental barriers allows interventions to occur to decrease these barriers, improving the fit between the person and the environment, thus increasing participation. An example of modifying the sensory components of the environment to increase participation is demonstrated in modification of the dental environment. As study that modified the sensory component of a dental office and procedure resulted in decreased anxiety, sensory discomfort, and lower pain (Cermak et al., 2015).

The basis of participation is the interaction of the person and environment (Ziviani & Rodger, 2006). Participation is specific to the environment and involves engagement in activities within an environment to the expectations of that environment (Chapparo & Lowe, 2012; Law, 2002). As the fit between the person and the environment increases, so does participation (Law et al., 1996). In the case of children with ASD that also experience sensory processing differences, the impact of the sensory environment can influence participation. Sensory components of the environment can act as faciliatory or inhibitory to participation (Piller & Pfeiffer, 2016). Typically, assessments look only at the sensory processing of the person, ignoring the environment. However, a better the fit between the person and the environment results in increased participation. The most straightforward and influential component to influence in this relationship is the environment. Yet, few assessments exist to examine the sensory environment and participation, two concepts that should be assessed together (Bedell, Khetani, Cousins, Coster, & Law, 2011).

1.1. Current assessments of sensory processing and community activities

There are several assessments designed to examine the sensory processing patterns of children. Some of the many assessments include the *Sensory Integration and Praxis Test* (Ayres, 1989), *Sensory Processing Measure* (Parham, Ecker, Miller Kahaneck, Henry, & Glennon, 2007) and the *Sensory Profile-2* (Dunn, 2014). These assessments provide a method to examine the sensory processing patterns of the person or participation, but do not specifically examine the sensory environment and how that impacts participation. They examine how a person processes sensory information and if and where dysfunction may occur. The assessments identify sensory modulation disorders, sensory discrimination disorders, and sensory-based motor disorders (Miller et al., 2009). These assessments can also provide information as to the types of sensory modulation disorders a child may exhibit as well as the sensory processing strengths of the child. Interventions can be designed to address specific sensory processing disorders, working with the child's strengths to increase participation. Interventions focus on remediating sensory processing differences, through interventions such as sensory integration, to increase participation (Bundy, Lane, & Murray, 2002).

Consideration of the person is important when designing interventions to increase participation. However, the environment is equally important in participation. The interaction of the person and the environment result in participation (Bronfenbrenner, 1994; Dunn, Brown, & McGuigan, 1994). The environment plays an important role in participation in that it can inhibit or facilitate participation (Law et al., 1996). Despite the understanding of the impact of the environment on participation, there are few assessments designed to examine the sensory components of the environment. One assessment, the *Participation and Environment Measure- Children and Youth (PEM-CY),* provides an instrument to examine participation in various environments (Coster et al., 2012). *Children's Assessment of Participation and Enjoyment* and *Preferences for Activities of Children* (CAPE/PAC) provides a method to examine participation and preferences for children, but does not examine the environment (King et al., 2004). The *Participation and*

Sensory Environment Questionnaire (P-SEQ)- Community Scales is a new assessment designed to specifically examine the impact of the sensory environment within community settings on participation of young children in community activities. It was developed under the Person-Environment-Occupation theory and theory that outlines the interaction of the person and the environment with the result of participation. Participation is increased when the environment is modified to increase the fit between the person in and the environment (Law et al., 1996). An evaluation of the sensory environment can lead to interventions within the community environment with the purpose of increasing participation.

1.2. Development of the P-SEQ: community scales

The National Institute of Health (NIH) outlines a process of developing valid patient-reported outcome measures (NIH, 2012). The basis of valid outcome measures begins with a qualitative study of the target group of individuals for which the assessment was designed (Brod, Tesler, & Christensen, 2009). The development of the P–SEQ: Community Scales is a direct result of a qualitative study that explored the perceptions of parent/caregivers on the impact of the sensory environment on participation of children with ASD (Pfeiffer et al., 2017). This study resulted in a bank of items utilized in the assessment P-SEQ: Community Scales. There are 19 items that include items such as "swimming," "playing at the park," "doctor appointments or procedures," and "using a public bathroom." The assessment uses a 5-point Likert scale response system of "none," "a little," "some," "a lot," "too much to participate." A response of "none" indicated that the sensory environment did not have any impact on the child's participation in the specific activity. A response of "some" indicated that the sensory environment somewhat impacted participation in the specific activity, and a response of "a lot" indicated that the sensory environment greatly impacted the child's ability to participate in the activity. A response of "too much to participate" indicated that the child's response to sensory stimuli was such that the child did not participate in the activity. A lower score is desired and is considered as less indicative of sensory environmental barriers affecting participation.

1.3. Purpose of the study

The P–SEQ: Community Activities provides a unique assessment to assess the perception of parents/caregivers of children with ASD in the amount of effort put forth to support participation in the community setting. The purpose of this study was to examine the reliability, namely the internal consistency and test-retest reliability of the P–SEQ: Community Scales. Further, this study sought to examine construct validity of the assessment in its ability to distinguish between children with ASD and children without ASD. The researchers hypothesized that the item distributions would be different for children with ASD and those without ASD indicating the impact of the sensory environment on participation of community activities for children with ASD.

2. Methods

A cross sectional quantitative design was used to establish the reliability and discriminate validity of the P–SEQ: Community Scales. Prior to initiation of the study, institutional review board approval was gathered from the university of the primary researcher. The assessments were uploaded into Qualtrics Survey Software (2016) to allow participants to access the assessments online. Data were stored within the Qualtrics (2016) database until data analysis. Participants completed three questionnaires, a demographic form, the Gilliam Autism Rating Scale – 3rd edition (GARS-3) (Gilliam, 2014), and the P–SEQ: Community Scales (Pfeiffer, 2017). A group of participants completed the P–SEQ: Community Scales a second time two weeks after initial completion to gather data for test-retest reliability. Data were uploaded from Qualtrics to RStudio (2015) for analysis.

2.1. Participants

Participants included parents/caregivers of children ages 2 years to 7 years of age. Two groups were recruited, parents/caregivers of children with ASD and parents/caregivers of children without ASD. Diagnosis of ASD was indicated through the recruitment methods of participants (parents of children with ASD were recruited separately from parents of children without ASD were recruited). The diagnosis of ASD was reported by parents. For the purpose of this study, the completion of the GARS-3 confirmed the reported diagnosis of ASD.

2.2. Data collection

Participants were recruited via online methods, such as social media sites, and through support groups and service sites for children with ASD. Participants provided informed consent prior to the initiation of the study. Participants completed the demographic form, followed by the GARS-3 and the P–SEQ: Community Scales. Participants were sent the questionnaire a second time two weeks after initial completion to gather information regarding test-retest reliability. All data were stored in Qulatrics data base until analysis.

2.3. Data analysis

Data were uploaded to R Studio (2015) for analysis. Analysis occurred in a series of phases to determine item distribution and content/construct validity, establish internal consistency, test-retest reliability. First, item analysis occurred for item distribution.

Overall distribution was analyzed along with the distribution of results from each group of participants. Missing data was excluded from final analysis, but examined for frequency of missing data by item. Missing data was determined to be of minimal concern. Unidemensionality of the assessment was determined through internal consistency using Cronbach's alpha. Reliability was determined for the entire assessment and for each item. Pearson's *r* was used to determine test-retest reliability.

3. Results

3.1. Description of sample

A total of 302 parents/caregivers completed the assessments. Of the total participants 141 were parents/caregivers of children with ASD and 161 were parents/caregivers of children that did not meet the criteria for ASD on the GARS-3. The majority of the participants (87%) identified themselves as the child's mother. Of the children, in the total populations, 65% of children were male and 34% female. The population of participants with ASD had 81% male with 19% female. Additional information on participants demographics can be found in Table 1. One hundred and twenty-nine participants completed the P–SEQ: Community Activities a second time for test-retest data.

3.2. Item distribution

Initial analysis of item distribution revealed that all items have reasonable overall distributions. Items completed by parents/caregivers of parents with ASD differed significantly from answers completed by parents/caregivers of parents without a diagnosis of ASD. Further, all the items completed by parents/caregivers of children without a diagnosis of ASD had extreme floor effects and clustering around a "one" response (none). Items completed by parents/caregivers of children with ASD demonstrated a more even distribution across responses. When responses from the two groups were compared, the responses of parents/caregivers of children with ASD demonstrated a more even distribution of responses while responses of parents/caregivers of children without ASD clustered near the bottom due to the floor effects.

3.3. Inter-item correlations

A correlation matrix, Table 2, revealed moderate to good correlations ranging from 0.61 to 0.90, an indication that items were consistent with one another. All correlations were significant at < 0.001. The mean of each item ranged from 2.2 to 2.7 across both populations of participants.

3.4. Internal consistency

Cronbach's alpha for the P–SEQ: Community Scales revealed a reliability of 0.98 with a 95% confidence boundary. Item correlations for the total score ranged from 0.80 to 0.91. Item-whole correlations for item overlap ranged from 0.79 to 0.91 while item-whole correlation with item removed ranged from 0.78 to 0.90. Internal consistency of the P–SEQ: Community Scales is found in Table 3. Overall, internal consistency was high for the entire assessment.

3.5. Test-Retest reliability

Pearson's *r* was used to determine test-retest reliability. Responses from completion one were compared to responses from the second completion. Pearson's correlations for each item are represented in Table 4. Overall, Pearson's *r* was 0.76 for the entire assessment, which is classified as moderate-high. Ranges for item test-retest started at 0.55 on the low end up to 0.85 indicating fair to good reliability (Cicchetti, 1994). There were two items that had a lower test-retest at 0.62. Those items were "using public bathroom" and "attending community events."

4. Discussion

The P–SEQ: Community Scales is a psychometrically sounds instrument with excellent reliability in internal consistency and adequate test-retest reliability. It provides a method to evaluate the impact of the sensory environment on participation within the community setting using a parent report method. In addition, initial analysis of item distribution indicates that the P–SEQ: Community Scales provides a significant distinction between the response of parents/caregivers of parents with ASD and the responses of parents/caregivers of children without ASD an indication of construct validity.

4.1. Reliability

Analysis revealed that the P–SEQ: Community Scales has a high reliability indicating that the scale is assessing one concept. Due to the narrow scope of the assessment, it is expected that reliability would be high without indicating redundancy. In this case, the reliability of 0.98 demonstrates unidimensionality of the assessment indicating that it is in fact measuring the impact of the sensory environment on participation of young children in the community setting (Portney & Watkins, 2009; Streiner, 2003). The specific

Table 1
Participant Demographics.

	ALL CASES *(n = 302)* n(%)	ASD *(n = 141)* n(%)	NON-ASD *(n = 161)* n(%)
*Child diagnosis**			
Autism (DSM-IV)	70 (23%)	70 (50%)	0 (0%)
PDD-NOS (DSM-IV)	5 (2%)	5 (4%)	0 (0%)
Asperger Disorder (DSM-IV)	4 (1%)	4 (3%)	0 (0%)
Autism Spectrum Disorder: Level 1 (DSM-V)	33 (1%)	33 (24%)	0 (0%)
Autism Spectrum Disorder: Level 2 (DSM-V)	15 (11%)	14 (10%)	1 (1%)
Autism Spectrum Disorder: Level 3 (DSM-V)	6 (2%)	6 (4%)	0 (0%)
Other	21 (7%)	8 (6%)	13 (8%)
N/A	144 (48%)	0	144 (91%)
Residential community			
Major urban	79 (26%)	40 (28%)	39 (24%)
Suburban	158 (52%)	68 (48%)	90 (56%)
Small town	45 (15%)	22 (16%)	23 (14%)
Rural	20 (7%)	11 (8%)	9 (6%)
Residential country-region			
US-North East	194 (64%)	61 (43%)	133 (83%)
US-Midwest	26 (9%)	14 (10%)	12 (7%)
US-South	29 (10%)	21 (15%)	8 (5%)
US-West	53 (18%)	45 (32%)	8 (5%)
Language Spoken at Home			
English	290 (96%)	137 (98%)	153 (96%)
Other	8 (3%)	3 (2%)	6 (4%)
Reporter relation to child			
Mother	262 (87%)	111 (79%)	151 (94%)
Father	37 (12%)	29 (21%)	8 (5%)
Female guardian	2 (1%)	1 (1%)	1 (1%)
Male guardian	0 (0%)	0 (0%)	0 (0%)
Reporter age			
20–29	36 (12%)	24 (17%)	12 (7%)
30–39	197 (65%)	89 (63%)	108 (67%)
40–49	64 (21%)	24 (17%)	40 (25%)
50–59	5 (2%)	4 (3%)	1 (1%)
Reporter education level			
High school or less	24 (8%)	20 (14%)	4 (2%)
Some college or technical training	53 (18%)	37 (26%)	16 (10%)
Graduated college	114 (38%)	54 (38%)	60 (37%)
Graduate degree	111 (37%)	30 (21%)	81 (50%)
Reporter employment status			
Caring for family full-time	121 (40%)	66 (47%)	55 (34%)
Working full-time	135 (45%)	58 (41%)	77 (48%)
Working part-time	36 (12%)	10 (7%)	26 (16%)
Going to school	1 (0%)	0 (0%)	1 (1%)
Recovering from illness/disability	3 (1%)	3 (2%)	0 (0%)
Other	5 (2%)	4 (3%)	1 (1%)
Child gender			
Male	197 (65%)	113 (81%)	84 (52%)
Female	104 (34%)	27 (19%)	77 (48%)
Reporter race			
Arab/West Asian	4 (1%)	4 (3%)	0 (0%)
Black	12 (4%)	10 (7%)	2 (1%)
Caucasian	249 (82%)	112 (79%)	137 (86%)
Chinese	4 (1%)	2 (1%)	2 (1%)
Japanese	1 (0%)	0 (0%)	1 (1%)
Korean	3 (1%)	0 (0%)	3 (2%)
Latin-American or Hispanic	16 (5%)	9 (6%)	7 (4%)
North American Indian	1 (0%)	0 (0%)	1 (1%)
South Asian	3 (1%)	0 (0%)	3 (2%)
South East Asian	1 (0%)	1 (1%)	0 (0%)
Other	7 (2%)	3 (2%)	4 (2%)
Child race			
Arab/West Asian	5 (2%)	5 (4%)	0 (0%)
Black	12 (4%)	11 (8%)	1 (1%)

(continued on next page)

Table 1 *(continued)*

	ALL CASES *(n = 302)* n(%)	ASD *(n = 141)* n(%)	NON-ASD *(n = 161)* n(%)
Caucasian	239 (79%)	101 (72%)	138 (86%)
Chinese	3 (1%)	2 (1%)	1 (1%)
Filipino	1 (0%)	1 (1%)	0 (0%)
Japanese	1 (0%)	0 (0%)	1 (1%)
Korean	2 (1%)	0 (0%)	2 (1%)
Latin-American or Hispanic	13 (4%)	11 (8%)	2 (1%)
North American Indian	1 (0%)	0 (0%)	1 (1%)
South Asian	2 (1%)	0 (0%)	2 (1%)
South East Asian	1 (0%)	1 (1%)	0 (0%)
Other	22 (7%)	9 (6%)	13 (8%)
Family annual income			
< $10,000	11 (4%)	10 (7%)	1 (1%)
$10,000–$39,999	43 (14%)	34 (24%)	5 (3%)
$40,000–$69,999	41 (13%)	22 (15%)	19 (11%)
$70,000–$99,999	83 (27%)	35 (25%)	48 (30%)
> $100,000	121 40%	37 27%	84 52%
Child preschool/daycare setting			
Regular preschool	111 (37%)	29 (21%)	82 (51%)
Both regular and special education preschool	23 (8%)	20 (14%)	3 (2%)
Special education preschool	55 (18%)	54 (39%)	1 (1%)
Daycare preschool	42 (14%)	9 (6%)	33 (20%)
Not in preschool/daycare	43 (14%)	15 (11%)	28 (17%)
Other	27 (9%)	13 (9%)	14 (9%)

nature of the scale would lend itself to a higher than average reliability because of the precision of the concept being assessed. Test-retest reliability was also moderate-high at 0.76 (Lance, Butts, & Michels, 2006). Test-retest reliability indicates how stable the assessment is over time. The variances within the children's performance patterns and personal factors affect participation from day to day and therefore may impact the participation of children within community activities. Despite these differences, the P–SEQ: Community Scales provides a scale that is reliable across administration time with less variability. Two items had lower test-retest reliability. These items were "using public bathroom" and "attending community events." The variability of environments in public bathrooms and community events may have contributed to the slightly lower test-retest for these two items. Although adequate, the test-retest reliability of the P–SEQ: Community Scales may indicate that the assessment is not sensitive enough to be used as an outcome measure. Further research is needed to determine if it would be a valid outcome measure.

4.2. Construct validity

The theoretical underpinnings to this assessment focus on the concept that by modifying or providing support within the environment, the fit between the person and the sensory environment will improve and participation will increase (Law et al., 1996). Item distribution revealed significant differences in item responses between the two populations assessed. The response of parents/caregivers of children without ASD demonstrated extreme floor effects and clustered around the response of "none." This indicates that the sensory environment did not significantly impact participation in community activities for the majority of respondents without ASD. This was an expected result as sensory processing differences are more prevalent in children with ASD. The ability to the P–SEQ: Community Scales to differentiate between the two populations, those with ASD and those without ASD, speaks to the construct validity of the assessment.

Children with ASD demonstrated limited participation in many tasks due to factors including social and language skill deficits, sensory processing differences, and restricted behaviors (APA, 2013). In this study, children without ASD were identified by the GARS-3 as not having behaviors indicative of children with ASD. Therefore, the traits of children with ASD were not present in the children without ASD. As a result, the sensory components of the environment did not significantly impact participation of children without ASD in community activities. The sensory processing differences in children with ASD affect participation (Schaaf & Mailloux, 2015; Smith Roley et al., 2015; Tomchek, Huebner, & Dunn, 2014) due to a child's response to the sensory features of the environment. For children with ASD, sensory sensitivities have been linked to decreased participation (Tomcheck & Dunn, 2007). Sensory processing differences impacts almost all areas of participation for children with ASD in social and physical activities (Hochhauser & Engel-Yeger, 2010) and school performance (Reynolds et al., 2011).

Community-based activities are a primary area of participation for young children with ASD (Little et al., 2014). The variety of sensory elements within the community environment can make participation within the community difficult for children with ASD. Parents identified the importance of modifying sensory features of the environment and ensuring that specific sensory elements were present within the environment as essential to successful participation within the community (Pfeiffer et al., 2017). The P–SEQ: Community Scales provides a method to evaluate the specifics of participation as related to the sensory features of the environment. Interventions can then target sensory aspects of the environment by modifying, decreasing, or ensuring the presence of sensory features.

Table 2
Correlation Matrix.

	Family Parties	Parties for others	Restaurant	Meals	Movies	Religious Service	Library	Dentist	Doctor
Family Parties	1.00	0.87	0.73	0.77	0.67	0.69	0.69	0.60	0.65
Parties for others	0.88	1.00	0.74	0.76	0.67	0.71	0.70	0.65	0.66
Restaurant	0.73	0.74	1.00	0.79	0.62	0.65	0.66	0.57	0.59
Meals	0.77	0.76	0.79	1.00	0.64	0.66	0.66	0.55	0.61
Movies	0.67	0.67	0.62	0.64	1.00	0.74	0.66	0.55	0.54
Religious Service	0.67	0.71	0.65	0.66	0.74	1.00	0.68	0.57	0.58
Library	0.70	0.70	0.66	0.66	0.66	0.68	1.00	0.64	0.66
Dentist	0.60	0.65	0.57	0.55	0.55	0.57	0.64	1.00	0.81
Doctor	0.65	0.66	0.59	0.61	0.54	0.58	0.66	0.81	1.00
Vacations	0.65	0.65	0.70	0.69	0.60	0.64	0.68	0.58	0.66
Playground	0.59	0.56	0.57	0.61	0.40	0.49	0.58	0.44	0.53
Playing	0.68	0.66	0.59	0.67	0.60	0.61	0.66	0.53	0.56
Sporting Events	0.69	0.72	0.69	0.65	0.71	0.73	0.70	0.60	0.60
Sporting Events	0.63	0.66	0.60	0.61	0.65	0.65	0.66	0.57	0.56
Swimming	0.38	0.43	0.43	0.42	0.38	0.40	0.27	0.50	0.51
Amusement Park	0.55	0.58	0.57	0.58	0.61	0.57	0.57	0.57	0.55
Public Bathroom	0.57	0.59	0.58	0.55	0.56	0.53	0.57	0.55	0.56
Community Events	0.70	0.74	0.71	0.68	0.65	0.65	0.69	0.64	0.67
Public Transportation	0.49	0.53	0.46	0.47	0.45	0.54	0.51	0.46	0.47

	Vacations	Playground	Playing	Sporting Events	Sporting Events	Swimming	Amusement Park	Public Bathroom	Community Events	Public Transportation
Family Parties	0.65	0.59	0.68	0.69	0.63	0.38	0.55	0.57	0.70	0.49
Parties for others	0.65	0.56	0.66	0.72	0.66	0.43	0.58	0.59	0.74	0.53
Restaurant	0.70	0.57	0.59	0.69	0.60	0.43	0.57	0.58	0.71	0.46
Meals	0.69	0.61	0.67	0.65	0.61	0.42	0.58	0.55	0.68	0.47
Movies	0.60	0.40	0.60	0.71	0.65	0.38	0.61	0.56	0.61	0.45
Religious Service	0.64	0.49	0.61	0.73	0.65	0.40	0.57	0.53	0.65	0.54
Library	0.68	0.58	0.66	0.70	0.66	0.47	0.57	0.57	0.69	0.51
Dentist	0.58	0.44	0.53	0.60	0.57	0.50	0.57	0.55	0.64	0.46
Doctor	0.66	0.53	0.56	0.60	0.56	0.51	0.55	0.56	0.67	0.47
Vacations	1.00	0.60	0.60	0.68	0.66	0.52	0.67	0.58	0.68	0.50
Playground	0.60	1.00	0.68	0.51	0.51	0.43	0.47	0.49	0.55	0.49
Playing	0.60	0.68	1.00	0.68	0.64	0.42	0.53	0.51	0.63	0.46
Sporting Events	0.68	0.51	0.68	1.00	0.79	0.45	0.62	0.61	0.73	0.55
Sporting Events	0.66	0.51	0.64	0.79	1.00	0.48	0.57	0.51	0.64	0.48
Swimming	0.42	0.43	0.42	0.45	0.48	1.00	0.66	0.52	0.56	0.48
Amusement Park	0.67	0.47	0.53	0.62	0.57	0.66	1.00	0.63	0.73	0.57
Public Bathroom	0.58	0.49	0.51	0.61	0.51	0.52	0.63	1.00	0.71	0.67
Community Events	0.68	0.55	0.63	0.73	0.64	0.56	0.73	0.71	1.00	0.64
Public Transportation	0.50	0.49	0.46	0.55	0.49	0.48	0.57	0.67	0.64	1.00

Note. Item descriptions are shortened for the table. For full item text see https://participationandsensoryenvironment.weebly.com/view-pseq.html.

Table 3
Internal Consistency.

	Raw Alpha	Std. Alpha	Inter-item correlation	Mean	Scale Sd
Family Parties	0.96	0.96	0.59	2.5	1.3
Parties for others	0.96	0.96	0.59	2.6	1.3
Restaurant	0.96	0.96	0.60	2.6	1.2
Meals	0.96	0.96	0.60	2.5	1.2
Movies	0.96	0.96	0.60	2.7	1.4
Religious Service	0.96	0.96	0.60	2.7	1.4
Library	0.96	0.96	0.59	2.5	1.3
Dentist	0.96	0.96	0.60	2.9	1.3
Doctor	0.96	0.96	0.60	2.8	1.1
Vacations	0.96	0.96	0.60	2.5	1.2
Playground	0.97	0.97	0.61	2.0	1.1
Playing	0.96	0.96	0.60	2.3	1.2
Sports Spectator	0.96	0.96	0.59	2.6	1.3
Sporting Events	0.96	0.96	0.60	2.6	1.4
Swimming	0.97	0.97	0.61	2.7	1.2
Amusement Park	0.96	0.96	0.60	2.6	1.3
Public Bathroom	0.96	0.96	0.60	2.6	1.3
Community Events	0.96	0.96	0.59	2.6	1.3
Public Transportation	0.97	0.97	0.61	2.5	1.4

Note. Item descriptions are shortened for the table. For full item text see https://participationandsensoryenvironment.weebly.com/view-pseq.html.

Table 4
Pearson's Correlation Test-Retest.

	Pearson R	*n*
Family Parties	0.81	129
Parties for Others	0.82	129
Restaurant	0.74	129
Meals	0.78	129
Movies	0.75	127
Religious Service	0.76	126
Library	0.70	129
Dentist	0.83	129
Doctor	0.77	129
Vacations	0.65	129
Playground	0.70	128
Playing	0.73	128
Sports Spectator	0.71	126
Sporting Events	0.62	125
Swimming	0.64	127
Amusement Park	0.70	126
Public Bathroom	0.63	127
Community Events	0.67	128
Public Transportation	0.62	126

Note. Item descriptions are shortened for the table. For full item text see https://participationandsensoryenvironment.weebly.com/view-pseq.html.

The sensory processing patterns of children with ASD vary from child to child (Smith Roley et al., 2015; Tomchek et al., 2014). Assessing the sensory processing of the person is important, but when looking at participation, it provides only a portion of the picture. The environment plays a key role in participation (Chapparo & Lowe, 2012; Law, 2002; Ziviani & Rodger, 2006). The P–SEQ provides an individualize assessment to identify potential sensory- related environmental barriers to participation, rather than the sensory processing patterns of the person. The inclusion of an assessment of the environment provides a more complete evaluation of participation in order to design interventions at the environmental level. For example, if the auditory environment presents as a barrier to participation, interventions to target sound reduction within that environment or modification of the environment would be implemented. The expected result would be increase in participation of that particular community-based activity. The unique contribution of this assessment is that it does not assess the sensory processing patterns of the person (i.e. hyper reactivity, hypo reactivity, etc.) Instead, the assessment allows for the identification of environmental sensory barriers that can be removed or modified to increase the participation of children. The information gathered from this assessment can be matched to the unique sensory processing needs of the child to increase participation within community activities.

4.3. Limitations and future research

The study presented in this paper provides initial tests of reliability for the P–SEQ: Community Scales. However, only two tests of reliability were performed. Future studies should focus on additional reliability tests and the establishment of other psychometric properties. In addition, the population of participants included primarily male children with ASD. Although males are more likely to be diagnosis with ASD, there may be an under diagnosis of females with ASD due to atypical presentation of symptoms (Lyall et al., 2017). A population that included more females with ASD, would allow results to be generalized more across genders.

4.4. Implications

The results of this study indicate the P–SEQ: Community Scales has very high internal consistency and adequate test-retest reliability making it a reliable method to assess the impact of the sensory environment on participation of young children within community activities. The assessment provides a valuable tool to identify sensory related environmental barriers to participation. By assessing barriers within the environment, interventions can target these barriers to increase participation. Instead of focusing on changing the sensory processing patterns of the person, interventions targeted at modifying the environment can increase participation for children with ASD regardless of the cause of sensory processing differences. In addition, the environment is the easiest place to intervene when modifying the fit between the person and the environment (Law et al., 1996). By adequately assessing barriers in the environment, effective interventions can be designed to increase participation.

Conflicts of interest

The authors declare that they have no conflicts of interest.

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