

# A PORTUGUESE VERSION OF THE SENSORY PROCESSING MEASURE FOR PRESCHOOL: ANALYSIS OF THE INTERNAL CONSISTENCY AND HOMOGENEITY OF THE ITEMS OF SCHOOL FORM<sup>1</sup>

## VERSÃO PORTUGUESA DA MEDIDA DO PROCESSAMENTO SENSORIAL PRÉ-ESCOLA: ANÁLISE DA CONSISTÊNCIA INTERNA E HOMOGENEIDADE DOS ITENS DO FORMULÁRIO ESCOLA

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**ABSTRACT:** Over the past several years, a wide range of estimates of the prevalence of sensory processing disorders has emerged in the literature. The assessment of these difficulties should be part of the competence of professionals working with children with these kinds of needs through validated instruments. This study examined the internal consistency and items homogeneity of a Portuguese language version of the Sensory Processing Measure-Preschool (SPM-P). One hundred typically developing children aged between 2 and 5 years were recruited at Nursery Schools and assessed using the SPM-P to determine its reliability and validity. Pearson correlation (item homogeneity) and Cronbach's alpha (internal consistency) determined the exclusion of 4 items. Cronbach's alpha values for the different dimensions ("Social Participation", "Vision", "Hearing", "Touch", "Body Awareness", "Balance and Motion", "Planning and Ideas") ranged from 0.742 ("Vision" and "Touch") and 0.908 ("Body Awareness"). The findings of this study showed that the SPM-P is a valid and reliable tool in screening for sensory processing difficulties in Portuguese preschool children aged between 2 and 5 years in a nursery school setting.

**KEYWORDS:** Sensory Processing Measure for Preschool. Internal consistency. Validity.

**RESUMO:** Nos últimos anos, tem havido na literatura uma larga estimativa de prevalência de desordens do processamento sensorial. A avaliação dessas dificuldades deve fazer parte da competência dos profissionais que desenvolvem o seu trabalho com crianças que as apresentam por meio de instrumentos validados. Este estudo examina a consistência interna e homogeneidade dos itens da versão portuguesa do *Sensory Processing Measure-Preschool (SPM-P)*. Foi aplicado o SPM-P a cem crianças entre os 2 e os 5 anos de idade que frequentavam a creche e o jardim de infância com o objetivo de determinar a sua fiabilidade e a validade. A análise da correlação de Pearson (homogeneidade dos itens) e do alfa de Cronbach (consistência interna) determinou a exclusão de quatro itens. Os valores de alfa de Cronbach para as várias dimensões ("Participação Social", "Visão", "Audição", "Toque", "Consciência Corporal", "Equilíbrio", "Planeamento Motor e Ideias") oscilou entre =0.742 ("Visão" e "Toque") e =0.908 ("Consciência Corporal"). Os resultados deste estudo mostram que o SPM-P é um instrumento de rastreio válido e fiável para despistar as dificuldades de processamento sensorial das crianças Portuguesas com idades compreendidas entre os 2 e os 5 anos integradas em contexto escolar.

**PALAVRAS-CHAVE:** *Sensory Processing Measure for Preschool*. Consistência interna. Validação.

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## 1 INTRODUCTION

Sensory processing disorders (SPD) have recently been acknowledged outside of the occupational therapy professions in three reference manuals of diagnostic classification: 1) *Diagnostic Classification of Mental Health and Developmental Disorders of Infancy and Early Childhood, Revised* (known as the *DC: 0–3R*) (Zero To Three, 2005); 2) *Diagnostic Manual for Infancy and Early Childhood* published by the Interdisciplinary Council on Developmental and Learning Disorders (ICDL, 2000); and 3) the *Psychodynamic Diagnostic Manual*, 2nd ed. (Lingiardi & McWilliams, 2017). These manuals include diagnostic taxonomies with three sub-classifications of SPD that were suggested by a committee of occupational therapists who assisted in developing guidelines for diagnosis (Miller, Anzalone, Lane, Cermak, & Osten, 2007).

One of these three sub-classifications, sensory modulation disorder (SMD) (Miller et al., 2007) normally occurs as the central nervous system regulates sensory stimuli. SMD is when a person has difficulty responding to sensory input with behavior that is appropriate to the degree, nature, or intensity of the sensory information being received (Schaaf, Miller, Seawell, & O’Keefe, 2003). This can affect a person’s flexibility and ability to adapt to situations in daily life, often resulting in difficulty in achieving and maintaining a developmentally appropriate range of emotional and attentional responses (Miller et al., 2007; Miller, Nielsen, Schoen, & Brett-Green, 2009).

## 2 USING SPD ASSESSMENT

Sensory integration (SI) is a common approach used by occupational therapists working with school-aged children to ameliorate SMD, so they can access the curriculum and participate in school-related activities. SI techniques are used as part of occupational therapy to improve a child’s engagement in everyday activities or “occupations” (American Occupational Therapy Association [AOTA], 2014).

Sensory processing difficulties can be identified using: standardized measurements, skilled observations, and parents’ and teachers’ reports (Ecker & Parham, 2010; Parham, Ecker, Miller-Kuhaneck, Henry, & Glennon, 2007). Instruments measuring sensory processing difficulties in various environments are essential for a thorough understanding of a child’s difficulties. Lai, Chung, Chan and Li-Tsang (2011) found in their Hong Kong study that it was not uncommon for children to behave differently at home than at school. Therefore, especially for school-based occupational therapists in clinical practice, using a standardized measurement tool that provides comparable scores on the performance (sensory processing and related functional performance) of children at home and at school is necessary (Lai et al., 2011). The Sensory Processing Measure-Preschool (SPM-P) is a set of rating forms that enable assessment of sensory processing issues, praxis, and social participation in preschool children aged two to five years (Ecker & Parham, 2010).

The SPM-P is anchored in Ayres’ sensory integration theory (Ayres, 1972, 1979, 2005) which proposes that the processing and integration of sensory inputs is a critical neuro-behavioral process that strongly affects development. The theory holds that children with compromised sensory processing may be unable to learn efficiently, regulate their emotions, and/or function at their expected age level for daily activities. Difficulties at the level of sensory

processing often contribute to impairment in higher level integrative functions such as social participation and praxis (the ability to plan and organize movement) (Miller et al., 2007).

Ayres' sensory integration theory delineates principles for the assessment of sensory function, many of which are embodied in the SPM-P. These include the following three key dimensions: 1) *Assessment of sensory systems*: The SPM-P scale scores provide norm-referenced indexes of function in the visual, auditory, tactile, proprioceptive, and vestibular systems, as well as the integrative functions of praxis and social participation; 2) *Assessment of sensory integration vulnerabilities*: The SPM-P item responses provide descriptive clinical information on processing vulnerabilities within each sensory system, including under- and over-responsiveness, sensory-seeking behavior, and perceptual problems; 3) *Assessment across multiple environments*: The SPM-P home form and SPM-P school form, together, permit the user to compare and contrast the child's functioning in the home, preschool, and community environment (Ecker & Parham, 2010; Glennon, Kuhaneck, & Herzberg, 2011; Henry & McClary, 2011; Lai et al., 2011).

The SPM-P authors selected items from the SPM and the *Evaluation of Sensory Processing* (ESP-, Johnson-Ecker & Parham, 2000) item set that could be adapted for use with preschoolers. After editing these items to refer to younger children, the authors wrote additional items to capture experiences specific to the preschool age range (e.g., "has trouble climbing in and out of the car seat"). This process resulted in candidate item sets for the SPM-P Home and School Research Forms. The two research forms were then evaluated in the standardization and clinical validity studies (Ecker & Parham, 2010; Glennon, Miller-Kuhaneck, Henry, Parham, & Ecker, 2010). After standardization the use of the SPM-P as a test and retest in promoting understanding of how sensory processing issues drive challenging behaviors have been used (Glennon et al., 2011; Henry & McClary, 2011). Studies to examine psychometric properties of the SPM around the world have been done (Lai et al., 2011).

The cultural validation of the measurement instruments should follow international guidelines: Stage I) Initial Translation; Stage II) Synthesis of the translations; Stage III) Back Translations; Stage IV) Expert Committee; Stage V) Test of the prefinal version; Stage VI) Submission of documentation of the developers or coordinating committee for appraisal of the adaptation process (Beaton, Bombardier, Guillemin, & Ferraz, 2000; Hambleton, 2005; Reichenheim & Moraes, 2007).

Since the translated version of SPM-P by Gomes et al. (2016) was tested in a pilot study of a hundred typically developing children and have no variability of responses, the investigators decided to consider the cross-cultural adaptation to avoid erroneous comparisons of results across translated version (Beaton et al., 2000; Guillemin, Bombardier, & Beaton, 1993). Because the purpose of any behavioral rating scale is to provide clinical inferences in support of diagnostic and treatment decisions, this study aimed to ensure that these inferences would be valid and based on reliable scores. To determine reliability of the inferences that were made, we instituted internal procedural consistency.

### **3 METHODS**

In this section, we initially address the research participants and the procedures used, and then the data collection measure.

#### **3.1 PARTICIPANTS AND PROCEDURES**

The School of Health Sciences and Western Psychological Services (WPS) agreement with the Nursery Schools allowed for a maximum of 100 children in the study. The study was explained to all parents so that they were informed before signing the consent form on behalf of their children. All parents were allowed access to the study results on their child. The research followed the ethical guidelines set out by the Helsinki Declaration. Fourteen educators were involved and all parents agreed to let them fill out the SPM-P school form on their children.

For all data collection and subsequent disclosure, prior approval from the National Data Protection Commission (Authorization nº 14315/ 2017) was requested and obtained.

To select the Nursery Schools, a survey was carried out in the northern and central areas of Portugal and requests were sent to school principals. Subsequent face-to-face meetings were arranged to explain the study procedures. The geographical area was chosen because researchers lived and worked there, and it was felt that this would facilitate the relationships with the chosen schools. The chosen Nursery Schools then confirmed whether or not they wished to participate in the study.

The sample was representative because the great majority of Nursery Schools contacted (90%) responded positively.

The principal researcher presented the research purpose and procedure at an educators' meeting held at each school, and handed out information regarding the nature of the research. At these meetings, educators were instructed on how to complete forms as part of the measurements they would be required to conduct and were also given the opportunity to ask questions.

The children were girls and boys between the ages of two and five years old, enrolled in Portuguese-speaking Nursery Schools. None of the children in the study were enrolled in special needs or special education programs. All educators had to have known the child for at least six months prior to the study. This was to ensure that the respondent was familiar enough with the child to rate the SPM-P school form items.

#### **3.2 MEASURES**

The SPM-P is a rating scale with two forms: the home form and the school form. Each form has 75 items for the parent/caregiver and teacher/day care provider to complete. The SPM-P forms are designed to assess preschool-aged children. The two forms are intended to be used together to provide a comprehensive overview of the child's sensory functioning across a home, school, and community context (Glennon et al., 2011; Parham et al., 2007). For those children who are five years old, but attend school, the original Sensory Processing Measure (SMP) (Parham et al., 2007) should be used, as the items are more reflective of classroom activities.

As with the original SPM, both the SPM-P home form and SPM-P school form provide eight scaled areas to be scored. Use of the home and school forms together was considered optimal as normative data was gathered on the same set of children on both forms, thus allowing for comparison of the child's performance between the two environments. The parent fills in the home form and an individual who has known the child for at least six months in his or her preschool environment fills in the school form. Each form takes approximately 15 to 20 minutes for the assessor to complete. Once the forms are completed, an occupational therapy practitioner takes approximately 5 to 10 minutes to score each form and this yields raw scores, *T* scores, and percentile ranks for each of the eight scales. Although each form can be used on its own, it is recommended that both forms are used together as this provides the team with a comprehensive view of the child's performance across the two environments. Both forms are organized in the same format using an autoscore form with carbon paper to automatically transfer the assessor's responses into the scoring worksheet. There is also a summary sheet with graphic representation of the scores. The scoring process and presentation of the results are easy and efficient (Parham et al., 2007).

The 75-item SPMP-P form is completed by the child's primary preschool teacher or day care provider. The eight scales on the SPMP school form are: social participation (SOC), vision (VIS), hearing (HEA), touch (TOU), body awareness (BOD), balance and motion (BAL), planning and ideas (PLA), and total sensory systems (TOT). The VIS, HEA, TOU, BOD, and BAL scales are referred to as the sensory systems scale. The SOC and PLA scales score a higher level of integrative functions that are strongly influenced by sensory inputs while encompassing other cognitive and contextual factors (Parham et al., 2007).

Each item in the SPM-P is rated in terms of the frequency of the behavior on a 4-point scale: never (score=1; criteria: "the behavior never or almost never happens"), occasionally (score=2; criteria: "the behavior happens some of the time"), frequently (score=3; "the behavior happens much of the time"), and always (score=4; criteria: "the behavior always or almost always happens").

In this study, the steps suggested by Reichenheim and Moraes (2007) were carried out: conceptual equivalence, semantic equivalence, operational equivalence, and equivalence measurement. These steps were previously described in other publications (Reis, Gomes, & Dixe, 2020; Gomes et al., 2016), however the main objective of our study was determining the internal consistency and homogeneity of the SPM-P school form.

## 4 RESULTS

In the analysis that follows, we present the internal consistency of the SPM-P school form, the item-scale correlations of the SPM-P school form, dimension consistency, the interscale correlations, the item-scale correlations and gender and age differences.

### 4.1 DATA ANALYSIS

The purpose of each assessment scale is to gather clinical inferences to support diagnosis and treatment intervention decisions. These inferences are only valid if they are

supported by reliable scores. One of the procedures carried out to test the reliability of an instrument is to determine internal consistency which means that all items on an evaluation scale should consistently measure the same, or that the average of correlations between the items that make up the scale should be measured. We used Cronbach's coefficient alpha (Cronbach, 1988) to measure the internal consistency of a scale. Its values can range from 0 to 1, and for this study the authors considered Cronbach's alpha values  $\geq .70$  acceptable with values  $\geq .80$  considered ideal.

For the construct validation, several procedures, including inter-scale correlation, item convergent validity, and item discriminant validity, were examined. The t-test was used to assess gender differences and the Mann-Whitney U test to assess age differences. A total of 100 children were evaluated: 51 males (51%) and 49 females (49%), with an average age of  $45.7 \pm 11.8$  months, of whom almost 99% were of white ethnicity.

- Internal consistency of the SPM-P school form

The internal validity of the items was evaluated when the educators' answers were correlated with the totals in their respective dimensions, and a trial estimate of the internal consistency of the items (Cronbach's alpha) was made by taking advantage of the coincident statistical procedure analysis generated by SPSS software.

- Item-scale correlations of the SPM-P school form

Coefficient correlations are measured by verifying the relationship between two variables, thus indicating their degree of association. Pearson's coefficient correlation indicates the linear correlation between two variables, and values vary in the range of -1 to +1. In this case, we wanted to verify whether each item had a higher Pearson correlation in the dimension where it was placed when compared to other dimensions as well as the total (see Table 3).

- Dimension consistency

Table 1 presents the values of the internal consistency within dimensions as well as the number of items that made up each dimension. In order to verify the differences found in relation to the original, we also included the items' values (Parham et al., 2007). It should be noted that in some dimensions, items were excluded due to low value correlation ( $r < 0.20$ ) of the item with factor total, namely: item 22 ("Is disturbed when others sing or use musical instruments"), item 60 ("Sways excessively, detrimental to other activities"), and item 66 ("Always does the same activity excluding others"). Higher Cronbach's alpha values resulted when item 66 was removed and made for a marked improvement in values overall.

Because the interpretation of the results depends on a weighted average, their interpretation will not be changed. Interpretation is made according to the weighted average and not the arithmetic mean.

	SPM-P		SPM-P Port.	
	No. of items	$\alpha$	No. of items	$\alpha$
Social Participation (SOC)	10	0,93	10	0,889
Vision (VIS)	10	0,79	10	0,799
Hearing (HEA)	10	0,79	9	0,742
Touch (TOU)	10	0,76	10	0,742
Body Awareness (BOD)	10	0,89	10	0,908
Balance and Motion (BAL)	10	0,72	9	0,800
Planning and Ideas (PLA)	10	0,85	9	0,859
Total Sensory Systems (TOT)*	55	0,94	53	,934

Table 1. Internal consistency of the original SPM-P school form and the Portuguese version  
Source: Elaborated by the authors.

Legend: \* (VIS; HEA; TOU; BOD; BAL; + 5 items of the TASTE and SMELL dimensions).

- Interscale correlations

The correlations among scales within each SPM-P form were studied in the normative sample. As shown in Table 2, the correlations between SOC and other scales were low (ranging from .199 to .374), PLA, VIS, HEA, BOD, BAL, and other scales were low to moderate (ranging from .243 to .708), while correlation with TOT was low to high (ranging from .348 to .857).

	SOC	VIS	HEA	TOU	BOD	BAL	PLA	TOT
SOC	1							
VIS	,199*	1						
HEA	,308**	,678**	1					
TOU	,299**	,310**	,462**	1				
BOD	,343**	,457**	,597**	,359**	1			
BAL	,243*	,613**	,708**	,545**	,525**	1		
PLA	,374**	,609**	,606**	,385**	,407**	,601**	1	
TOT	,348**	,802**	,857**	,653**	,765**	,839**	,664**	1

Table 2. Inter-scale correlations of the SPM-P school form.

Source: Elaborated by the authors.

Legend: \*\*. The correlation is significant for the 0.01 level (bilateral). \*. The correlation is significant at the 0.05 level (bilateral).

- Item scale correlations

Taste and smell items were excluded because they did not have their own scale and were included in TOT. Sixty-two of 67 items (92.5%) correlated most highly (Table 3).

	SOC	VIS	HEA	TOU	BOD	BAL	PLA	TOT
1. Willingly plays with peers in a variety of games and activities.	,62 <sup>**</sup>	,10	,18	,36 <sup>**</sup>	-,01	,16	,26 <sup>**</sup>	,188
2. Waits his or her turn.	,716 <sup>**</sup>	,153	,185	,059	,360 <sup>**</sup>	,136	,197 <sup>*</sup>	,239 <sup>*</sup>
3. Participates appropriately in circle time.	,785 <sup>**</sup>	,225 <sup>*</sup>	,267 <sup>**</sup>	,183	,373 <sup>**</sup>	,064	,340 <sup>**</sup>	,285 <sup>**</sup>
4. Transitions smoothly to new activities.	,716 <sup>**</sup>	,012	,155	,173	,154	,083	,148	,125
5. Enters into play with peers without disrupting the ongoing activity.	,749 <sup>**</sup>	,218 <sup>*</sup>	,256 <sup>*</sup>	,148	,449 <sup>**</sup>	,238 <sup>*</sup>	,216 <sup>*</sup>	,331 <sup>**</sup>
6. Follows class rules and routines.	,759 <sup>**</sup>	,105	,251 <sup>*</sup>	,195	,465 <sup>**</sup>	,108	,168	,284 <sup>**</sup>
7. Shares classroom toys and materials when asked.	,805 <sup>**</sup>	,094	,211 <sup>*</sup>	,259 <sup>**</sup>	,113	,096	,297 <sup>**</sup>	,186
8. Works cooperatively with peers toward a common goal (e.g., during cleanup, block building).	,765 <sup>**</sup>	,158	,258 <sup>**</sup>	,206 <sup>*</sup>	,286 <sup>**</sup>	,236 <sup>*</sup>	,371 <sup>**</sup>	,283 <sup>**</sup>
9. Interacts with peers during pretend play.	,597 <sup>**</sup>	,150	,206 <sup>*</sup>	,312 <sup>**</sup>	,003	,230 <sup>*</sup>	,370 <sup>**</sup>	,219 <sup>*</sup>
10. Resolves peer conflict without teacher intervention.	,567 <sup>**</sup>	,202 <sup>*</sup>	,223 <sup>*</sup>	,269 <sup>**</sup>	,186	,402 <sup>**</sup>	,317 <sup>**</sup>	,311 <sup>**</sup>
11. Squints, cover eyes, or complains about classroom lighting or bright sunlight.	-,069	,670 <sup>**</sup>	,384 <sup>**</sup>	,272 <sup>**</sup>	,290 <sup>**</sup>	,453 <sup>**</sup>	,207 <sup>*</sup>	,549 <sup>**</sup>
12. Is distracted by nearby visible objects or persons (pictures, items on walls, Windows, other children, etc.).	,262 <sup>**</sup>	,695 <sup>**</sup>	,549 <sup>**</sup>	,139	,412 <sup>**</sup>	,399 <sup>**</sup>	,490 <sup>**</sup>	,569 <sup>**</sup>
13. Has difficulty locating items or people by visually scanning the room or playground.	,003	,494 <sup>**</sup>	,474 <sup>**</sup>	,293 <sup>**</sup>	,109	,360 <sup>**</sup>	,443 <sup>**</sup>	,427 <sup>**</sup>
14. Has difficulty finding required items on desk or table among many other items.	,237 <sup>*</sup>	,463 <sup>**</sup>	,309 <sup>**</sup>	,232 <sup>*</sup>	,160	,236 <sup>*</sup>	,453 <sup>**</sup>	,371 <sup>**</sup>
15. Looks around the room or at peers while the teacher is speaking.	,217 <sup>*</sup>	,588 <sup>**</sup>	,451 <sup>**</sup>	,017	,200 <sup>*</sup>	,417 <sup>**</sup>	,451 <sup>**</sup>	,426 <sup>**</sup>
16. Has trouble matching items by color or shape.	,254 <sup>*</sup>	,403 <sup>**</sup>	,246 <sup>*</sup>	,209 <sup>*</sup>	,257 <sup>**</sup>	,200 <sup>*</sup>	,475 <sup>**</sup>	,367 <sup>**</sup>
17. Walks into others who are playing in the playground.	,277 <sup>**</sup>	,623 <sup>**</sup>	,461 <sup>**</sup>	,178	,591 <sup>**</sup>	,387 <sup>**</sup>	,486 <sup>**</sup>	,593 <sup>**</sup>
18. Stares intensely at people or objects.	,013	,729 <sup>**</sup>	,394 <sup>**</sup>	,221 <sup>*</sup>	,151	,404 <sup>**</sup>	,338 <sup>**</sup>	,508 <sup>**</sup>
19. Enjoys watching objects that spin or move, more than most children of his or her age.	,005	,721 <sup>**</sup>	,395 <sup>**</sup>	,134	,247 <sup>*</sup>	,371 <sup>**</sup>	,194	,498 <sup>**</sup>
20. Enjoys looking at moving objects out of the corner of his or her eye.	,005	,552 <sup>**</sup>	,389 <sup>**</sup>	,298 <sup>**</sup>	,378 <sup>**</sup>	,455 <sup>**</sup>	,139	,548 <sup>**</sup>
21. Shows distress (or is upset) at loud sounds (crashing blocks, yelling or crying from other children, noisy hallways, toilet flushing, etc.).	-,218 <sup>*</sup>	,313 <sup>**</sup>	,455 <sup>**</sup>	,368 <sup>**</sup>	,082	,362 <sup>**</sup>	,260 <sup>**</sup>	,377 <sup>**</sup>



	SOC	VIS	HEA	TOU	BOD	BAL	PLA	TOT
23. Appears unaware of new voices and new sounds in the room.	,271"	,440"	,542"	,295"	,257"	,502"	,493"	,494"
24. Is unable to determine the location of sound and voices.	,225"	,450"	,604"	,332"	,285"	,376"	,445"	,514"
25. Makes noises, hums, sings, or yells during quiet class time.	,328"	,271"	,568"	,230"	,522"	,313"	,306"	,488"
26. Likes to cause certain sounds to happen repeatedly (e.g., flushing toilet several times in a row).	,365"	,455"	,670"	,324"	,702"	,538"	,406"	,686"
27. Seems unaware of sounds that are noticed by others.	,257"	,357"	,512"	,309"	,280"	,511"	,370"	,490"
28. Has trouble paying attention when the classroom is noisy.	,189"	,410"	,699"	,121"	,380"	,387"	,347"	,486"
29. Appears unable to follow verbal directions.	,188"	,489"	,686"	,240"	,402"	,483"	,379"	,563"
30. Is bothered or comments on constant background sounds that others ignore (e.g., fans, ticking clocks).	,184"	,450"	,489"	,300"	,215"	,315"	,240"	,451"
31. Avoids being touched by others (e.g., refuses to be cuddled or hugged, refuses to hold hands in line).	,143"	,184"	,296"	,556"	,127"	,481"	,086"	,376"
32. Shows distress when hands or face are dirty (with glue, finger paintings, food, dirt, etc.).	,114"	,069"	,192"	,745"	,011"	,230"	,226"	,292"
33. Shows distress when washing hands in either hot or cold water.	-,214"	-,016"	,163"	,364"	-,001"	-,018"	,022"	,109"
34. Is distressed by accidental touch of peers (may lash out or withdraw).	,329"	,225"	,297"	,692"	,215"	,523"	,215"	,460"
35. Does not clean saliva or food from face.	,134"	,067"	,272"	,382"	,276"	,045"	,115"	,284"
36. Is distressed by the feel of certain textures (classroom materials, utensils, sports equipment, etc.).	,215"	,156"	,307"	,659"	,173"	,302"	,277"	,375"
37. Refuses to wear "dress-up" clothing.	,143"	,239"	,359"	,587"	,279"	,300"	,221"	,450"
38. Has an unusually high tolerance to pain (e.g., shows little or no distress at cuts and bruises that other children would find painful).	,041"	,301"	,273"	,417"	,256"	,193"	,207"	,396"
39. Seems unaware of the need to use the toilet (or when diaper is wet or soiled).	,281"	,463"	,350"	,476"	,474"	,481"	,513"	,585"
40. Avoids touching or playing with finger paints, paste, sand, clay, mud, glue, or other messy things.	,248"	-,031"	,099"	,639"	,174"	,222"	,140"	,254"
41. Tastes or licks nonfood items (playground equipment, furniture, toys, etc.).	,130"	,568"	,381"	,271"	,486"	,290"	,341"	,563"
42. Seems unaware of strong or unusual odours (glue, paint, markers, etc.).	,154"	,501"	,358"	,376"	,267"	,456"	,579"	,542"
43. Shows distress at odours that come from soap, perfume, hairspray, or skin lotions.	,054"	,107"	,273"	,365"	,261"	,013"	-,047"	,284"

	<b>SOC</b>	<b>VIS</b>	<b>HEA</b>	<b>TOU</b>	<b>BOD</b>	<b>BAL</b>	<b>PLA</b>	<b>TOT</b>
44. Shows distress from tastes of foods that do not bother other children.	-,014	,277**	,215*	,305**	,093	,324**	,093	,329**
46. Moves chair roughly (shoves chair under desk or pulls out chair with too much force).	,293**	,314**	,417**	,218*	,766**	,312**	,267**	,543**
47. Accidentally breaks glue sticks, crayons, or pencils, or tears paper from too much force.	,183	,303**	,275**	,224*	,632**	,354**	,445**	,486**
48. Jumps excessively; seeks out "crash landings" from heights.	,123	,394**	,434**	,252*	,781**	,413**	,179	,591**
49. Slams door shut or opens doors with excessive force.	,270**	,316**	,585**	,348**	,876**	,500**	,281**	,667**
50. Uses too much force when playing with objects (e.g., bangs musical instruments or crashes blocks into one another).	,240*	,468**	,546**	,288**	,873**	,544**	,350**	,700**
51. Bumps into peers excessively (e.g., while in line or moving around the playground).	,233*	,326**	,517**	,340**	,840**	,497**	,318**	,639**
52. Chews or mouths clothing, pencils, crayons, or classroom containers.	,275**	,369**	,330**	,318**	,590**	,282**	,405**	,507**
53. Handles food and drink containers too roughly (may dent, break, or spill containers).	,314**	,363**	,463**	,404**	,810**	,443**	,426**	,651**
54. Knocks over other children's building projects (e.g., blocks, marble runs, tracks, cars).	,424**	,301**	,425**	,174	,642**	,278**	,244*	,479**
55. Closes scissors forcefully with tight squeeze for each snip.	,239*	,264**	,393**	,059	,559**	,153	,204*	,379**
56. Twirls or spins excessively on equipment.	,041	,387**	,435**	,253*	,618**	,519**	,263**	,567**
57. Leans on walls, furniture, or other people for support when standing.	,118	,351**	,429**	,405**	,376**	,698**	,320**	,558**
58. Slumps, leans on desk/table, or holds head up in hands while seated at desk/table.	,288**	,504**	,630**	,484**	,737**	,797**	,574**	,793**
59. Seems excessively fearful of movement activities, such as riding swings, teeter-totters, slides, or other playground equipment.	,141	,286**	,345**	,386**	,022	,584**	,281**	,384**
61. Becomes disoriented or shows fear when leaning over to get materials off the ground.	,034	,235*	,265**	,267**	-,095	,489**	,094	,263**
62. Fails to catch himself or herself when falling.	,182	,436**	,415**	,369**	,194	,716**	,371**	,521**
63. Shows distress when on high playground equipment.	,146	,389**	,536**	,401**	,194	,725**	,353**	,536**
64. Has poor coordination.	,202*	,481**	,490**	,203*	,447**	,591**	,574**	,565**
65. Has difficulty moving body to rhythm (e.g., clapping hands, tapping feet).	,151	,337**	,369**	,270**	,212*	,489**	,473**	,406**
67. Has trouble coming up with new ideas during play activities.	,272**	,431**	,434**	,151	,277**	,302**	,784**	,411**

	SOC	VIS	HEA	TOU	BOD	BAL	PLA	TOT
68. Plays repetitively during free time; does not alter an activity to increase challenge.	,162	,351**	,506**	,178	,271**	,354**	,549**	,409**
69. Requires realistic props (e.g., play telephone) to engage in pretend play.	,247*	,360**	,496**	,260**	,266**	,565**	,559**	,476**
70. Has difficulty correctly imitating demonstrations (e.g., movement games, songs with motions).	,316**	,554**	,471**	,273**	,323**	,519**	,838**	,550**
71. Plays own games, avoids imitating others.	,091	,216*	,279**	,260**	,081	,228*	,486**	,254*
72. Has difficulty copying an adult or another child when building with blocks.	,351**	,381**	,249*	,188	,294**	,271**	,728**	,375**
73. Has difficulty using both hands for cutting, drawing, and painting (e.g., one hand holds the paper while the other works).	,368**	,405**	,278**	,243*	,345**	,349**	,735**	,429**
74. Fails to complete tasks with multiple steps.	,259**	,559**	,567**	,417**	,400**	,644**	,788**	,652**
75. Fails to perform the proper sequence of actions in everyday routines (e.g., putting away school materials, throwing trash out after snack time, putting coat on when time to go home).	,203*	,525**	,571**	,481**	,240*	,567**	,671**	,603**

Table 3. Reviewed item-scale correlations of the SPM-P school form.

Source: Elaborated by the authors.

- Gender and age differences

We verified that there was no statistical significance between genders ( $p < 0.05$ ); so, the same instrument can be used reliably for girls and boys (Table 4).

Total e Dimensions	Male		Female		T	p
	Mean	SD	Mean	SD		
Social participation (SOC)	20,56	4,83	18,06	5,20	2,498	0,014
Vision (VIS)	14,17	3,64	13,79	3,40	0,539	0,591
Hearing (HEA)	11,19	2,51	11,06	2,20	0,285	0,776
Touch (TOU)	12,13	2,60	12,08	2,56	0,107	0,915
Body Awareness (BOD)	12,58	3,94	11,20	2,98	1,972	0,051
Balance and Motion (BAL)	10,35	2,37	10,75	2,77	-0,780	0,437
Planning and Ideas (PLA)	11,31	3,25	10,85	2,62	0,771	0,443
Total Sensory Systems (TOT)	66,35	13,09	64,8	11,62	0,613	0,541

Table 4. Results of the T test between the results of the SPM-P - School form and the child's gender.

Source: Elaborated by the authors.

We decided to put the children in two age groups: two-year-olds and three- to five-year-olds. We found no statistical significance ( $p < 0.05$ ) in the social participation (SOC) and body awareness (BOD) (Table 5). It should also be highlighted that average values were higher in children aged two to three (we used the weighted average to make comparability easier).

	2-3 year of age			3-5 year of age			U	p
	Mean*	median	SD	Mean*	median	SD		
Social participation (SOC)	2,04	2,05	0,48	1,90	2,00	0,52	752,500	,197
Vision (VIS)	1,72	1,65	0,39	1,30	1,20	0,27	297,500	,000
Hearing (HEA)	1,39	1,33	0,33	1,19	1,11	0,22	507,500	,001
Toque (TOU)	1,45	1,35	0,32	1,13	1,00	0,17	335,000	,000
Body Awareness (BOD)	1,45	1,50	0,29	1,31	1,25	0,31	719,000	,082
Balance and Motion (BAL)	1,41	1,28	0,44	1,10	1,00	0,16	446,000	,000
Planning and Ideas (PLA)	1,37	1,22	0,42	1,19	1,06	0,28	607,500	,010
Total Sensory Systems (TOT)	1,46	1,38	0,30	1,16	1,12	0,15	274,000	,000

Table 5. Mann Whitney U test results between the SPM-P school form and the child's age. Source: Elaborated by the authors.

## 5 DISCUSSION

In this study, the SPM-P-Portugal school form was adapted from the original English language SPM-P school form. The advantage of the SPM-P-Portugal school form was that it gathered comparable scale scores from school to school, providing comprehensive information about the sensory profiles of the children in the study. Several procedures were adopted to examine the reliability, content validity and construct validity of the SPM-P-Portugal form. The results of this study showed that the SPM-P-Portugal school form was a reliable and a valid tool for screening for sensory processing difficulties in children between two and five years old.

As shown in Table 1, the internal consistency of data gathered using the Portuguese SPM-P school form was good for five out of eight schools. These classroom forms had Cronbach's alpha values of .80 or greater. There were no coefficients less than .70.

In the "hearing" sub-scale, it was noted in a first analysis that item 22 resulted in a correlation value of -.003, which was below the minimum required level (.20) and proved problematic. As a consequence, item 22 was deleted. Although item 21 presented higher Cronbach's alpha values than the total dimension (.76), this item was not discarded, as it was relevant for our evaluation from a clinical content point of view.

Analysis of Cronbach's alpha values for the "touch" dimension found good internal consistency ( $\alpha = .74$ ), as all the items had a correlation value greater than .20, the integrity of all items in this dimension was maintained. In the first analysis of the sub-scale "balance" Cronbach's coefficient alpha was good (.791). However, item 60 had a correlation value of less than .20 which did not relate sufficiently to the dimension total without the item ( $ritc = .100$ ). We therefore deleted this item from the sub-scale, raising Cronbach's alpha values (.800) and

the other items were also better related. If we compare these values with results obtained in the original English version (Glennon et al., 2011), we can see that the values of Cronbach's alpha are higher in this dimension (.720). However, the dimension lost one item as compared to the original version (number of SPM-P-Portugal items: 9, number of SPM-P-US items: 10).

In the subscale analysis of "motor planning and ideas," the only item with a Cronbach's alpha greater than the  $\alpha$  total was item 66 with a total correlation value of  $r_{itc}=.161$ . When eliminated,  $\alpha$  values improved (.859) as did correlation between items, which is advocated by several authors (Nunnally & Bernstein, 1994; Streiner & Norman, 2008).

Although some items (e.g. 27, 39, 41, etc.) show a correlation with more than one dimension, we chose to keep them in the original dimension given the analysis of the construct and content as for example, the item 16 (which also has a strong correlation with Motor Planning dimension). However, considering the construct and content validity we had to consider whether the item would be well defined in one or another dimension. For that, it was consulted the "sensory integration vulnerability" that contribute to the child's dysfunction with the sensory system and that the authors presented in the original SPM-P manual. Analyzing the item and considering that it intends to evaluate the "perception" (sensory integration vulnerability) (Parham et al., 2007, p. 18) we chose to keep it in the dimension to which it belongs instead of placing it in the "Motor Planning" dimension. Effectively, in terms of sensorial integration vulnerabilities, the "Motor Planning" dimension is only composed of items that evaluate "ideation" and "motor planning", so there is no framework here for an item like 16 on Motor Planning dimension. Item 27 belongs to "Hearing" dimension and has a very close correlation with the balance dimension; however, it maintains the highest value (.512) in its own dimension when compared to the dimension "balance" (.511). Regarding item 39 it was chosen to keep it in the original dimension (Touch) given its construct validity. The great majority of items belonging to "Touch" dimension are items that assess tactile hyperactivity. In 10 items that make up the "Touch" dimension, only three belong to hyporesponsiveness as item 39. Again, considering the construct validity, if it were removed from this dimension, it would be a significant loss since "Touch" dimension would be left with only two items to assess hyperresponsiveness.

## 6 CONCLUSION

According to the *Division for Early Childhood* (2014), assessment is a critical component of services that support children with dysfunctions. It serves the purpose of screening and determining eligibility for services, planning individualized interventions, monitoring a child's progress, and determining whether objectives are being achieved. Validation quality inherent in the instruments of assessment determines the accuracy of and confidence in the information obtained. With culturally validated instruments, we intend to obtain valid and reliable information capable of supporting decision-making. It is in pursuit of this objectivity that quantitative tests or standards-referenced tests are particularly relevant; as is the case with the SPM-P-Portugal. Despite the efforts made by researchers, the SPM-P-Portugal school form has yet to be validated for purposes of determining percentiles and standardized values, as happened with the original English-language instrument.

The SMP school form for Portuguese children can be used to assess sensory processing disorders and allows decisions to be made with the confidence that there are few measurement errors. Based on these results, professionals can legitimately determine whether to refer a child with a sensory processing disorder to specific services or whether, together with the family, to design intervention programs tailored to the needs of the child (Bagnato, 2008).

## 6.1 LIMITATIONS AND FURTHER RESEARCH

The current study had some limitations. There is a scarcity of studies on the validation of the SPM-P leading to difficulty in comparing results with other findings. Convergent validity has not been achieved because it is a recent assessment area in Portugal and there is no other validated instruments with the same purpose. The typical sensory processing of the Portuguese children was not presented in this work because researchers are currently doing the clinical validation to determine percentiles as original authors do.

In addition, further research with a larger sample size is recommended. The authors of this study hope that its publication will stimulate additional research. Projects that will build constructively on the current database include: a) psychometric validation for the second form, SPM-P home form;; b) cross-validation of the SPM-P factor structure across diverse clinical samples using confirmatory factor analysis; c) studies of the relationship between the SPM-P scales and direct performance assessments of children's sensorimotor function, such as Peabody Developmental Motor Scales (Folio & Fewell, 2000; Lingiardi & McWilliams, 2017); and d) treatment outcome studies using the SPM-P as the measure of change following sensory integration-based occupational therapy and/or school-based sensory and environmental strategies.

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