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Psychometric Properties of the Sensory Processing and Self-Regulation Checklist- Tagalog Version

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Abstract

Background: The Sensory Processing and Self-Regulation Checklist (SPSRC) is a parent or caregiver-reported instrument that measures a child's self-regulation and sensory processing ability as they perform daily activities. The original version in Chinese and a more recent English version has reported favorable reliability and validity. While the SPSRC has undergone translation into a Tagalog version, its psychometric properties are unknown. **Objectives:** This study aims to examine the psychometric properties of the SPSRC-Tagalog. **Methods:** Reliability and validity properties were tested among a sample of Filipino children with (*n*= 45) and without disability (*n*= 45), based on the reports of the parents or caregivers on the SPSRC-Tagalog. **Results:** This study found that the SPSRC-Tagalog has good internal consistency, excellent test-retest reliability, and good cross-cultural, discriminant, structural, construct, and criterion validity. **Conclusion:** The psychometric properties of the SPSRC-Tagalog corroborate with its other language versions in its reliability and validity to measure the sensory processing and self-regulation abilities in Filipino children with and without a disability. The information obtained from the SPSRC-Tagalog may be useful in informing our understanding of sensory processing difficulties among children.

Keywords: *SPSRC; sensory processing; self-regulation; psychometric property; children*

INTRODUCTION

Sensory processing is the ability of an individual to organize, regulate, and interpret external sensory stimuli in order to adaptively respond to the environment.[1-3] This is supported by nervous systems, both the central and peripheral regions.[4-7] The ability to process sensory information adaptively lays the foundation for learning more advanced skills and behaviors needed to support a child's development.[8,9] Sensory processing difficulties can occur in both typically developing children and children with various forms of developmental disabilities.[10] The prevalence of sensory processing difficulties occurs as much as 5-25% among the normative population and as high as 40-90% among clinical childhood populations.[2,11-15] Signs of sensory processing may involve one or a combination of sensory overresponsiveness, underresponsiveness, or seeking/craving.[16]

Self-regulation is one's ability to change in order to meet the demands of the internal and external environments.[17] Adaptively responding to the external environment involves regulating internal processes and mechanisms, often related to the functions of the central and peripheral nervous system.[18] The development of self-regulation is grounded on well-functioning neurophysiological foundations to

support behavioral regulation.[19,20] Difficulties in self-regulation and sensory processing may overlap.[21-23] A child may have difficulty regulating their behaviors because they are overresponsive or underresponsive to sensory input. Nevertheless, the maladaptive behavior may occur exclusive of sensory processing difficulties. Thus, it is important to understand the possible factors contributing to children's behavioral patterns.[24]

The Sensory Processing and Self-Regulation Checklist[24,25] was developed as a single instrument that can measure sensory processing and self-regulation abilities of children. It is composed of two parts: self-regulation and sensory processing. The self-regulation section provides information on the patterns of behavioral regulation reflecting exclusive self-regulation abilities. The sensory processing section provides information on a child's patterns of behaviors in response to different sensory inputs that they encounter in daily life activities. The original version of the SPSRC is in Chinese and was tested to have good reliability and validity properties.[24,25] More recently, an English version was published and found to have good psychometric properties comparable to the original version.[26] While the English version might be useful for a bilingual population such as the case of the Philippines, there is still a need for a linguistically equivalent and cross-culturally adapted instrument that reflects the constructs within the target context.[27] A Tagalog version of the SPSRC was developed that addresses these issues.[27] However, it is unknown whether the same constructs remain in the process of translation and adaptation.[28]

This study aims to examine the psychometric properties of the SPSRC-Tagalog, specifically testing its reliability and validity. The information obtained from the SPSRC-Tagalog may support our current understanding of sensory processing difficulties among childhood populations.

METHODS

Participants. This study recruited *n*= 90 Filipino boys and girls using convenient sampling methods (45 typically developing children; 45 children with disabilities). The recruited participants represent a subsample of the larger part of this study which determines the factorial validity of the SPSRC-Tagalog. The typically-developing children included in this study are currently enrolled in a regular classroom that appropriately matches their developmental age, without any significant parent-reported medical, psychological, or developmental condition as reported by their parents. If the child failed a grade level (as reported by their parents), this warranted exclusion. Children with disabilities were identified based on parent-reported declarations or submitted medical, educational, or legal reports. The person most knowledgeable (i.e., spends the most time with the child) completed the questionnaires used in this study. All participants are of Filipino descent and residing in the Greater Metro Manila Area, and the person most knowledgeable about the child should have completed at least secondary school and bilingual (i.e., Tagalog and English). This study has been given ethical approval from the Ethics Review Committee of the University of Santo Tomas-College of Rehabilitation Sciences.

Instruments

Sensory Processing and Self-Regulation Checklist (SPSRC). The SPSRC[25] is a checklist that can measure both sensory processing and self-regulation abilities among children. It is comprised of 130-items divided into two parts with subscale and factor scales, each that has individual scores apart from a composite total score. Part 1 of SPSRC measures self-regulation abilities (37 items) further divided into three sections: 1) physiological, 2) social/cognitive/emotional and 3) facing changes or challenges); and four-factor scales: 1) emotional regulation, facing challenges, 2) emotional regulation, facing changes, 3) physiological regularity and response to soothing, and 4) autonomic activity. Part 2 of SPSRC measures sensory processing abilities (93 items), which is subdivided into six subscales: 1) auditory, 2) visual, 3) tactile, 4) gustatory/olfactory, 5) vestibular, and 6) proprioceptive; and four-factor scales: 1) sensory-seeking behavior, 2) sensory underresponsivity, 3) sensory overresponsivity, and 4) stability of sensory responsivity). SPSRC

is accomplished by parents or caregivers who know the child's typical performance in everyday situations using a 5-point Likert scale (5: Never, 4= seldom, 3= Sometimes, 2= Most of the time, 1= Always). Scoring is accomplished by adding certain items together (some items with scoring reversed), where a higher score denotes a more favorable performance. In this study, we used the SPSRC-English version,[29] which has been found to be reliable and valid,[26] and the cross-culturally translated SPSRC-Tagalog version.[27] In this study, we used an online version of these checklists. Specific to this study, we found the composite internal consistency for SPPSRC-Tagalog and SPSRC-English to be at Cronbach's α= 0.98 and 0.98, respectively.

Short Sensory Profile (SSP). The SSP measures a child's ability to process sensory information as they participate in daily activities completed by a parent/caregiver.[30] Each item is rated using a 5-point Likert scale where a higher score indicates a more favorable performance across seven sections and a composite total score. The reliability and validity of the SSP have been previously described elsewhere.[30] We used an online version of the tool to gather data. When used in this study, the online version of the SSP had an internal consistency of Cronbach's α= 0.90.

Sense and Self-Regulation Checklist (SSC). The SSP is an instrument completed by the child's parent/caregiver that measures behaviors and symptoms in daily life situations related to sensory processing and self-regulation in children with autism.[23] It has six sensory subdomains (touch-pain, auditory, visual, taste-smell, hyperreactive to non-injurious stimuli, and hyporeactive to injurious stimuli) translated into 65 items, each answered using a three-point Likert scale; higher scores indicate a performance that is less favorable. The reliability and validity of SSC have previously been reported.[23] This study used an online version of the tool, and when its internal consistency was computed, the results indicate a Cronbach's α= 0.91.

Procedures. This study was conducted between April 2020 – March 2021. All methods were done through online means. Participants were recruited through various procedures, which included seeking the assistance of the Department of Education, recruitment from university partner institutions and communities, online forums and groups, and personal networks. Parents who consented to participate were contacted individually using their preferred means (i.e., email, text message, social network messaging) to send them a link to the online checklists and questionnaires. They were instructed to accomplish the forms based on their child's performance within the last twelve weeks. A conveniently sampled subgroup of these parents was asked to either answer a different version of the SPSRC (Tagalog or English) after two weeks of submitting their initially completed forms. Parents were given reminders if, after two weeks, they have not yet returned the forms. The researchers exerted all effort to request completion of incomplete forms. All data collected were anonymized and encrypted in a password-protected cloud and hard drives to maintain its utmost confidentiality.

Data Analysis. Testing of the psychometric properties was guided by the COSMIN checklist.[31] We used SPSS ver 23.0 for data management and all statistical computations of SPSRC-Tagalog's reliability and validity measures.

Reliability properties were measured in terms of internal consistency and test-retest reliability using Cronbach's α and *ICC*, respectively for SPSRC-Tagalog Parts 1 and 2, and total scores.

Validity measures were tested using several properties. Cross-cultural validity was accomplished by comparing scores on the SPSRC Tagalog and English versions using internal consistency measures represented by Cronbach's α. Construct validity was tested using hypothesis testing, which involved discriminant, structural and known-groups validity. We used Pearson's correlation coefficient to test SPSRC-Tagalog's discriminant properties by examining the relationship between Parts 1 and 2. Structural validity was evaluated to determine the dimensionality of the subscales and factor scales for each part of SPSRC-Tagalog using intraclass correlation statistics. Group differences on the mean scores for SPSRC-Tagalog between typically developing children and those with

disabilities were tested using an independent t-test. Criterion validity was tested using known instruments (i.e., SSP, SSC) to determine whether the constructs of SPSRC-Tagalog are related to similar commonly used instruments. An alpha level of 0.05 was set to determine statistical significance.

RESULTS

Participant Demographics. This study was able to recruit *n*= 90 (45 without disabilities; 45 with disabilities) school-aged children with a mean age of 8.07 (2.13) years in this study, with an age range of 4-12 yr. There were more males (56.90%) in this sample compared to females. The specific diagnosis of the sampled children with disabilities varied. Table 1 presents a summary of the demographics of the participants in this study.

Table 1. Summary of participant characteristics (*n*= 90).

Variables	Typically Developing Children	Children with Disability
Sample	45	45
Age (*M* ± *SD*)	8.24 ± 2.27	7.93 ± 1.97
Gender	Girls: 48.89% Boys: 51.11%	Girls: 33.33% Boys: 66.67%
Condition		ASD: 60.00% ADHD: 11.11% GDD: 8.89% Others: 20.00%

Internal Consistency. The consistency of responses to the items of the SPSRC-Tagalog was tested to determine whether each part of the checklist and the composite scores measured the same general construct. Cronbach's α coefficients were 0.88 and 0.87 for the items in Part 1 (37 checklist items) and Part 2 (93 checklist items) of the SPSRC, respectively. Overall, Cronbach's α coefficient for the SPSRC composite (130 checklist items) was 0.98.

Test-Retest Reliability. The test-retest validity of SPSRC-Tagalog was evaluated by comparing Parts 1 and 2 and Total scores on two separate occasions (two weeks apart) among a conveniently sampled *n*= 25 typically developing children with the same parent/caregiver answering the checklist. This sample has been deemed ample for the psychometric property being tested.[31,32] The test-retest coefficient represented by *ICC* was 0.98 for Part 1, 0.99 for Part 2, and 0.99 for the Total score.

Cultural Validity. The cultural validity of SPSRC-Tagalog was tested by comparing Parts 1 and 2 and Total scores with those of the original SPSRC-English version among a conveniently sampled *n*= 20 typically developing children. This sample has been deemed ample for the psychometric property being tested.[31,32] The parents or caregivers of the sampled children answered both versions of the SPSRC twice with a two-week interval for each measurement (the same parent/caregiver answering the checklist). The Cronbach's α was 0.97 for Part 1, 0.99 for Part 2, and 0.99 for the Total score.

Discriminant Validity. The discriminant validity was examined by testing the relationship between the mean scores of Part 1 (Self-regulation ability) and Part 2 (Sensory processing ability) of the SPSRC-English. The Pearson correlation coefficient was r= 0.78, p<0.000.

Structural Validity. The structural validity of SPSRC-English was examined using intraclass correlation statistics for the subscale (r= 0.72, p<0.001) and factor scale (r= 0.61, p<0.001) of Part 1 and was found to be significant. Similar significant results were also obtained for the subscale (r= 0.91, p<0.001) and factor scale (r= 0.80, p<0.001) of Part 2.

Known-Groups Validity. We compared the SPSRC-Tagalog mean scores (part, subscale, factor, composite) between a sample of 45 typically developing children, and 45 children with disability using an independent t-test (Table 2). The results indicate significant differences in self-regulation ability (p<0.001), sensory processing ability (p<0.001), and overall ability (p<0.001). Typically-developing children showed significantly higher scores indicative of favorable performance.

Concurrent Validity. Mean scores (part, subscale, factor, and composite) of *n*= 45 children with disabilities ages 4-12 years on their SPSRC-Tagalog were examined on their

concurrent relationship to respective scores on the SSP with SSP and SSC (Table 3).

The overall direction Pearson correlation between the SPSRC-Tagalog and SSP was positive, with the magnitude of relationship ranging from weak to moderate. For factor score correlations, only the SPSRC-Tagalog factor scores for Sensory underresponsivity and SSP factor score for Underresponsive/Seeks Sensation reached a significant moderate correlation (r= 0.46, p= 0.03).

Generally, we found negative correlations between the SPSRC-Tagalog and SSP, with the strength of relationship ranging from weak to moderate. The Pearson correlation between the total scores of the second parts of SPSRC-Tagalog and SSC (sensory domain) is significantly moderate (r= -0.48, p= 0.025). We compared relevant SSC domains with Part 1 scores of the SPSRC-Tagalog. There was significant correlation between SPSRC-Tagalog Social/cognitive/ emotional subscale and the SSC Self-regulation (Behaviour: Irritability, Aggression, Self-injurious) subdomain (r= -0.43, p= 0.048); and the SPSRC-Tagalog Facing changes or challenges subscale with the SSC Self-regulation (Orientation/Attention/Self-soothing/Sleep) subdomain (r= -0.48, p= 0.026). Likewise, the results indicate that the SSC Self-regulation (Orientation/Attention/Self-soothing/Sleep) subdomain was significantly correlated with the Autonomic activity SPSRC-Tagalog factor subscale (r= -0.49, p= 0.020).

Table 2. Summary of mean scores comparison on the SPSRC-Tagalog (n= 90).

SPSRC-Tagalog Scores		**Typically Developing Children (n= 45)**	**Children with Disability (n= 45)**	***p***
Part 1: Self-regulation ability		85.11 ± 15.36	65.49 ± 12.47	<0.001
Subscale	A. Physiological	23.87 ± 4.95	21.44 ± 5.03	0.024
	B. Social/cognitive/emotional	35.44 ± 6.16	27.00 ± 5.25	<0.001
	C. Facing changes or challenges	25.80 ± 8.06	17.04 ± 5.96	<0.001
Factor scale	1. Emotional regulation, facing challenges	22.87 ± 5.67	19.22 ± 4.82	0.001
	2. Emotional regulation, facing changes	11.76 ± 3.43	11.04 ± 2.67	0.28
	3. Physiological regularity and response to soothing	30.16 ± 7.79	21.64 ± 6.14	<0.001
	4. Autonomic activity	20.33 ± 7.41	13.58 ± 4.65	<0.001
Part 2: Sensory processing ability		189.53 ± 47.14	137.84 ± 44.61	<0.001
Subscale	A. Auditory	28.60 ± 9.95	21.40 ± 7.83	0.026
	B. Visual	22.89 ± 8.98	18.80 ± 8.12	<0.001
	C. Tactile	35.40 ± 14.09	25.53 ± 8.81	<0.001
	D. Taste and smell	26.84 ± 8.26	18.73 ± 6.56	<0.001
	E. Vestibular	39.78 ± 11.10	29.18 ± 11.14	<0.001
	F. Proprioceptive	36.02 ± 10.21	24.20 ± 7.17	<0.001
Factor scale	1. Sensory-seeking behaviour	78.93 ± 21.13	54.00 ± 17.15	<0.001
	2. Sensory underresponsivity	39.36 ± 12.32	31.58 ± 12.71	0.004
	3. Sensory overresponsivity	57.42 ± 20.11	41.49 ± 14.84	<0.001
	4. Stability of sensory responsivity	13.82 ± 5.48	10.78 ± 5.55	0.01
Overall ability		274.64 ± 59.28	203.33 ± 53.52	<0.001

Table 3. Summary of correlation between SPSRC-Tagalog, SSP, and SSC scores among children with disabilities (*n*= 45).

SSP			SPSRC-Tagalog	SSC		
p	***r***	**Items**		**Items**	***r***	***p***
			Part 1			
			Subscale			
			Physiological	Self-regulation – Orientation/Attention/Self-soothing/Sleep	-0.27	0.23
				Self-regulation – Toilet Training	-0.2	0.36
			Social/cognitive/ emotional	Self-regulation - Digestion	-0.3	0.88
				Self-regulation – Orientation/Attention/Self-soothing/Sleep	-0.19	0.39
				Self-regulation – Behaviour: Irritability, Aggression, Self-injurious	-0.43	0.048
			Facing changes or challenges	Self-regulation – Orientation/Attention/Self-soothing/Sleep	-0.48	0.026
			Factor			
			Emotional regulation, facing challenges	Self-regulation – Orientation/Attention/Self-soothing/Sleep	-0.2	0.38
				Self-regulation – Behaviour: Irritability, Aggression, Self-	-0.37	0.08
			Emotional regulation, facing changes	Self-regulation – Orientation/Attention/Self-soothing/Sleep	-0.13	0.56
				Self-regulation – Behaviour: Irritability, Aggression, Self-injurious	-0.34	0.12
			Physiological regularity and response to soothing	Self-regulation – Orientation/Attention/Self-soothing/Sleep	-0.11	0.64
			Autonomic activity	Self-regulation – Orientation/Attention/Self-soothing/Sleep	-0.49	0.02
				Self-regulation – Toilet Training	-0.07	0.77
				Self-regulation - Digestion	-0.39	0.08
			Part 2			
			Subscale			
0.37	0.2	Auditory Filtering	Auditory	Hearing	-0.44	0.4
0.12	0.34	Visual/Auditory Sensitivity	Visual	Vision	-0.07	0.76
0.79	0.06	Tactile Sensitivity	Tactile	Touch/Pain	-0.13	0.56
0.13	0.33	Taste/Smell Sensitivity	Taste and smell	Taste/Smell	-0.04	0.85
0.15	0.32	Movement Sensitivity	Vestibular			
0.85	0.04	Low Energy/Weak	Proprioceptive			
0.06	0.42	Total	Total	Total	-0.48	0.025
			Factor			
0.06	0.04	Underresponsive/Seeks Sensation	Sensory-seeking behaviour			
0.03	0.46	Underresponsive/Seeks Sensation	Sensory underresponsivity			
0.97	0.01	Visual/ Auditory Sensitivity				
0.83	0.05	Tactile Sensitivity	Sensory overresponsivity			
0.45	0.17	Taste/Smell Sensitivity				
0.53	0.14	Movement Sensitivity				

Discussion

This study examined the psychometric properties of the SPSRC-Tagalog, a cross-culturally translated version[27] of the original SPSRC in Chinese[24,25] and the recently published English version.[26,29] The original version of the SPSRC was designed as a single instrument that measures the self-regulation and sensory processing abilities of 3 to 8-year-old children with and without Autism. However, the results of this study suggest that it may also be useful to a wider age range (i.e., 4-12 yrs.) across other clinical conditions and corroborate the initial findings of its English version.[26]

The process of cross-culturally translating the SPSRC-Tagalog has been reported elsewhere.[27] However, this study provides salient support on its cross-cultural validity using statistical testing. On both parts and the composite score of the SPSRC, the English and Tagalog version of the SPSRC has demonstrated stability and consistency of responses. The SPSRC-English version has previously been tested and recommended among Filipino parents to determine their children's sensory processing and self-regulation abilities.[26] Cross-cultural validation can inform end-users whether important differences exist between different language versions of an instrument.[31,32] In a multilingual and predominantly bilingual population such as the case of Filipinos, the SPSRC-Tagalog, therefore, affords an additional option of language preference to parents and concerned clinicians.

The reliability properties of the SPSRC-Tagalog were assessed at the levels of its internal consistency and test-retest reliability. This study demonstrates a high level of interrelatedness among the SPSRC-Tagalog for its parts and as a whole, which supports earlier similar findings reported for its Chinese[24,25] and English version.[26] The excellent test-retest reliability of the SPSRC-Tagalog mirrors that of its other language versions[24-26] in its ability to steadily measure children's sensory processing and self-regulation abilities over time in the absence of major changes.

Adopting the COSMIN taxonomy, discriminant validation was accomplished to determine whether the salient measures of sensory processing and self-regulation abilities measured by the SPSRC-Tagalog do not overlap.[31] We found a moderate correlation between Parts 1 and 2 of the SPSRC-Tagalog, below the traditionally set 0.85 thresholds.[33] A similar finding was reported for its English version.[26] The findings in this study provide supporting evidence that the SPSRC-Tagalog is able to sufficiently differentiate a child's sensory processing and self-regulation abilities. SPSRC-Tagalog allows a more specific assessment of a child's behavior as to whether the underlying issues are related to difficulty in sensory processing, self-regulation, or both.

Structural validity testing was approached by looking at the unidimensionality of the subscales and factor scales between Parts 1 and 2 of the SPSRC-Tagalog. The structural validity of an instrument reflects how well the dimensions of its different constructs adequately parallel each other.[31] This study demonstrates significant positive relationships among these construct dimensions, similar to its English language version,[26] which suggests validity in the analogous measurement of the intended measure of the instrument. Nevertheless, the structural validity of the SPSRC-Tagalog will need to be robustly tested in a larger population in the future to determine whether standardized loadings for the same subscales and factor scales of its Parts 1 and 2 are unidimensional, similar to the factor analysis of its Chinese language version.[24,25]

The SPSRC was developed to measure sensory processing and self-regulation abilities among typically developing children and children with autism.[24,25] However, its English version suggested that its use can be extended to other types of disabilities.[26] This study corroborates the latest findings in the ability of the SBSRC-Tagalog to detect known group differences, especially when comparing children with and without disabilities.

The construct measured by the SPSRC is unique in its ability to provide a single instrument that can measure both sensory processing and self-regulation abilities among children, thus finding a similar instrument is challenging.[34,35] This study found positive correlations between similar items of the SPSRC-Tagalog and the SSP,

demonstrating the former's criterion validity. The original SPSRC demonstrated similar results when compared to the Chinese Sensory Profile.[24,25] This was further corroborated with the criterion validity of the SPSR-English when examined with the SSP.[26] Furthermore, we found similar results when the SPSRC-Tagalog was correlated with the SSC. The negative correlations, owed to the opposite Likert scale of the two instruments, throughout the different subscales and factor scales of the SPSRC-Tagalog and SSC parallels the results criterion validity reported in the SPSRC-English version.[26] This was an added psychometric property feature to the SPSRC, not originally seen with the Chinese version. The development of the SSC is quite different[23] from the SPSRC, which is reflected in the scaled scores between the two instruments. This may be the reason for the statistical significance of the degree and strength of relationships found by this study. Nevertheless, the findings generated here support the SPSRC-Tagalog's ability to measure similar constructs concurrently reflected by previously published instruments.

Altogether, this study has presented favorable findings supporting the reliability and validity of the SPSRC-Tagalog in its ability to measure sensory processing and self-regulation abilities. However, this study is without limitations. First, the limited number of recruited samples prevented us from testing age-related construct hypothesis testing and dimensionality factorial analysis. In its present form, the SPSRC-Tagalog is now ready for field testing among a robust sample that will further address this. Second, this study was conducted during the COVID-19 global pandemic, where all children were mostly quarantined in their homes, and its effect on their sensory processing and self-regulation ability is unknown or, at best, yet to be explored. Lastly, whereas Tagalog is widely spoken in the Philippines, other languages are spoken in the other regions. While this study found no important difference between the English and Tagalog versions of the SPSRC, future researchers will need to translate it to the other major Filipino languages and provide evidence on their cross-cultural validity.

CONCLUSIONS

This study provided evidence on the favorable reliability and validity of the SPSRC-Tagalog in measuring sensory processing and self-regulation abilities of Filipino children, with or without disability, aged 4-12 years. The findings in this study corroborate with the psychometric properties of the SPSRC in its different language versions, supporting its claim of having good internal consistency, excellent test-retest reliability, and good cross-cultural, structural, construct, and criterion validity.

Individual author's contributions

All authors contributed equally to the conduct of this study.

Disclosure statement

The University of Santo Tomas supported this research.

Conflicts of interest

Some of the authors of this study are part of the PJAHS Editorial Board. Other than that, the authors declare no conflicts of interest.

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