

Reference Values for the Adolescent/Adult Sensory Profile in Spain

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Importance: In Spain, only one culturally adapted assessment tool is available for children between ages 3 and 11 yr. There are no assessments of adolescent and adult sensory processing, and no normative data.

Objective: To obtain reference values for the Adolescent/Adult Sensory Profile (AASP) in Spain for adolescents (aged 11–17) and adults (aged 18–64 and ≥ 65).

Design: A multivariate analysis of variance was used to compare specific mean values (-2 , -1 , $+1$, and $+2$ standard deviation [SD]) by age group, gender, geographic area, education level, and employment status.

Participants: We randomly recruited 787 participants (55.8% female) aged 11 yr or older (mean age = 32.1, $SD = 21.1$) in Spain. We excluded those with a diagnosis of depression, chronic disease (e.g., diabetes, cancer, neurological disease), or cognitive disability and those who used medication that could affect the central nervous system.

Results: Quadrant mean (SD) scores ranged from 29.3 (6.6) for low registration to 49.1 (8.3) for sensory seeking, with significant differences by age group ($p < .001$) in all quadrants. Significant differences were also found for scores in different quadrants by gender, geographic area, education level, and employment status. Although statistically significant, the differences between scores were not clinically relevant; the mean scores fell within the typical range for sensory processing.

Conclusions and Relevance: We offer reference values for the cultural adaptation to Spain of the AASP and recommend its use for the typically developing Spanish population ages 11 and older.

What This Article Adds: We provide normative data for the AASP for three age groups of the Spanish population: adolescents, adults, and older adults.

The sensory integration frame of reference evolved following a process supported by scientific methods and knowledge in the neurosciences that led to both the creation of its theoretical premises and the development of its clinical applications. Its development by A. Jean Ayres in the 1960s came at a time when research, occurring mainly in the United States, was focused on analyzing the relationship among hyperactivity, learning problems, and alterations in sensory processing in children (Ayres, 1963). Since then, occupational therapy and sensory integration have become more closely tied on the basis of multiple studies that have linked difficulties integrating and processing sensory input to inadequate occupational performance in various areas of daily life for both children and adults (Blanche, 2005; Dunn, 2007).

Studies have shown that 5.3%–18.0% of children ages 3–11 yr have sensory processing issues (Ahn et al., 2004; Tirosh et al., 2003), a proportion that may be comparable to that of the adult population. These studies were carried out using validated and adapted assessment tools with preestablished normative values.

In Spain, the only culturally adapted assessment tools are the Short Sensory Profile (Beaudry-Bellefeuille & Lane, 2015; Dunn, 1999) and the Adolescent/Adult Sensory Profile (AASP; Brown & Dunn, 2002), in Spanish called *Perfil sensorial del adolescente/adulto* (PSAA; Gándara-Gafo et al., 2016). The AASP questionnaire is used to assess a person's sensory processing characteristics; results help clinicians plan individualized intervention based on each client's sensory processing characteristics. The AASP is based on Dunn's (1997) Model of Sensory Processing, which

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relates sensory thresholds (high–low) to self-regulation responses (active–passive), resulting in four quadrants (low registration, sensory seeking, sensory sensitivity, and sensory avoiding), each describing a sensory processing pattern. According to this model, people may have a low sensory threshold, meaning that the central nervous system (CNS) is easily activated when faced with specific sensory stimuli (sensory sensitivity and sensory avoiding), or a high sensory threshold, which requires more intense stimuli for CNS activation (low registration and sensory seeking).

The AASP consists of 60 items that inquire about reactions to daily sensory events; responses provide information related to a person's sensory processing pattern. Each item is related to a sensory factor (taste/smell, movement, visual, tactile, activity level, and auditory processing) and to a sensory quadrant. The reliability and validity of the AASP are well established. Internal consistency (Cronbach's α) of the quadrants is between .66 and .82. An analysis of discriminant validity (Brown & Dunn, 2002) showed significant differences among people with typical development ($n = 29$), bipolar disorder ($n = 30$), and schizophrenia ($n = 27$). The performance of a sample of 950 people without disabilities in the United States was published for three age groups: 11–17 yr, 18–64 yr, and 65 yr and older (Brown & Dunn, 2002).

We selected the AASP for the current study for three reasons: (1) The original version of the AASP (Brown & Dunn, 2002) included solid psychometric data; (2) the AASP is part of the Sensory Profile family of assessments (Brown & Dunn, 2002; Dunn, 1999, 2002) for different ages, allowing evaluation and monitoring across the lifespan; and (3) at the time our investigation began, the Sensory Profile questionnaires for children ages 0–3 yr and 3–11 yr were available in Spanish, but the adolescent/adult version was not.

Researchers have examined the influence of culture and environment on sensory processing and identified differences in sensory processing among countries including the United States (Brown & Dunn, 2002), China (Chung & 2006), and Israel (Engel-Yeger, 2012). These findings support the need for normative studies of sensory processing in different populations. Accordingly, the aim of this study was to obtain sensory processing reference values for the typical Spanish population using the PSAA, a cultural adaptation of the AASP for Spain.

Method

Instrument

The cultural adaptation of the Spanish version of the AASP followed standard procedures for this type of adaptation: direct and back translation, cognitive interviews ($n = 18$) with adolescents ages 11–13, linguistic expert review, and test–retest reliability verified with monolingual (Spanish speaking only; $n = 30$) and bilingual (Spanish and English speaking; $n = 30$) participants who completed the AASP twice within a 15- to 20-day interval. The cognitive interviews revealed no serious difficulties in comprehension. The test–retest reliability of items showed a low intraclass correlation coefficient ($<.50$) for only 1 item.

Once the cultural adaptation was finalized, we examined the internal consistency ($n = 434$) and discriminant validity for people with typical development ($n = 54$) and people with schizophrenia ($n = 18$; Gándara-Gafo et al., 2016). Internal consistency across the quadrants ranged from .69 to .73. The strongest correlation was found in the sensory sensitivity and sensory avoiding quadrants ($r = .67$). Participants with schizophrenia scored higher than the typical development group in the low registration (36.11 and 27.17, respectively; $p < .001$), sensory sensitivity (43.78 and 35.22; $p < .001$), and sensory avoiding (40.61 and 34.35; $p = .049$) quadrants. No differences were observed in sensory seeking (47.19 and 45.17; $p = .394$).

Participants

Given that this study sought to provide population reference values for each of three age groups (adolescents ages 11–17, adults ages 18–64, and older adults ages 65 and older), the minimum sample size was estimated for each group using the average estimation formula. To achieve a 95% reliability level, a standard deviation (SD) of 6 units, and accuracy of ± 1 unit, efforts were made to recruit at least 139 individuals for each age group. This calculation was carried out using EPIDAT Version 3.1 (Consellería de Sanidade, Xunta de Galicia, Santiago de Compostela, Spain).

The final sample included 787 people (adolescents, $n = 201$; adults, $n = 462$; older adults, $n = 124$) who met the following inclusion criteria: age 11 or older, of Spanish nationality and residing in Spain, signed informed consent to participate, and completion of the PSAA in its entirety. Exclusion criteria were diagnosis of depression, chronic disease (e.g., diabetes, cancer, neurological disease), or cognitive disability and use of medication that could affect the CNS.

To obtain a sample representing the entire country, we divided the map of Spain into three geographic areas (north, center/south, and east). We contacted schools, universities, occupational and senior centers, associations, and private companies in each area and visited institutions interested in helping us recruit people for the study.

Each participant was given an information sheet, an informed consent form, a PSAA, and a questionnaire requesting personal information including gender, age, nationality, geographic area (north, center/south, or east), education level (high school, advanced vocational training, university), employment status (student, paid worker, other), and health status because we wanted to examine whether these factors were related to sensory processing abilities in our sample. Participation was voluntary, and participants or their parent or legal guardian provided informed consent.

To define typical reference values for the population, we used statistical criteria based on the normal distribution for each quadrant and factor and computed average values and *SDs*. Using these scores and following the original study (Brown & Dunn, 2002), we classified results as follows: much less than most people (lower than $-2 SD$), less than most people (lower than $-1 SD$), similar to most people (between -1 and $+1 SD$), more than most people (higher than $+1 SD$), and much more than most people (higher than $+2 SD$).

To check for statistically significant differences between the quadrant scores and each of the variables (age group, gender, geographic area, education level, and employment status), we conducted a multivariate analysis of variance (MANOVA). Social class, although a necessary consideration in the analysis of health inequalities (Krieger et al., 1997), was not included in the current study because of difficulty in reliably characterizing responses (Reiss, 1991) and the potential negative effect on participation, acceptability, and item completion of requesting this information (Salvia & Donza, 1999). These issues are common with items respondents may perceive as uncomfortable (Ellingson et al., 1999). We chose to obtain information on social class by classifying participants according to their employment situation (student, paid worker, or other). For any differences found, we used Tukey or Tamhane post hoc test depending on whether the equality of variances, as assessed using Levene test, was verified or not (Rohatgi & Saleh, 2015).

Significance was set at $p < .05$. IBM SPSS Statistics (Version 19; IBM Corp., Armonk, NY) was used to analyze the data.

Ethical Considerations

This study was approved by the Galician Clinical Research Ethics Committee and meets the requirements stipulated in the AASP license contract with NCS Pearson. Data were collected in strict observance of participants' anonymity.

Results

A total of 890 people took part in the study, although 103 of the questionnaires were excluded because the respondents met one or more of the exclusion criteria. The resulting sample ($N = 787$) had an average age of 32.13 ($SD = 21.06$), 32.27 ($SD = 22.60$) for women and 31.96 ($SD = 18.94$) for men. Table 1 displays characteristics of the sample.

The mean raw scores per quadrant ranged from 29.26 ($SD = 6.56$) to 49.14 ($SD = 8.26$). The lowest average was in the low registration quadrant and the highest in the sensory seeking quadrant (Table 2). Table 3 shows the reference values for the typical Spanish population, classified as much less than most people, less than most people, similar to most people, more than most people, and much more than most people.

The MANOVA showed the following significant differences (Table 4):

Table 1. Participant Characteristics (N = 787)

Characteristic	n (%)
Gender	
Female	439 (55.8)
Male	348 (44.2)
Age group, yr	
11–17	201 (25.5)
18–64	462 (58.7)
>65	124 (15.8)
Nationality: Spanish	787 (100)
Gender	
Female	
Ages 11–17 yr	117 (14.9)
Ages 18–64 yr	233 (29.6)
Ages >65 yr	89 (11.3)
Male	
Ages 11–17 yr	84 (10.7)
Ages 18–64 yr	229 (29.1)
Ages >65 yr	35 (4.4)
Geographic area	
North	376 (47.8)
Center/south	347 (44.1)
East	105 (13.3)
Education level	
High school	335 (42.6)
Advanced vocational training	347 (44.1)
University	105 (13.3)
Employment status	
Student	442 (56.2)
Paid worker	181 (23.0)
Other	164 (20.8)

- Differences were found between age groups in the sensation seeking ($p = .011$) and sensory avoiding ($p = .047$) quadrants. The analysis for sensation seeking revealed significantly lower scores for older adults compared with adolescents and with adults ($p < .001$ for both). For sensory avoiding, significant differences were obtained for all group comparisons ($p < .01$ for all).
- Women scored significantly higher than men in low registration ($p = .001$), sensation seeking ($p = .018$), and sensory sensitivity ($p < .001$).
- The only significant differences involving geographic area were in sensory seeking ($p < .001$); participants from northern Spain scored lower than those in eastern ($p < .001$) and central/southern Spain ($p = .003$).
- Regarding education level, significant differences were shown only in the low registration quadrant ($p = .025$). Participants with university studies had significantly lower scores compared with the other two groups ($p < .001$ for both).
- Significant differences were found for employment status in the low registration ($p = .019$), sensory sensitivity ($p = .024$), and sensory avoiding quadrants ($p = .005$). A more exhaustive post hoc analysis of the three quadrants showed significantly higher scores for participants in the other category compared with students and paid workers.

Although we found some significant differences related to gender, geographic area, education level, and employment status, these differences were not significant relative to the reference values. That is, the means and SDs for each variable were within the typical range of the reference values.

Discussion

This study is the first to obtain reference values for sensory processing derived from a standardized questionnaire adapted and validated in Spain. Collecting normative data was key to satisfactory completion of the cultural adaptation of the AASP for

the Spanish population. These reference values enable clinicians to interpret the meaning of assessment results for specific clients; such results mean nothing unless clinicians are able to compare them to normative data. This research sets the stage for further analysis on a national scale of sensory processing in the Spanish population ages 11 and older.

In this study, our exhaustive data-gathering process ensured that the sample was heterogeneous across the variables (age group, gender, geographic area, education level, and employment status) and generally representative of the Spanish population, supporting questionnaire applicability and serving as a reference for future studies carried out with the PSAA. Although a limitation of our study is that the sample may not be strictly representative, we drew participants from cities throughout Spain and various environments (e.g., schools, universities, associations, senior centers) to maximize representativeness.

The sample of participants for the three age groups was adequate, similar in size to that of the original study (Brown & Dunn, 2002). Our older adult group was smaller, however, because 96 potential participants in this age group were excluded because they had an

Table 2. Mean Raw Scores, by Quadrant and Age Group

Quadrant	11–17 yr (n = 201)		18–64 yr (n = 462)		>65 yr (n = 124)	
	M	SD	M	SD	M	SD
Low registration	30.27	6.67	29.26	6.56	34.86	8.74
Sensation seeking	49.14	8.26	48.63	7.50	43.31	9.28
Sensory sensitivity	36.96	7.88	37.08	8.71	42.07	10.05
Sensation avoiding	33.46	6.48	35.38	7.59	41.94	9.52

Note. M = mean; SD = standard deviation.

Table 3. Sensory Processing Reference Ranges for the Spanish Population, by Age Group

Age Group and Quadrant	Much Less Than Most People	Less Than Most People	Similar to Most People	More Than Most People	Much More Than Most People
11–17 yr					
Low registration	15–16	17–23	24–37	38–44	45–75
Sensation seeking	15–32	33–40	41–57	58–66	67–75
Sensory sensitivity	15–20	21–28	29–45	46–53	54–75
Sensation avoiding	15–20	21–26	27–40	41–46	47–75
18–64 yr					
Low registration	15–16	17–22	23–37	38–44	45–75
Sensation seeking	15–33	34–40	41–56	57–64	65–75
Sensory sensitivity	15–19	20–27	28–46	47–55	56–75
Sensation avoiding	15–19	20–27	28–43	44–51	52–75
>65 yr					
Low registration	15–17	18–25	26–44	45–52	53–75
Sensation seeking	15–24	25–33	34–53	54–62	63–75
Sensory sensitivity	15–21	22–31	32–52	53–62	63–75
Sensation avoiding	15–22	23–31	32–51	52–61	62–75

illness or took medication that affected the CNS. As expected, significant differences were found in all four average quadrant scores when comparing adolescents and adults to older adults. As in the original study, these results indicate the need to establish reference values specific to each age group. The significant differences we found for the other variables (gender, geographic area, education level, and employment status) did not indicate a need for different reference values among subgroups; none of the mean values were outside the sensory processing range typical of the Spanish population.

The adolescent sample scored higher on average in sensory seeking, consistent with results obtained in the original study (Brown & Dunn, 2002) and with young people’s greater need for sensory richness than adults. Nevertheless, this group scored lower on average in the sensory sensitivity quadrant, somewhat consistent with the original study, in which adolescents scored slightly lower than other groups in sensory avoiding.

The adult group obtained average scores that were slightly different (1–2 points) from those of the adolescent group (see Tables 2 and 3) in the low registration, sensation seeking, and sensory sensitivity quadrants. These results indicate that although sensory processing is similar in adolescents and adults, adults are slightly more sensory sensitive and avoidant.

Compared with the adolescent and adult groups, older adults scored higher on average in the low registration, sensory sensitivity, and sensory avoiding quadrants and lower in the sensory seeking quadrant. Older adults may be more likely to have lower or higher sensory thresholds than younger people, which may lead to different behavioral responses to certain stimuli. Higher sensory sensitivity and sensory avoiding scores indicate greater difficulty in inhibiting CNS response to sensory

Table 4. Post Hoc Testing, by Quadrant and Age Group

Quadrant and Age Group (yr)	Average Difference	p	95% Confidence Interval
Low registration			
11–17/18–64	1.04	.182	[-0.31, 2.38]
11–17/>65	-4.57	<.001	[-6.77, -2.37]
18–64/>65	-5.61	<.001	[-6.64, -3.58]
Sensation seeking			
11–17/18–64	0.51	.833	[-1.12, 2.14]
11–17/>65	5.83	<.001	[3.38, 8.27]
18–64/>65	5.32	<.001	[3.14, 7.49]
Sensory sensitivity			
11–17/18–64	-0.12	.997	[-1.77, 1.52]
11–17/>65	-5.11	<.001	[-7.66, -2.56]
18–64/>65	-4.99	<.001	[-7.37, -2.60]
Sensation avoiding			
11–17/18–64	-1.92	.003	[-3.31, -0.54]
11–17/>65	-8.49	<.001	[-10.82, -6.15]
18–64/>65	-6.56	<.001	[-8.80, -4.33]

stimuli that are irrelevant to specific tasks and times, which may cause health problems such as anxiety, depression, and stress (Bakker & Moulding, 2012). Regarding results for the low registration and sensory seeking quadrants, older adults may notice fewer sensory stimuli in the environment and exhibit less sensory seeking behavior. Studies have confirmed that older adults have lower responses to stimuli (Ford et al., 1995; Taylor et al., 1995). Like Pohl and colleagues (2003), we found a decrease in sensory seeking starting at age 65.

In our sample, women scored higher than men in the sensory sensitivity quadrant. This finding supports that of Engel-Yeger (2012), who also found that women were more sensory sensitive than men.

To best ensure that our results are representative of all of Spain in terms of cultural diversity, we recruited participants in three areas (north, center/south, and east). Participants living in northern Spain had lower average scores than those living in eastern or central/southern Spain. This finding suggests that, at least for certain sections of the questionnaire, cultural differences may be at play even within a single country. No available data shed light on this unexpected finding, so further research is required.

The current study included enough participants across a range of age, gender, geographic area, education level, and employment status variables to provide accurate data not limited by a small sample size. The statistically significant differences we found are not clinically meaningful; none of the variables yielded mean values outside the typical range for sensory processing in the Spanish population. These results suggest that it is reasonable to present reference values for these variables as a whole, whereas the age group variable requires separate values for adolescents, adults, and older adults.

The sensory processing findings obtained across age group, gender, geographic area, and education and employment variables suggest that the PSAA reference data can be generalized to the entire Spanish population. These data can promote the exchange of information in the clinical and scientific community and the comparison of research findings from different countries.

The typical sensory processing values we identified for the Spanish population differ from those in the original study (Brown & Dunn, 2002) and in other populations, such as those of Israel (Engel-Yeger, 2012) and China (Chung, 2006). The findings in Spain produced averages in all sensory quadrants similar to those in the United States, except for the sensory sensitivity quadrant; the Spanish population showed greater sensitivity, mainly in the older adult group (42.07 for Spain, 33.81 for the United States). These averages show that the two populations differ in this area of sensory processing.

Compared with the Israeli population (Engel-Yeger, 2012), our Spanish sample obtained significantly lower average values in all quadrants. Differences between the reference values obtained in Spain and China can be analyzed only for people older than age 65 (the only population studied in China; Chung, 2006); the values indicate that the Chinese population engages in less sensory seeking behaviors, is less sensitive, and is less avoidant of sensory stimulation than the Spanish population.

Implications for Occupational Therapy Practice

The findings of this study have the following implications for occupational therapy practice:

- Clinicians working with clients in Spain can use the PSAA to differentiate typical sensory processing patterns from altered patterns, to understand sensory patterns in specific subpopulations, and to interpret results obtained for specific clients.
- Differences among reference values across countries confirm that culture is a significant issue in sensory processing. Culture, which is influenced by numerous factors, including sensorimotor, cognitive, and psychosocial experiences, has been shown to permeate both neural development and individual behavior and to strengthen or inhibit thoughts, feelings, and actions, which are critical components of occupational performance (Dunn et al., 1994).
- Because reference values differ among countries, clinicians need adapted and validated measures and typical population values specific to their country to objectively identify sensory processing differences in clients. The reference values proposed in this study are appropriate when assessing the Spanish population.

Conclusion

The process of cultural adaptation and validation of the PSAA for use in Spain made it possible to obtain normative values for sensory processing in people aged 11 and older. Accordingly, we recommend using the normative data from this study, rather than the data derived from studies conducted in other countries, with Spanish clients. ■

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