




Cross-Cultural Adaptation and Validation of the Highly Sensitive Person Scale to the Adult Spanish Population (HSPS-S)

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Purpose: This article describes a cross-cultural adaptation of the Highly Sensitive Person Scale (HSPS) to the adult Spanish population, and psychometric analysis of its validation and reliability.

Methods: Convenience sampling by participant accessibility was used. The original version was adapted culturally and linguistically using the back-translation method, and a pilot study was done with 88 participants. Data processing and analysis was performed with the SPSS v.25 and LISREL v.9.2 statistical packages. The psychometric properties were studied in a sample of 8358 participants using exploratory factor analysis and confirmatory factor analysis, and examining factorial invariance and internal consistency.

Results: The results confirmed a Spanish version with 27 items in five-dimensions: sensitivity to overstimulation (SOS), aesthetic sensitivity (AES), low sensory threshold (LST), fine psychophysiological discrimination (FPD) and harm avoidance (HA). Invariance across gender of this factor structure was demonstrated and reliability indices were good.

Conclusion: These findings demonstrate that the HSPS is an appropriate tool for evaluating high sensitivity in the adult Spanish population.

Keywords: sensory processing sensitivity, sensitivity to overstimulation, aesthetic sensitivity, low sensory threshold, fine psychophysiological discrimination, harm avoidance

Introduction

Sensitivity of sensory processing (SPS) is related to the concept of sensitivity to sensory stimulation, although it involves a broader view under the theoretical framework of environmental sensitivity.¹ Aron and Aron² defined SPS as heightened awareness of sensorial stimulation, deeper cognitive processing of environmental stimuli, more emotional and physiological reactivity and behavioral inhibition. People with this personality trait show stronger autonomic nervous system activation in stressful situations, more intense positive and negative emotional responses, and feelings toward others, strong perception of subtle differences, knowledge of long-term consequences, and low threshold of pain and low tolerance to high levels of sensory input.^{3,4}

The literature does not refer to SPS related as to a mental disorder, although it was reported to have psychological consequences. Several studies have demonstrated its relationship with emotional alterations,^{5–8} stress,⁹ and other variables of personal development^{8–10} and wellbeing.^{7–10}

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Adverse childhood environments may cause a stronger negative impact on highly sensitive people, leaving them at higher risk of developing behavioral or psychopathological problems in adulthood.^{7–11} This vulnerability is demonstrable throughout their development,¹² and affects their health. A possible explanation is that higher sensitivity increases general physiological excitation, causing chronic stress with later adverse consequences to their health¹³ and work.^{9–14} However, in adequate environments, they may show optimum development, with positive effects on health, education and professional development.¹⁵

This stable personality trait is associated with a more sensitive central nervous system. Recent studies report that sensory hypersensitivity is a manifestation of central sensitization, an amplification of the neural signal that triggers hypersensitivity to pain, such as fibromyalgia and chronic fatigue, as well as complex diseases with multiple symptoms.¹⁶ Dixon et al¹⁶ reported that women are more sensitive, with lower thresholds and tolerances than men to some pain stimuli, possibly attributable to attention bias,¹⁷ higher perceived stress,¹³ and others.

The applicability of this instrument will provide us with feedback in our cultural context, which has not been available until now. The active processes of elaboration and modification of the instrument in the cross-cultural adaptation to Spanish will allow us to compare participants from other cultures and countries with Spanish-speaking participants, due to the dynamic nature of the scale. This adaptation may help these individuals flourish in Spanish society.

The 27-item Highly Sensitive Person Scale (HSPS) was developed by Aron and Aron² to identify people with the high sensitivity trait. The original design showed a unidimensional SPS structure.^{13–18} Later, studies have demonstrated possible multidimensionality of the HSPS, identifying two-, three- and four-factor structures in validations in Europe, Asia and Central America.

One of these studies in an adult population suggested a sensitivity model with two factors, low sensory threshold (LST) and ease of excitation (EOE), in 19 items.¹⁹ Montoya-Pérez et al²⁰ found a dimension called processed sensitivity (PS,) maintaining the low sensory threshold factor in a 16-item version. Smolewska et al²¹ proposed a three-factor structure comprising aesthetic sensitivity (AES), low sensory threshold (LST) and ease of excitation (EOE). These refer to aesthetic awareness of the setting, unpleasant sensory excitation and a feeling of being

overwhelmed by external and internal stimuli, respectively. This structure was supported by later studies.^{22,23} In the four-factor solution,²⁴ the first factor was related to overstimulation under pressure over time, called sensitivity to overstimulation (SOS). The second, called sensitivity to external stimuli (SES), represents high levels of excitation and reaction to strong stimuli. The third factor reflects affectation by aesthetics and art, called aesthetic sensitivity (AES). Finally, the fourth factor being on guard against threatening situations, is defined as harm avoidance (HA), related to the behavioral inhibition system (BIS), specifically with the tendency in SPS to adopt controlled avoidance strategies to prevent distress.⁴

In the literature on scales for measuring high sensitivity in adults, most of the studies share some characteristics, such as the sample size (around 1000 participants or fewer), a mostly student population (aged 18–22), except for the one by Konrad and Herzberg,²² more participation of women and shorter versions than the original. In spite of the strong social interest that high sensitivity and people with SPS have awakened in recent years, there are no validated instruments for the Spanish population. Therefore, our objectives were to adapt and validate an instrument for the adult Spanish population. Two studies were performed, one for each of the respective objectives. The objective of Study 1 was the linguistic and cultural adaptation of the original English version of the Highly Sensitive Person Scale (HSPS) developed for a North American population.² The objective of Study 2 was to examine the psychometric properties of that Spanish version. The HSPS-S factor structure was studied to see whether it fit a unidimensional factor structure similar to the original version by Aron and Aron² or a structure with several factors as in later validations done in other countries as mentioned above. We also wanted to test for factorial invariance across gender.

Study I Objective

Make a cross-cultural adaptation of the original version of the HSPS for the adult Spanish population (HSPS-S).

Method

The process included translation and linguistic and cultural adaptation of the HSPS questionnaire from English to Spanish. Adaptation and translation to Spanish of the HSPS was done by bilingual experts following the reverse translation methods of Beaton et al²⁵ and Wild et al,²⁶ and

the guidelines of the International Test Commission,²⁷ for test translation/adaptation.

Instrument

The HSPS² is a self-report test for identifying highly sensitive people. It consists of 27 items with seven answer choices rated on a Likert-type scale from 1 (not at all) to 7 (extremely). All the items are direct in a range of 27–189. Higher scores show more sensory sensitivity. In their original research, Aron and Aron² found internal consistency scores of $\alpha = 0.87$ and $\alpha = 0.85$

Procedure

Study 1 was carried out from October 2019 through September 2020. The stages and a summary of HSPS transcultural adaptation to the Spanish population are shown in [Appendix 1](#).

Results

Translation and Linguistic and Cultural Adaptation

A Committee of eight Experts trained in the English language and in English translation, of whom two were Health Sciences professionals, three were university professors and three were psychologists (two clinical psychologists), considered semantic and contextual equivalence between the HSPS and the HSPS-S. The 27 items on the original scale were retained in the HSPS-S. At the end of the first seven stages of the translation-back-translation process, a pilot test was administered to 88 participants.

Three yes/no answer questions were asked on comprehension (Did you have any problem understanding the questions asked?), clarity (Did you have any problem with the clarity of the questions asked?) and ambiguity (Did you find any of the questions ambiguous?) to evaluate equivalence. The answers showed that the questions had been asked clearly (92.05%), were understood (95.46%) and unambiguous (94.32%).

The results of items translation were classified by how well their conceptual meaning was conserved, showing that nine items (33%) were considered literal (linguistic back-translation and/or semantically equivalent to the question in the original version) and 18 items (67%) were described as similar (linguistically and/or semantically equivalent, but with words with a different meaning). After the pilot study, it was unnecessary to make any changes in any of the items, since they were all understood correctly (See [Appendix 1](#)).

In conclusion, the transcultural adaptation of the original version of the HSPS to an adult Spanish population (HSPS-S) meets the highest level of linguistic, cultural and conceptual equivalence.

Study 2

Objective

To study the psychometric properties of the scale, that is, factor structure, reliability and invariance across gender of the Spanish version of the HSPS-S.

Method

Participants

The sample was from a larger study with 10,821 adults recruited in a community context by convenience sampling, for accessibility. For this study, inclusion criteria were as follows: 1) Spanish nationality and 2) minimum age of 18. The exclusion criteria were as follows: 1) participants from Spanish-speaking countries but not Spanish nationality, even though they share the same language,²⁵ 2) all the data not filled out or the test battery not answered properly, and 3) informed consent not expressly given.

After applying these criteria, the sample in this study was a total of 8358 adults aged 18 to 70 ($M = 33.44$; $SD = 11.53$). The participants were from all of the autonomous regions of Spain, but mostly from Catalonia (20.11%), Madrid (19.41%), Andalusia (14.18%), Valencia (8.56%) and Galicia (6.58%). Occupations were mostly in education (12.28%), healthcare (9.77%), administration/management (8.17%), trade (4.99%), hotel/restaurant (3.55%) and ICT (3.35%).

Procedure

First, the population of highly sensitive people, associations interested in the subject and professionals and staff of Spanish universities, were contacted for its diffusion. Then the tests were administered anonymously in an online application, which took 45–60 min. After reading a brief introduction with the study objectives, the participants signed their informed consent to participate under the conditions of research. Then they proceeded to the tests that were always presented in the same order. Participation was voluntary, anonymous, and no compensation of any kind was received for it. The participants could drop out of the study at any time.

The study was approved by the Doctoral Studies Program Academic Committee of the Escuela

Internacional de Doctorado de la Universidad de Sevilla [International Doctoral School of the University of Seville] (EIDUS). Appropriate measures were taken to safeguard the information in compliance with Organic Law 3/2018 on data protection and guarantee of digital rights. The study was performed following the code of ethics of the World Medical Association (Helsinki Declaration, 2013), the Código Deontológico del Psicólogo [Psychologist's Code of Ethics] (Colegio Oficial de Psicólogos, 1987) and the recommended ethical principles for research with human participants.²⁸

Data Analysis

HSPS-S data processing and analysis was done using the SPSSv.25 and LISRELv.9.2 statistical packages. Exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were calculated. Significance was accepted at 5% throughout.

Descriptive analyses of the sample were performed using the mean and standard deviation as quantitative variables, and absolute and relative frequency of the categorical variables. The underlying HSPS dimensions were determined by cross validation. The sample was divided into two halves at random for internal structure validity. Exploratory factor analysis was performed with the first half (Subsample 1) and confirmatory factor analysis with the second half (Subsample 2). For the EFA, sample adequacy was measured using the Kaiser-Meyer-Olkin test (KMO)²⁹ and Bartlett's sphericity.³⁰ Exploratory factor analysis (EFA) of principal components (PCA) was conducted with PROMAX rotation. After the EFA, confirmatory factor analysis was estimated with Subsample 2, using Diagonally Weighted Least Squares (DWLS). The following indices were calculated to evaluate CFA fit: Non-Normed Fit Index (NNFI) and Comparative Fit Index (CFI). Values >0.90 were interpreted as indicators of acceptable fit.³¹ A root mean square error of approximation (RMSEA) <0.08 indicates adequate fit.³² Pearson's correlation coefficient was used for the scores of the items and the dimensions of the HSPS-S. Multi-group CFA was performed with LISREL to test HSPS-S measurement invariance across gender. Invariance exists if the Δ in the CFI and RMSEA are low (usually accepted as $\Delta < 0.01$).³³

The Cronbach's alpha and McDonald's ordinal omega were used to estimate the overall reliability of the HSPS and the factors found. Internal consistency was considered acceptable at > 0.80.

The Student's *t*-test was used to examine the differences in means between men and women on the total HSPS-S and its factors. The Cohen's coefficient was used to evaluate the effect size. Reference values <0.30, 0.30–0.50 and >0.50 were taken as low, medium and large sizes, respectively.³⁴

Results

Descriptive Analysis of HSPS-S Items

Table 1 shows the means and standard deviations of the 27 items and the HSPS-S average. All of the items had adequate variability ($SD \geq 0.89$). Skewness and kurtosis (absolute values centered at 0) varied from 0.54 to 2.32 and from 0.06 to 6.68, respectively. These results show that the main trend and variability of absolute values of the items on the scale were adequate, and therefore item distribution was not severely vulnerable to the normality assumption, as most of them were below 2 for skewness and 7 for kurtosis.³⁵

Construct Validity

Exploratory Factor Analysis of the HSPS-S

EFA was estimated with Subsample 1 ($n = 4091$ participants) of the 27 HSPS-S items. The results of the Kaiser-Meyer-Olkin test ($KMO = 0.94$) and the Bartlett's sphericity test ($\chi^2 (351) = 43771.65$; $p < 0.001$) were adequate. The EFA one-, three-, four- and five-factor structures were tested to determine the best fit to the data. The five-factor solution, according to the Kaiser criterion (eigenvalues over 1) explained 53.73% of the variance (see Table 2).

Table 3 shows the five-factor factor solution found. Factor I, related to the feeling of being overwhelmed by internal and external demands, explained the highest percentage of variance (33.76%). Its nine items reflect sensitivity to overstimulation (SOS) (5, 11, 14, 16, 19, 21, 23, 26 and 27). Factor II, aesthetic sensitivity (AES), includes six items related to aesthetic awareness of the environment (2, 3, 8, 10, 15 and 22). Factor III groups items related to sensory distress from overstimulation in five items covering the low sensory threshold (LST) dimension (1, 7, 9, 18 and 25). These three factors correspond to the ease of excitation (EOE), aesthetic sensitivity (AES) and low sensory threshold (LST) factors in the Smolewska et al²¹ and Grimen and Diseth²³ models. Factor IV refers to discrimination of subtleties or physical/physiological sensitivity in reaction to internal stimuli (pain, fear, effects of caffeine or hunger). This dimension, called fine psychophysiological discrimination (FPD), consists of four items (4, 6, 13 and 20). Factor V,

Table 1 Means and Standard Deviations in the HSPS-S Items in the EFA and CFA

	Items*	EFA Subsample 1 (n = 4091)		CFA Subsample 2 (n = 4170)	
		M	SD	M	SD
1	Do you easily get overwhelmed by strong sensory stimuli?	5.75	1.34	5.77	1.30
2	Do you seem to be aware of the subtleties around you?	5.95	1.21	5.99	1.18
3	Do other people's moods affect you?	6.18	1.16	6.20	1.10
4	Do you tend to be more sensitive to pain?	5.05	1.66	5.06	1.70
5	Do you need to get away and have some privacy during busy and hard work days in a dark room or in any place where you can have some privacy and relief from so much stimulation?	5.88	1.53	5.89	1.47
6	Are you particularly sensitive to the effects of caffeine?	4.77	1.90	4.78	1.89
7	Do you easily feel overwhelmed by things like bright lights, strong smells, coarse fabric or nearby sirens?	5.52	1.60	5.54	1.58
8	Do you have a rich and complex inner life?	5.89	1.39	5.93	1.36
9	Do loud noises bother you?	6.06	1.33	6.06	1.32
10	Are you deeply touched by the visual arts or music?	6.14	1.21	6.19	1.18
11	Does your nervous system sometimes make you feel so exhausted that you just want to get away from it all?	6.06	1.36	6.11	1.30
12	Are you conscientious?	5.93	1.16	5.95	1.14
13	Do you get easily startled?	5.31	1.64	5.27	1.63
14	Are you badly affected by having a lot to do in a short time?	5.78	1.48	5.76	1.47
15	When people feel uncomfortable in a physical environment, do you tend to know what needs to be done to make them feel more comfortable (such as changing the lighting or seats)?	5.39	1.43	5.40	1.40
16	Does it bother you when people make you do too many things at once?	5.99	1.30	5.99	1.30
17	Do you try hard to avoid making mistakes or forgetting things?	6.22	1.16	6.23	1.13
18	Do you try to avoid violent movies and television shows?	5.14	1.94	5.17	1.91
19	Are you uncomfortable when a lot is going on around you?	5.63	1.38	5.57	1.39
20	Does being very hungry create a strong reaction in you, disrupting your concentration or mood?	5.40	1.67	5.41	1.66
21	Do changes in your life affect you a lot?	5.87	1.31	5.82	1.31
22	Do you easily notice delicate or fine aromas, flavors, sounds, works of art ... and enjoy them?	5.98	1.28	5.99	1.27
23	Do you find it unpleasant when many things are happening at once?	5.49	1.38	5.44	1.38
24	Do you give high priority to organizing your life to avoid disturbing or overwhelming situations?	5.59	1.46	5.63	1.44
25	Are you disturbed by intense stimuli, such as loud noises or chaotic scenes?	5.95	1.35	5.95	1.34
26	When you compete or are watched while doing a task, do you get so nervous or shaky that you do it much worse than you would?	5.92	1.44	5.91	1.43
27	When you were a child, did parents or teachers seem to see you sensitive or shy?	5.69	1.66	5.68	1.68

Notes: *HSPS-S items reproduced from Aron and Aron.² Copyright © 1997, American Psychological Association.

Table 2 Comparison of Fit of the HSPS-S Models

Factorial Solution	χ^2	df	CFI	NNFI	RMSEA (90% CI)	Δ CFI
One-factor model	11,051.63	324	0.94	0.94	0.091 (0.089–0.092)	0.00
Three-factor model	3506.71	101	0.96	0.95	0.090 (0.087–0.093)	0.00
Four-factor model	4354.16	164	0.96	0.96	0.078 (0.076–0.080)	0.00
Five-factor first-order model	4696.02	314	0.98	0.97	0.059 (0.058–0.060)	0.00

Note: $p < 0.001$.

Abbreviations: χ^2 , chi-square; CFI, comparative fit index; NNFI, non-normed fit index; RMSEA, root mean square error of approximation; Δ CFI, difference in CFI between models; CI, confidence interval.

called the harm avoidance (HA) dimension, is comprised of three items (12, 17 and 24) related to controlled harm avoidance (see Table 3). Explained variance of Factors II to V is 6.99% (Factor II), 5.10% (Factor III), 4.05% (Factor IV) and 3.88% (Factor V). Correlations between factors, after PROMAX rotation, ranged from 0.36 to 0.58, and all factors together were statistically significant ($p < 0.01$).

Confirmatory Factor Analysis of the HSPS-S

A CFA was done with Subsample 2 ($n = 4170$) to test the suitability of the EFA structure. The five-factor model was selected because it had the best fit and the items made theoretical sense. The goodness-of-fit indices were CFI = 0.98, NNFI = 0.97, and RMSEA = 0.059 (90% CI) (see Table 3 and Figure 1).

Mean Gender Differences

The comparison of means with Subsample 2 revealed significant differences between the five factors and total HSPS-S ($p < 0.01$). Women had significantly higher means and less dispersion in all factors and higher total scores than men on the SOS, AES and HA factors with small effect sizes, and medium on the total HSPS-S and LST and FPD factors (see Table 4).

The subgroup of highly sensitive people was determined by previously grouping the sample in terciles corresponding to low ($P \leq 33$), medium ($P \geq 34$ and $P \leq 66$) and high sensitivity. High sensitivity was considered equal to or above the 67th percentile based on the total HSPS-S, which was surpassed by 32.83% of the participants. Following this criterion, the cut-off score for men was a total HSPS-S score of ≥ 160 and for women ≥ 167 .

Measurement Invariance

A set of increasingly constrained models was used to evaluate invariance across sex (male vs female). The general idea is to compare the model fit when individual

model parameters were estimated separately for different subpopulations with the fit when some parameters are fixed, they are constrained to be equal across subpopulations.³⁶ The invariance was proven with the following models from least to most constrained:³⁷ Model 1, configural (the same factor structure in all groups); Model 2, metric (same factor load in all groups); and Model 3, scalar (same intercept in all items). In this context, when invariance is proven, in addition to demonstrating satisfactory fit of the model (DFI and NNFI), the increase in the CFI is also taken into account, considering it acceptable at ≤ 0.01 .

The goodness-of-fit indices of the models used were satisfactory and the increase in CFI was below 0.01 in the models tested, as shown in Table 5, so the translation of the HSPS adapted to the Spanish population may be said to be equivalent for men and women.

Reliability of the HSPS-S

Reliabilities for the final model were calculated using Subsample 2. The Cronbach's α and McDonald's ω for the subscales, respectively, were as follows: SOS = 0.86 and 0.87, AES = 0.79 and 0.80, LST = 0.82 and 0.85, FPD = 0.56 and 0.57, HA = 0.67 and 0.68. For the total HSPS-S Score, they were = 0.92 and 0.93. All scales can be considered internally consistent when the number of items is taken into account. Mean values and standard deviations for the subscales and total HSPS-S for the five-factor model were as follows: SOS: $M = 52.17$, $SD = 8.63$; AES: $M = 35.73$, $SD = 5.19$; LST: $M = 28.48$, $SD = 5.75$; FPD: $M = 20.51$, $SD = 4.54$; HA: $M = 17.82$, $SD = 2.88$ and for total HSPS-S: $M = 154.71$, $SD = 21.68$. The correlations ranged from 0.10 to 0.61, and therefore, with all items together, statistically significant ($p < 0.01$).

Table 3 Matrix of Factor Loadings Exploratory Factor Analysis (Principal Components Extraction/PROMAX Rotation)

	Items*	Component Loadings				
		SOS	AES	LST	FPD	HA
14	Are you badly affected by having a lot to do in a short time?	0.735				
16	Does it bother you when people make you do too many things at once?	0.713				
26	When you compete or are watched while doing a task, do you get so nervous or shaky that you do it much worse than you would?	0.598				
23	Do you find it unpleasant when many things are happening at once?	0.584				
11	Does your nervous system sometimes make you feel so exhausted that you just want to get away from it all?	0.569				
19	Are you uncomfortable when a lot is going on around you?	0.524				
21	Do changes in your life affect you a lot?	0.521				
5	Do you need to get away and have some privacy during busy and hard work days in a dark room or in any place where you can have some privacy and relief from so much stimulation?	0.519				
27	When you were a child, did parents or teachers seem to see you sensitive or shy?	0.409				
10	Are you deeply touched by the visual arts or music?		0.688			
22	Do you easily notice delicate or fine aromas, flavors, sounds, works of art ... and enjoy them?		0.655			
2	Do you seem to be aware of the subtleties around you?		0.655			
8	Do you have a rich and complex inner life?		0.599			
15	When people feel uncomfortable in a physical environment, do you tend to know what needs to be done to make them feel more comfortable (such as changing the lighting or seats)?		0.557			
3	Do other people's moods affect you?		0.486			
25	Are you disturbed by intense stimuli, such as loud noises or chaotic scenes?			0.761		
9	Do loud noises bother you?			0.750		
7	Do you easily feel overwhelmed by things like bright lights, strong smells, coarse fabric or nearby sirens?			0.708		
1	Do you easily get overwhelmed by strong sensory stimuli?			0.614		
18	Do you try to avoid violent movies and television shows?			0.490		
4	Do you tend to be more sensitive to pain?				0.673	
13	Do you get easily startled?				0.668	
6	Are you particularly sensitive to the effects of caffeine?				0.474	
20	Does being very hungry create a strong reaction in you, disrupting your concentration or mood?				0.438	
24	Do you give high priority to organizing your life to avoid disturbing or overwhelming situations?					0.673
17	Do you try hard to avoid making mistakes or forgetting things?					0.601
12	Are you conscientious?					0.557
	Factor Correlations					
	Factor II	0.55				

(Continued)

Table 3 (Continued).

	Items*	Component Loadings				
		SOS	AES	LST	FPD	HA
	Factor III	0.61	0.58			
	Factor IV	0.57	0.42	0.52		
	Factor V	0.54	0.56	0.50	0.36	–

Notes: The bottom part of the table corresponds to the correlations between the factors (Factor I = SOS sensitivity to overstimulation; Factor II = AES aesthetic sensitivity; Factor III = LST low sensory threshold; Factor IV = FPD fine psychophysiological discrimination; Factor V = HA harm avoidance). All correlations were statistically significant ($p < 0.01$). *HSPS-S items reproduced from Aron and, Aron.² Copyright © 1997, American Psychological Association.

Discussion

This study provides an appropriate tool for SPS, validated in the Spanish population with good psychometrics, and coinciding with the original version,² as well as with later adaptations in other countries with adult general populations.^{19–24}

We contribute an adaptation with the highest level of linguistic, cultural and conceptual equivalence, without modifying any of the items on the scale, as demonstrated by correct interpretation of the 27 items adapted to Spanish.

The sample used for the Spanish adaptation was considerably larger than for most of the adult high sensitivity scales. The mean age was older, and it contained a mixed representation of workers in different sectors and participants from all the regions of Spain, therefore offering a more enriching perspective in the study of high sensitivity, more so considering that a third of the sample was in the highly sensitive person range according to the selected criteria. Our study showed women to be more affected in both the total HSPS-S and its factors in line with previous studies that have reported higher sensitivity of women.¹⁶

Our findings on the factorial structure of the Spanish version of the HSPS, were in agreement with previous studies, supporting the multidimensionality of the HSPS-S and including essential facets of the trait in SPS theory,⁴ as reflected in most of the studies referenced, which had two and three-factor solutions. However, our study, with a five-factor structure, approaches the one found by Sengül-Inal and Sümer,²⁴ an adaptation which discriminates inhibited behavior, the fourth essential facet of the SPS trait⁴ related to harm avoidance, in a fourth factor. Aron and Aron² considered the behavioral inhibition system as the neuropsychological substrate of the personality trait, and by Smolewska et al²¹ considered it an overall construct associated with SPS, as well as with its components. In the study by Sengül-Inal and Sümer,²⁴ excessive

sensitivity to negative stimuli, ease of excitation of the sensory system tends to be considered an indicator of response to stressful situations or events, demonstrating the relationship between sensitivity to overstimulation (SOS) and harm avoidance (HA).

Unlike previous general population studies, we found a fifth factor, fine psychophysiological discrimination (FPD). In previous studies, the four items that comprise it (4, 6, 13 and 29) had saturated on the EOE factor,^{19–21} on the factor called processed sensitivity (PS),²⁰ were modified,²² or left out altogether.²³ We at least partly share with Montoya-Pérez et al²⁰ the concept that these items respond to processed sensitivity, understanding that sensitivity is the response or psychophysiological reaction an individual experiences when the stimulus has been interpreted, not just perceived. Thus, there would be a cognitive response, with attentional biases in people with anxiety trait. There is a tendency to focus attention automatically on potentially threatening external and internal stimuli, with a shorter response latency than those who do not have this trait, and this in turn causes them to remain anxious. This dimension of the HSPS-S would identify sensitivity to stress related to a special vulnerability or higher biological sensitivity to the context,³⁸ and this reactivity could emerge disproportionately in highly stressful or protected environments. The study by Pérez-Chacón et al³⁹ demonstrated that certain SPS characteristics would be risk factors for burnout and fatigue from compassion in healthcare and education professionals. Some studies have also demonstrated the relationship between pain, anxiety and SPS.⁴⁰ In line with the above, hypersensitivity would lead to stronger attention to painful stimuli and stronger emotional reactions to pain. In most people, exposure to threatening stimuli contributes to habituation, diminishing anxiety. On the contrary, pain causes the opposite effect,

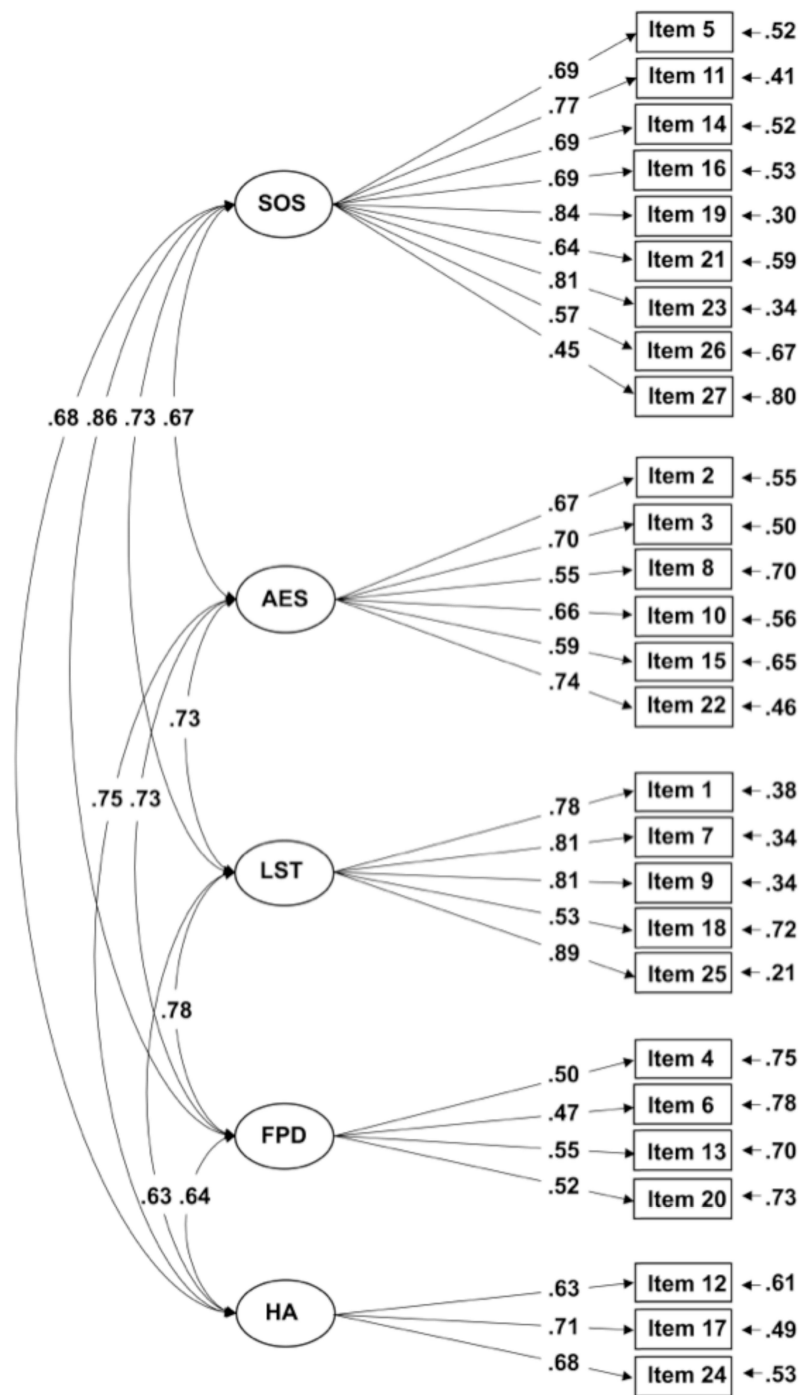


Figure 1 Model resulting from confirmatory factor analysis of HSPS-S.

higher sensitivity as a consequence of a reduction in prefrontal cortex modulation.⁴¹ This leads to greater anxiety, in some highly sensitive people, since in addition to exhaustively analyzing the threatening stimulus, they process this information more thoroughly.⁴² In the light of the results of our study, this more sensitive reaction made us

wonder to what extent high sensitivity, in addition to having an innate component, would be affected by context or environment. That is, even though these people share a similar pattern as mentioned by Aron et al,⁴ the extent of their sensitivity to what occurs around them could differentiate them.

Table 4 Mean Gender Differences

	Male		Female		t	df	p	Cohen d	95% CI
	M	SD	M	SD					
Global HSPS-S	148.23	24.83	155.73	21.99	-7.170	855.440	0.000	0.34	-9.550 to -5.440
SOS	50.95	9.58	52.57	8.74	-3.998	868.680	0.000	0.18	-2.440 to -0.824
AES	34.45	6.02	35.74	5.28	-5.104	851.443	0.000	0.24	-1.789 to -0.795
LST	26.22	6.54	28.83	5.50	-9.541	841.650	0.000	0.46	-3.156 to -2.079
FPD	19.29	4.92	20.72	4.40	-7.021	859.266	0.000	0.32	-1.864 to -1.049
HA	17.32	3.12	17.83	2.92	-3.874	881.358	0.000	0.17	-0.772 to -0.253

Notes: male n = 667; female n = 350.

Abbreviations: SOS, sensitivity to overstimulation; AES, aesthetic sensitivity; LST, low sensory threshold; FPD, fine psychological discrimination; HA, harm avoidance; M, mean; SD, standard deviation; t, Student's t; d, Cohen's value (effect size); CI, confidence interval.

Table 5 Goodness-of-Fit Statistics for Tests of Measurement Invariance of the HSPS-S Across Sex

Sex	χ^2	df	CFI	NNFI	RMSEA (90% CI)	Δ CFI
Configural invariance	5068.40	628	0.97	0.97	0.059 (0.58–0.061)	0.00
Metric invariance	5294.25	655	0.97	0.97	0.059 (0.58–0.061)	0.00
Scalar invariance	5371.10	668	0.97	0.97	0.059 (0.58–0.061)	0.00

Note: p < 0.001.

Abbreviations: χ^2 , chi-square; CFI, comparative fit index; NNFI, non-normed fit index; RMSEA, root mean square error of approximation; Δ CFI, difference in CFI between models; CI, confidence interval.

Thus, a subscale that can identify hypersensitivity to both pain and the rest of psychophysiological and emotional responses of highly sensitive people in the HSPS-S, which has been shown to be equivalent for men and women, would be useful in establishing the relationship between high sensitivity and psychological affectations and complaints typical of central sensitivity syndrome, such as fibromyalgia, headache⁴³ or chronic fatigue.⁴⁴ It is also essential for future studies to be able to determine whether high sensitivity and central sensitivity have a parallel course, or on the contrary, high sensitivity would be a risk factor for developing central sensitivity syndrome.⁴⁵

This question is of special importance for designing and preparing intervention and prevention programs for highly sensitive people with presence of anxiety symptoms, emotional alterations and stress, and sensitization to pain. Cognitive-behavioral treatments have been demonstrating their efficacy in multicomponent interventions for the treatment of chronic affectations involving pain,^{46,47} for improving quality of life.⁴⁰ There are very few controlled psychological studies on highly sensitive people,⁴⁸ although it is true that people who demand professional help to manage their anxiety and depression tend to be diagnosed with a dysthymic disorder, and are

treated with SSRI antidepressants and anxiolytics, and psychological intervention is for stress management and emotional alterations.

Conclusions

The results of the HSPS version validated for the Spanish population enable us to state that the HSPS-S has adequate psychometric properties comparable to other international studies. It maintains the 27 items that make up the original version integrating five high sensitivity components. It is considered suitable for use in daily clinical practice, for mental health conditions, stress and quality of life, especially for common mental disorders or problems, as well as for the professional who studies personalities with sensory processing sensitivity under different circumstances. In addition, it can be used in the workplace for detecting highly sensitive people and studying in greater depth the possible obstacles these people could have in performing their jobs and in their relations with the rest of the staff.

Study Limitations

We should mention as a limitation of this study that the sample was acquired through social networks closest to the researchers. However, we do not have any proof of bias in the sample properties, considered representative of the

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Spanish population. In addition, having employed convenience sampling, its application in a sample of exclusively highly sensitive people would remain pending, although a third of our study sample, a sufficiently representative percentage to be considered a limitation, responded to this pattern. Another limitation has to do with the possible bias in interpreting the items due to the use of self-report questionnaires. Similarly, the impossibility of checking criterion validity, there being no other high sensitivity scale validated for the Spanish population, implies that its results could only be compared with the original HSPS questionnaire, which was the gold standard. It should also be emphasized that, as no instruments were included for criterion and convergent validity, it would need to be determined what aspects of sensitivity are related to other constructs such as the classic version of neuroticism or negative affect. It remains for later studies to disentangle the sense of high sensitivity and its relationship with intolerance to stress and/or indicators of central sensitivity, affectation of the immune response, low threshold of pain, sleeping problems, or any other type of health dysfunction and alteration.

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Disclosure

The authors report no conflicts of interest in this work.

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