Polish adaptation and validation of the standard 27-item Highly Sensitive Person Scale

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Summary

Aim. The aim of the study was to create a Polish adaptation of the Highly Sensitive Person Scale (HSPS), assess its psychometric properties and conduct factor analysis in a group of adults.

Material and methods. Five hundred two students of the Poznan University of Medical Sciences, aged 19–40 were studied, assessed by the 27-item HSPS, Beck Depression Inventory (BDI) and NEO-FFI Questionnaire. Exploratory and confirmatory factor analysis was performed in two subgroups ($N = 250$ and $N = 252$, respectively).

Results. The Polish version was accepted by the authors of the scale. Cronbach's α was 0.90 and the ICC intraclass correlation coefficient was 0.95 for retest data. Exploratory factor analysis distinguished a three-factor model of the HSPS scale (EOE, LST and AES factors), and confirmatory analysis confirmed its better fit. The HSPS scale, EOE and LST showed a significant relationship with the BDI and "Neuroticism" and a negative relationship with "Extraversion", while the AES factor was strongly related to "Openness". Women scored higher on all HSPS subscales, HSPS total score and "Conscientiousness".

Conclusions. The Polish version of the HSPS scale is characterized by good reliability, consistency and validity, and the results indicate a three-factor model. We recommend the use of the HSPS scale in Polish conditions by mental health professionals.

Key words: temperament, validation, Highly Sensitive Person Scale

Introduction

The concept of sensory processing sensitivity (SPS) was introduced in 1997 by an American clinical psychologist, prof. Elaine N. Aron [1]. SPS is treated as a type of temperament and is part of a long history of research on the biological basis of behavior, individual differences, and heritable personality traits [2]. SPS was described and compared in the context of well-established concepts in psychology, i.e., Eysenck's introversion [3], neuroticism [4], Gray's behavioral inhibition system (BIS) [5], and shyness as an innate feature of "low sociability" [6], demonstrating the distinctiveness of SPS dispositions as a separate construct [1, 7, 8]. In 2022, Turjeman-Levi and Kluger [8], in a meta-analysis of the study group (over 1,700 people), found the SPS construct distinct from the sensory processing theory, stating that SPS mainly concerns the emotional reaction to environmental stimulation.

Sensory processing sensitivity is characterized by four features, described by the acronym DOES, i.e., D – depth of processing, O – overstimulation, E – emotional reactivity and empathy, and S – sensing the subtle. Functional magnetic resonance imaging (fMRI) studies confirmed the above theoretical assumptions, showing greater activation of higher cortical centers responsible for consciousness, attention processes, memory consolidation, planning, integration of sensory stimuli, and empathy in highly sensitive people. Diffusion tensor imaging (DTI) studies of white matter microstructure place new emphasis on brain areas related to attention and cognitive flexibility, empathy, emotions, and sensory processing in the primary auditory cortex. Greven et al. [9] described the neural characteristics of SPS, stating that the key areas for SPS coincide with the resting state network (DMN) and the salience network, which mediate mentalization and attention to salient and emotional stimuli. One of the characteristic features of SPS is sensitivity to environmental factors, both negative and positive, with the sensitivity to positive factors being significantly greater [10, 11]. A summary of research on high sensitivity, considering the evolutionary context, neuroimaging studies, and the relationship with mental disorders, is presented in a publication from 2024 in Psychiatria Polska [12].

The prevalence of SPS is estimated at 20-35% of the general population, regardless of gender and cultural context [13-15]. Using a data-driven approach and latent class analysis, Lionetti et al. [14] described the existence of three sensitivity groups in the population: low (29%), medium (40%), and high (31%). They stated that environmental sensitivity is a continuous and normally distributed trait, with people falling into three distinct groups along a sensitivity continuum [14]. The third group characterized by high sensitivity exhibits the SPS temperament, and these people are called HSP (highly sensitive person). With regard to personality traits, known as The Big Five, people with high sensitivity achieved significantly higher scores in neuroticism and emotional reactivity and lower in extraversion than the other two groups [14].

1. HSPS scale

The tool for measuring the SPS trait is the Highly Sensitive Person Scale (HSPS). For research purposes, a 27-item self-assessment version on a 7-point Likert scale is recommended. The original analysis of the HSPS scale (which was a summary of seven studies) showed adequate reliability (Cronbach's alpha = 0.85-0.87) and validity of the scale [1].

Recent years have seen the scale's psychometric properties favorably evaluated across several populations, including Norwegian [16], Mexican (27-item version) [17], Russian [18], German [19], Spanish [20, 21], Polish [22, 23], and the Japanese version (10-item version) [24]. Depending on the study, factor analysis of the 27-item scale distinguished a one-factor [1], two-factor [18, 25], three-factor [7, 16], four-factor [26] or five-factor [20] model. The original analysis conducted by Aron and Aron (1997) indicated that the HSPS scale examines only one factor, so the SPS construct is unidimensional [1].

Smolewska et al. [7] offer the most widely accepted interpretation of the HSPS scale identifying three dimensions: ease of excitation (EOE), aesthetic sensitivity (AES), and low sensory threshold (LST). This division has been used by researchers in other scientific studies [27, 28], and the results indicating three dimensions have been repeated by others [16]. Subsequent publications have reiterated the originally established dimensions highlighting the distinctive features of SPS. The two-factor models distinguished: (1) the EOE and LST dimensions [18], while the AES dimension identified by the clustering method showed a very low correlation with the first two factors; (2) "processed sensitivity" (PS) and LST dimensions [17]; (3) the "negative affect" and "orienting sensitivity" dimensions [25]. In the four-factor model described using exploratory structural equation modeling (ESEM), in addition to factors such as: sensitivity to external stimuli (SES), aesthetic sensitivity (AES), and sensitivity to over-stimulation (SOS), the factor "harm avoidance" (HA) was additionally distinguished [26]. However, in the five-factor model, in addition to the previously described three basic factors, the HA factor was described, and additionally: fine psychophysiological discrimination (FPD) [20].

In the presented factor analyses, due to low correlation coefficients, some questions were excluded, resulting in a smaller number of questions for analysis: from 13 [16] to 25 [7]. Various statistical methods were also used, i.e., Velicer Map criterion [25], hierarchical cluster analysis [18], exploratory and confirmatory factorial analysis [17, 20], and exploratory structural equation modeling (ESEM) [26].

The study had three goals: (1) adaptation of the Polish version of the HSPS scale; (2) assessment of the psychometric properties of the HSPS scale and (3) factor analysis of the HSPS scale.

2. Material and methods

2.1 Development of the Polish translation of the Highly Sensitive Person Scale

Work on the Polish version of the scale began after obtaining the authors' consent to translate the original questionnaire into Polish. The adaptation process was performed in accordance with generally accepted guidelines [29]. In the first stage, the English version of the tool was translated into Polish independently by a psychiatrist and an occupational physiotherapist, both with advanced knowledge of English. In the next stage, a second independent team of two psychiatrists with the title of professor performed a back translation into English. Upon verifying both translations the final version was established. The back translation received approval from the tool's co-author, Prof. Arthur Aron. The Polish translation of the HSPS scale was accepted and intended for use in the study. Participants were fine understanding the meaning of the questions presented in the Polish version of the HSPS.

2.2 Study group

The study included 502 students and PhD students at the Karol Marcinkowski University of Medical Sciences in Poznań aged between 19 to 40 (mean 22.9 ± 2.52 SD). For validation purposes the Highly Sensitive Person Scale was readministered to a subgroup of 50 individuals after seven days (paper-and-pencil method). The questionnaires were collected in two ways: the traditional paper-and-pencil method and using an online form via the website of the Poznań University of Medical Sciences. The subjects were volunteers who participated in practical classes (paper-and-pencil method) and responded to an invitation to participate in the study (online form). The study was anonymous, and participants were informed about its purpose and the rules for correctly completing the questionnaires. The study met the conditions required by the Bioethics Committee of the Poznań University of Medical Sciences.

2.3 HSPS scale – a separate counting method

The validated method was the Highly Sensitive Person Scale, which included 27 questions regarding stimulus processing [1]. The items included direct questions about the sensitivity of signals coming from the environment such as sound, light, smells (Question 4 – "Do you tend to be more sensitive to pain?"; Question 9 – "Are you made uncomfortable by loud noises?"), a subjective assessment of temperamental traits associated with sensitivity – being subject to other people's moods, susceptibility to overstimulation (Question 3 – "Do other people's moods affect you?"; Question 21 – "Do changes in your life shake you up?") and aesthetic sensitivity (Question 8 – "Do you have a rich, complex inner life?"; Question 10 – "Are you deeply moved by the arts or music?"). All questions were rated on a 7-point scale by the respondents them-

selves, where 1 means "not at all/never" and 7 means "maximally" (self-assessment scale). The total score of the scale is the sum of all points obtained.

The HSPS questionnaire is a useful tool for self-assessment and quick identification of a population of highly sensitive people who are predisposed to certain mental disorders.

2.4 Reference to existing tools (Beck Depression Inventory and NEO-FFI)

For the purpose of validating the method, the following measurement tools were used:

1. Beck Depression Inventory (BDI) [30] in the Polish translation by Parnowski and Jernajczyk [31]. This tool was used to exclude the feature of "negative affect", in accordance with recommendations for researchers [32]. This exclusion results from the use of negatively worded questions in the Highly Sensitive Person Scale, which correspond to the way in which highly sensitive people process stimuli, but this negative affect may be the result of depressiveness as a trait.

2. NEO-FFI Personality Inventory by Costa and McCrae in the Polish adaptation by Zawadzki, Strelau, Szczepaniak and Śliwińska [33]. This is a shortened version of the NEO-PI-R scale, which was used to examine the severity of five main traits: Neuroticism, Extraversion, Openness to experience, Agreeableness, and Conscientiousness, otherwise known as the Big Five. The questionnaire consists of 60 self-description statements rated on a 5-point scale from "strongly disagree" (1) to "strongly agree" (5), scoring from 0 to 4 points, respectively, according to the answer key.

Polish translations of the methods used are characterized by satisfactory reliability and validity results.

2.5 Statistical analysis

The normality of data distribution was assessed using the Kolmogorov-Smirnov, where a value below 0.05 signified deviation from normal distribution. The test-retest method was used to assess the reliability of the scale, and the intraclass correlation coefficient (ICC) was calculated to measure the agreement between the quantitative measures obtained from the questionnaire. Internal consistency was assessed using Cronbach's α. Convergent validity was assessed by examining the correlation between HSP scores and scores on each of its subscales using the Beck Depression Inventory (BDI) and the NEO-FFI five-factor inventory. Spearman's coefficient was used to assess correlation. Student's t-test and Mann-Whitney U test were used to assess gender differences. P-values < 0.05 were considered significant.

For the purpose of factor analysis, the participants were randomly allocated into two subgroups. The first subgroup, A, included 250 respondents and an exploratory factor analysis (EFA) was performed on this group; the second subgroup, B, included

252 people and a confirmatory factor analysis (CFA) was performed on it. Before conducting EFA, data validity was assessed using Kaiser-Meyer-Olkin (KMO) and Bartlett tests of sphericity. These tests were used to verify that the data were suitable for conducting EFA. To ensure the reliability of the factor loadings, each item had to have a value of ≥ 0.40 to be included in the final selected factor.

After EFA, confirmatory factor analysis was estimated based on the results of subgroup B. To assess the CFA fit, the following indices were calculated: chi^2/df, Comparative fit index (CFI), Root mean square error of approximation (RMSEA), Normed fit index (NFI). The following fit criteria for the chi^2/df model were adopted: 2-5, CFI > 0.9, RMSEA < 0.08, NFI > 0.9 [34]. SPSS v23 for Windows (SPSS, Inc., Chicago, IL, USA) was used for statistical analysis. IBM Amos v26 was used to perform CFA.

3. Results

3.1. Characteristics of the study group (Table 1)

Among the 502 participants from the Poznań University of Medical Sciences, 74 % were female. The age of the study group was 22.9 ± 2.52 years. The majority (71.5%) were medical students (1st year – 13.5%, 2nd year – 15.9%, 3rd year – 9.8%, 4th year – 29.1%, 5th year – 7.8 %, 6th year – 23.9%). Other participants included students from physiotherapy (5.2%), PhD students (4.8%), nursing (4%), biotechnology (3.6%), pharmacy (3.2%), medical and dental (1, 8%) and other fields (6%). The mean total score on the HSPS scale in the entire group was 4.43 ± 0.9.

Table 1. **Characteristics of study participants**

Parameter	Mean ± SD
Age (years)	22.9 ± 2.52
Sex (F/M)	372/130
HSPS – total score	119.59 ± 24.21
Factor 1 – EOE	66.13 ± 16.38
Factor 2 – LST	18.28 ± 6.46
Factor 3 – AES	29.73 ± 5.42
Beck Depression Scale	10.94 ± 10.31
NEO-FFI: Neuroticism	5.72 ± 2.68
NEO-FFI: Extraversion	5.28 ± 2.29
NEO-FFI: Openness	6.10 ± 1.86
NEO-FFI: Agreeableness	5.96 ± 2.62
NEO-FFI: Conscientiousness	6.70 ± 2.44

SD – standard deviation; F – female, M – male; EOE – Ease of Excitation; LST – Low Sensory Threshold, AES – Aesthetic Sensitivity

3.2 Factor analysis

3.2.1 Exploratory factor analysis (EFA)

To determine the internal structure of the scale, an exploratory factor analysis was performed using the principal components method. An orthogonal rotation analysis of factors using the Varimax method was performed.

Variant 1. To analyze construct validity, factor analysis was performed. The Kaiser–Meyer–Olkin test gave a value of 0.907, and the Bartlett test of sphericity was statistically significant ($p < 0.001$). Kaiser factor analysis revealed a structure consisting of six factors that accounted for 58.1% of the total variance in scores. The values of individual factors were: factor 1 – 30.1%, factor 2 – 8.3%, factor 3 – 6.1%, factor 4 – 4.8%, factor 5 – 4.6%, and factor 6 – 4.1%.

Variant 2. In addition to the Kaiser criterion, the Raymond Cattell scree test was employed as a more stringent method for determining the optimal number of factors. Based on Figure 1, three factors were distinguished, and the affiliation of individual questions to factors is presented in Table 2. In the 3-factor version, question 17 does not correlate with any factor at a level of at least 0.4.
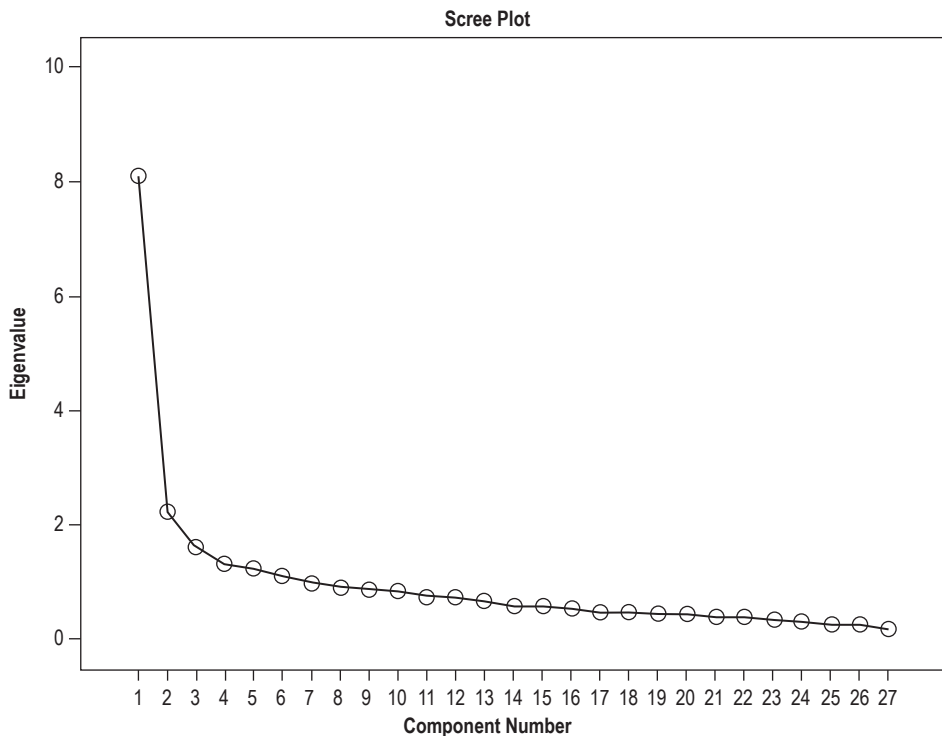

Figure 1. **Scree plot – eigenvalues and component numbers**

Table 2. **Factor loadings of individual questionnaire questions. Matrix of rotated components. Raymond Cattell Criterion**

HSPS scale question number	Factor 1	Factor 2	Factor 3
Q14	0.762		
Q23	0.679		
Q21	0.678		
Q26	0.675		
Q3	0.661		
Q19	0.636		
Q16	0.627		
Q13	0.590		
Q5	0.573		
Q11	0.539		
Q1	0.531		
Q27	0.497		
Q24	0.496		
Q20	0.458		
Q4	0.444		
Q25		0.637	
Q18		0.628	
Q9		0.601	
Q7	-	0.598	
Q12		0.510	
Q6		0.414	
Q17	0.181	0.242	0.197
Q22			0.748
Q10			0.736
Q8			0.704
Q2			0.650
Q5			0.517

3.2.2 Confirmatory factor analysis (CFA)

In a confirmatory factor analysis (CFA) conducted with 252 participants, we evaluated the suitability of both the 3-factor and 6-factor model, as detailed in Table 3. Despite the 3-factor model demonstrating a superior fit compared to 6-factor model,

it is noteworthy that the CFI and the NFI fell short of reaching the pre-established benchmarks. Nevertheless, due to its better alignment with our data, the 3-factor model was chosen for subsequent analysis.

Table 3. **Confirmatory factor analysis**

Number of factors	X^2	df	X^2/dF 2-5	CFI >0,9	RMSEA <0,08	NFI >0,9
3-factor model	631.045	296	2.132	0.840	0.067	0.738
6-factor model	683.913	309	2.213	0.829	0.070	0.731

CFI – Comparative fit index; RMSEA – Root mean square error of approximation; NFI – Normed fit index

3.3 Reliability

We achieved a high level of internal consistency as indicated by Cronbach's alpha coefficient of 0.90. The lowest score of 0.72 was obtained by the LST subscale and the highest of 0.89 by the EOE subscale. In a test-retest study conducted with a group of 50 students over a weekly interval, the intraclass correlation coefficient (ICC) for the entire questionnaire was 0.95. Such a high ICC value, close to 1, indicates strong agreement and suggests that the measurements are reliably consistent over time. The results are presented in Table 4.

Table 4. **Reliability: Cronbach's α value and intraclass correlation coefficient (ICC)**

HSPS	Cronbach's α	ICC
HSPS – total score	0.902	0.954
Factor 1 – EOE	0.890	0.931
Factor 2 – LST	0.720	0.926
Factor 3 – AES	0.741	0.835

HSPS – Highly Sensitive Person Scale; ICC – Intraclass correlation coefficient; EOE – Ease of Excitation; LST – Low Sensory Threshold; AES – Aesthetic Sensitivity

3.4 Validity

The study further analyzed the correlation between the total score of the HSP questionnaire and the scores on each of its subscales using the Beck Depression Inventory (BDI) and the five-factor NEO-FFI inventory. This analysis was conducted as part of the convergent validity process. The results are presented in Table 5.

Table 5. **Correlation of the total score of the HSP scale and the total score of the BDI and individual NEO-FFI subscales (Spearman's rank correlation)**

HSPS	Beck Depression Inventory	NEO-FFI: Neuroticism	NEO-FFI: Extraversion	NEO-FFI: Openness	NEO-FFI: Agreeableness	NEO-FFI: Conscientiousness
HSPS – total score	0.47**	0.61**	-0.36**	0.23**	-0.04	-0.07
Factor 1 – EOE	0.53**	0.69**	-0.44**	0.11*	-0.09*	-0.18*
Factor 2 – LST	0.29**	0.36**	-0.27**	0.10*	-0.01	-0.01
Factor 3 – AES	0.06	0.12**	0.06	0.60**	0.17**	0.19**

* The correlation is significant at the 0.05 level (2-sided)

** The correlation is significant at the 0.01 level (2-sided)

Significant correlations were found between (1) the total score of the HSPS scale and the BDI, Neuroticism, Extraversion (negative), and Openness; (2) EOE and LST factor and BDI, Neuroticism, and Extraversion (negative); (3) the AES factor and Openness.

The HSPS scale total score and the EOE subscale showed moderate correlations with the Beck Depression Inventory, while the LST and AES showed low and very low correlations, respectively. The EOE (high correlation) and LST (moderate correlation), but not the AES subscales were significantly related to Neuroticism, as was the entire 27-item scale. Extraversion was negatively correlated with the EOE factor (moderate), LST (low), and total HSPS score (low).

Fortunately, a high positive correlation was found between AES and Openness, with openness being the only variable that showed such a strong relationship with AES. There were no or very weak associations between Agreeableness and Conscientiousness and any of the HSPS dimensions.

Floor and ceiling effects were also calculated, taking into account the percentage of respondents who scored below the lower (floor) and upper (ceiling) cutoffs. The above-mentioned effects were confirmed when they occurred in at least 1% of the respondents. The lower cut-off limit was set at the following level: minimum score + 5% of the total score (floor effect – ≤36 points) and maximum score – 5% of the total score (ceiling effect ≥180 points). In summary, there were no floor or ceiling effects.

3.5 Gender analysis

The analysis by gender is presented in Table 6.

Table 6. **Analysis of HSPS, BDI and NEO-FFI scale results depending on gender**

Variable	F	M	Statistical significance
Age	22.77 ± 2.37	23.33 ± 2.85	p = 0.051
HSPS – total score	124.01 ± 23.35	106.67 ± 21.98	p < 0.001*
Factor 1 – EOS	68.96 ± 15.76	57.88 ± 15.40	p < 0.001*
Factor 2 – LST	19.44 ± 6.19	14.88 ± 6.03	p < 0.001*
Factor 3 – AES	30.06 ± 5.44	28.80 ± 5.28	p = 0.024*
BDI	11.70 ± 10.74	8.71 ± 8.61	p = 0.002*
NEO-FFI: Neuroticism	5.80 ± 2.63	5.48 ± 2.81	p = 0.290
NEO-FFI: Extraversion	5.20 ± 2.24	5.51 ± 2.43	p = 0.121
NEO-FFI: Openness	6.08 ± 1.78	6.17 ± 2.08	p = 0.588
NEO-FFI: Agreeableness	6.07 ± 2.64	5.65 ± 2.54	p = 0.067
NEO-FFI: Conscientiousness	6.86 ± 2.46	6.23 ± 2.32	p = 0.017*

F – female, M – male; p – statistical significance; EOE – Ease of Excitation; LST – Low Sensory Threshold; AES – Aesthetic Sensitivity; BDI – Beck Depression Inventory
* p < 0.05 – statistically significant

Broken down by gender, significantly higher scores were observed in women across all three factors of the HSPS scale, as well as its total score. Additionally, women achieved higher scores on the BDI and Conscientiousness scales in the NEO-FFI.

4. Discussion of results

The high internal consistency (Cronbach's alpha = 0.9) indicates very good reliability of the Polish version of the HSPS scale. Among the available studies, our results represent the second highest level of internal consistency reported. The inaugural study by Aron and Aron documented a Cronbach's alpha of 0.85 [1]. Subsequent studies reported values of 0.92 for the Spanish version [20], 0.89 for both the Mexican version [17] and English version [7], 0.75 for the Norwegian version [16] and 0.702 for another Spanish version [21].

4.1 Factor analysis

In our factor analysis, we selected 26 questions from the HSPS scale for evaluation. Question 17: "Do you try hard to avoid making mistakes or forgetting things?" achieved a loading below 0.4 and was therefore removed from the assessment. All remaining questions had a loading above 0.4 and were qualified for factor analysis.

The analysis distinguished three factors. The first factor, which we defined as Ease of Excitation (EOE), included 15 questions (Questions 14, 23, 21, 26, 3, 19, 16, 13, 5, 11, 1, 27, 24, 20, 4). The second factor, called Low Sensory Threshold (LST), included six questions (Questions 25, 18, 9, 7, 12, 6). The third factor, described as Aesthetic Sensitivity (AES), included five questions (Questions 22, 10, 8, 2, 15).

We will compare the obtained results primarily to the results of the factor analysis obtained by Smolewska et al. [7], which we (hereinafter) call the reference study (RF), where the authors included 25 questions in the assessment (questions 1 and 11 were removed). The first factor, EOE, included 12 questions (Questions 3, 4, 13, 14, 16, 17, 20, 21, 23, 24, 26, 27), the second factor, AES, included 7 questions (Questions 2, 8, 10, 12, 15, 22 and 5), and for the third factor, LST – 6 questions (Questions 6, 7, 9, 18, 19, 25).

In our assessment, we identified three factors: EOE, LST and AES, retaining their names from the RS, considering that they best reflect the theoretical construct of SPS. The first EOE factor encompassed 11 of the 12 questions from the RS, resulting in a 92% overlap. The remaining four questions included in our study in the EOE factor are: questions 1 and 11, not included in the RS; question 19, qualified in the RS for LST; and question 5, qualified in the RS for AES. In our opinion, question 19: "Do you become unpleasantly aroused when a lot is going on around you?" and question 5: "Do you find yourself needing to withdraw during busy days, into bed or into a darkened room or any place where you can have some privacy and relief from stimulation?" may better reflect factor 1, i.e., Ease of Excitation, than Aesthetic Sensitivity (question 5).

We classified 5 out of 6 questions from RS into the second factor, which we called LST. Additionally, we included question 12: "Are you conscientious?", which was included in AES in the RS. Question 19 cited above, which was included in the LST factor in the RS, was included in the EOE factor in our analysis. We classified 5 out of 7 questions indicated in the RS as the third factor, AES. In our analysis, question 5 was included in the EOE factor, and question 12 was included in the LST factor.

In summary, our results closely align with Smolewska et al.'s [7] initial factor analysis of the HSPS scale, which identified three factors with largely overlapping question assignments.

In other factor analyses, researchers used different names for individual factors. Evans and Rothbart [25] distinguished two factors; one of them "orienting sensitivity/ openness" (questions 22, 15, 10, 8, 2, 17) contains almost all questions (except 17) overlapping with the AES factor in our study and the RS. In the 2-factor analysis by Ershov et al. [18], the names EOE (3, 4, 5, 11, 13, 14, 16, 20, 21, 26) and LST (1, 7, 9, 25) were repeated, where 10/10 questions (100%) from EOE and 3 out of 4 questions from LST coincide with our analysis. Grimen and Diseth [16] found three factors (in a shorter, 13-item scale), which they named as in the RS (EOE, AES, LST). All questions (100%) in individual factors overlap with our analysis and with the RS: EOE: 5/5 questions, LST: 3/3 questions, AES: 5/5 questions.

In the study by Şengül-İnal and Sümer [26], four factors were distinguished, with: 10 questions forming factor 1 of SOS (questions 14, 23, 16, 19, 26, 27, 5, 21, 20, 11) entirely overlap (100%) with the EOE factor in our study (and 7 with EOE questions in RS); the five questions forming SES factor 2 (questions 7, 1, 9, 25, 13) cover questions from EOE and LST in our study; and seven questions forming the AES factor (questions 22, 10, 15, 2, 8, 4, 3) entirely overlap (100%) with our study and the RS. In Chacón et al.'s [20] 5-factor model, the SOS factor included nine questions (14, 16, 26, 23, 11, 19), which were entirely included in the EOE factor in our study; the AES factor included six questions (10, 22, 2, 8, 15, 3), which, apart from question 3 form the AES factor in our study and the RS; the LST factor included five questions (25, 9, 7, 1, 18), which, apart from question 1, overlap with the LST factor in our study and the RS. The FPD factor, which does not appear in other works, included four questions (questions 4, 13, 6, 20), which, apart from question 4, were included in EOE in our study and the RS.

The results of two studies seem interesting, in which the factor of "harm avoidance" (HA) was distinguished [20, 26]. In the study by Şengül-İnal and Sümer [26], the HA factor included questions 12, 24 ("Do you make it a high priority to arrange your life to avoid upsetting or overwhelming situations?"), 17 ("Do you try hard to avoid making mistakes or forgetting things?") and 18 ("Do you make a point to avoid violent movies and TV shows?"), and in the study by Chacón et al. [20], questions 12, 17, and 24. In our study, questions 12 and 18 were included in the LST, question 24 in EOE, and question 17 were dropped from the analysis. In the RS study, questions 12, 17, and 18 were each included in a different factor: AES, EOE and LST, respectively, while behaviors defined as avoiding negative consequences and unpleasant states were associated with the BIS behavioral inhibition system and a strong correlation between the BIS scale and the EOE factor. However, in variant 1 of our factor analysis, questions 12 and 17 formed a separate sixth factor. The study by Hofmann et al. [35] showed a correlation between the HSPS scale and the trait of "harm avoidance" measured using Cloninger's Tridimensional Personality Questionnaire.

To conclude, research on the multidimensional model of the HSPS consistently reveals three core factors, EOE, LST and AES, that align with the question assignments in both our study and the reference study (RS). Although these factors are given different names, it can be said that the questions of the HSPS scale reflect the assumed theoretical foundations of the SPS construct. Furthermore, future research should explore the "harm avoidance" factor and its integration within the SPS model more closely.

4.2 Correlation between HSPS and BDI and NEO-FFI

Using the NEO-FFI questionnaire to evaluate the HSPS enabled us to assess the scale's validity and its relation to existing personality models. We found that the HSPS scale and its main factor EOE, and to a lesser extent LST, are significantly related to the Beck Depression Inventory and Neuroticism, but show a negative relationship

with Extraversion. The AES scale exhibited unique properties, being strongly related to Openness. However, it showed no relation to the BDI, Neuroticism, or other NEO-FFI subscales.

Our analysis reflected Elaine Aron's assumption of similarities between HSPS and the traits of introversion and neuroticism. We showed a relationship between HSPS and "negative affect" and Neuroticism, which is an element of the so-called The Big Five. The results obtained are again similar to those obtained by Smolewska et al. [7]. The authors explain the similarities between the above concepts, including a predisposition to worry, cautious behavior, and behavioral responses to stimuli that may lead to avoidance. On the other hand, the EOE factor showed the strongest correlation with Neuroticism. In contrast, the AES factor was not related to it, which indicates a relationship, but not the identity, of the concepts of SPS and neuroticism.

The initial research by Elaine and Arthur Aron [1] demonstrated that SPS transcends merely being a blend of social introversion and emotionality, establishing it as a distinct disposition. Smolewska et al. [7] showed only low-level negative correlations between LST and Extraversion. In our study, we obtained more evident results, showing moderate negative associations between EOE and Extraversion and low associations for the LST factor. This may highlight the stronger association between SPS and introversion and the BIS system in our group. Our results are most similar to those obtained by Grimen and Diseth [16], where relationships with Neuroticism and Extraversion were also confirmed, but the total HSPS score was positively correlated with Openness. The authors believe that SPS may be a mixture of neuroticism, reverse extraversion, and openness. Şengül-İnal and Sümer [26] also confirmed strong correlations between all HSPS subscales and Neuroticism, negative correlations with Extraversion and a strong connection between AES and Openness.

Smolewska et al. [7] explain the relationship between AES and Openness through Gray's Reinforcement Sensitivity Theory (RST) [36], where the activation of the BIS system occurs only simultaneously with the stimulation of the behavioral approach system (BAS). This assumption is consistent with previous results obtained by McCrae [37], where openness correlated with the "sensation-seeking" trait. As described by Costa and McCrae [38], the Openness scale covers areas such as fantasy, aesthetic impressions, feelings, actions, ideas, and values. In other approaches, Openness is termed intellect or culture and shows the highest factor loadings with adjectives such as artistically sensitive/insensitive, creative/uncreative, with broad/narrow interests, intelligent/unintelligent, with high/low imagination [39]. On the temperamental side, it correlates with features of the nervous system, such as the strength of the arousal process and mobility [39]. This factor, therefore, spreads its importance between temperament and personality. However, in relation to the SPS construct, the AES factor, through its correlation with Openness, would be associated with such features of highly sensitive people as creativity [40], empathy [41], and deriving greater benefits from positive experiences [11, 42].

The lack of relationship between HSPS and its factors and Conscientiousness and Agreeableness may indicate a significant and modulating influence of cultural and environmental factors, especially since higher Conscientiousness scores were obtained in women.

4.3 Correlation with gender

Although high sensitivity is believed to be genetically determined without direct correlation to gender, men typically score lower than women on assessments. Cultural differences likely account for our findings, which confirm previous observations, but there is a lack of in-depth work in this area, which justifies distinguishing the male and female populations in subsequent studies. The analysis by Şengül-İnal and Sümer [26] showed similar conclusions, where women obtained higher scores in three factors, the equivalent of EOE, AES and HA.

5. Conclusions

The research confirmed good psychometric properties, including reliability, consistency, and validity of the Polish version of the HSPS scale. This means that the HSPS scale measures a postulated coherent theoretical construct: sensory processing sensitivity. We believe the HSPS scale is a three-factor scale, described as EOE, LST and AES, and therefore reflects the theoretical and substantive assumptions of the SPS construct and the HSPS scale.

Research into SPS builds on the historical research of environmental sensitivity, previously described, among others, as the s/s phenotype of the serotonin transporter gene and in the evolutionary context as vantage sensitivity or biological sensitivity to context [10]. Currently, psychiatry is looking for new models of understanding mental disorders, going beyond the categorical approach and the medical model of disability towards the development of a dimensional approach, personalized psychiatry, and the social model of mental disorders. The identification of an SPS temperament as one of the patient's characteristics will enable the development of a better, individualized approach in understanding by the psychiatrist the course of the mental disorder as well as in striving for and maintaining remission. Additionally, the presence of SPS may presumably allow for predicting individual responses to treatment, taking into account potential side effects of medications; however, further studies in this area are needed.

The study of high sensitivity, due to its unique features, i.e., significant reactivity to protective factors and reward (probably related to the dopaminergic system), fits into a new context of research in psychiatry, considering protective factors and the social impact on mental well-being. The development and adaptation of the Highly Sensitive Person Scale that measures SPS aims to identify individuals for whom both risk and protective factors play a crucial role in the development of symptoms of

mental disorders (mainly depression and anxiety) and in achieving mental well-being (according to the WHO definition of mental health), as well as in finding more adapted therapeutic strategies.

The study's strengths include its large sample size, application of sophisticated statistical techniques, the clarity and transparency of the results obtained, and the ease of translating the results into practical application. The limitation of the study is its sample composition, predominantly women and younger individuals (average age 22.9 years). Future research should focus on the population of people >35-40 years of age, as it has been shown that with age the severity of EOE and LST features decreases and AES increases [43]. The relationship between the influence of pharmacotherapy on SPS traits also seem interesting, e.g., in view of studies indicating that long-term lithium treatment has a beneficial effect on certain temperament traits [44]. In addition, the potential results of validation studies including the Polish FCZ-KT(R) Questionnaire and a description of the SPS concept in relation to Jan Strelau's Regulative Theory of Temperament seem interesting.

We believe that the Polish adaptation of the HSPS scale is highly applicable for practical use by psychiatrists in outpatient settings in order to identify the factor that predisposes to and maintains psychopathological symptoms, as well as the protective factor in patients with mainly depressive and anxiety disorders. It is also useful for psychotherapists and psychologists in creating individualized psychotherapy and counseling in everyday practice. Additionally, for the patients themselves, the element of psychoeducation related to the temperament of high sensitivity will allow them to acquire the ability to adapt their environment, including work and relationships, to their own needs, which will increase the patients' agency in the therapeutic process, thus strengthening mental immunity (resilience).

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Attachment

Questionnaire (Highly Sensitive Person Scale)

INSTRUCTIONS: This questionnaire is completely anonymous and confidential. Answer each question according to the way you personally feel, using the following scale:

1	2	3	4	5	6	7
Not at All			Moderately			Extremely

1. Are you easily overwhelmed by strong sensory input?
2. Do you seem to be aware of subtleties in your environment?
3. Do other people's moods affect you?
4. Do you tend to be more sensitive to pain?
5. Do you find yourself needing to withdraw during busy days, into bed or into a darkened room or any place where you can have some privacy and relief from stimulation?
6. Are you particularly sensitive to the effects of caffeine?
7. Are you easily overwhelmed by things like bright lights, strong smells, coarse fabrics, or sirens close by?
8. Do you have a rich, complex inner life?
9. Are you made uncomfortable by loud noises?
10. Are you deeply moved by the arts or music?
11. Does your nervous system sometimes feel so frazzled that you just have to go off by yourself?
12. Are you conscientious?
13. Do you startle easily?
14. Do you get rattled when you have a lot to do in a short amount of time?
15. When people are uncomfortable in a physical environment do you tend to know what needs to be done to make it more comfortable (like changing the lighting or the seating)?
16. Are you annoyed when people try to get you to do too many things at once?
17. Do you try hard to avoid making mistakes or forgetting things?
18. Do you make a point to avoid violent movies and TV shows?
19. Do you become unpleasantly aroused when a lot is going on around you?
20. Does being very hungry create a strong reaction in you, disrupting your concentration or mood?

21. Do changes in your life shake you up?

22. Do you notice and enjoy delicate or fine scents, tastes, sounds, works of art?

23. Do you find it unpleasant to have a lot going on at once?

24. Do you make it a high priority to arrange your life to avoid upsetting or overwhelming situations?

25. Are you bothered by intense stimuli, like loud noises or chaotic scenes?

26. When you must compete or be observed while performing a task, do you become so nervous or shaky that you do much worse than you would otherwise?

27. When you were a child, did parents or teachers seem to see you as sensitive or shy?