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SHORT REPORT

Sensory processing sensitivity is negatively associated with sensation seeking

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BACKGROUND
This study investigated the relationship between sensory processing sensitivity and sensation seeking.

PARTICIPANTS AND PROCEDURE
The sample consisted of 625 subjects (*n* women = 225, *n* men = 400). Sensory processing sensitivity was assessed using the Highly Sensitive Person Scale (HSPS), and sensation seeking with the Arnett Inventory of Sensation Seeking (AISS).

RESULTS
AISS accounted for 11.1% of the variance in HSPS. Regression analyses revealed a negative association between AISS Intensity and HSPS. There was no significant association between AISS Novelty and HSPS. Men exhibited lower scores on HSPS but displayed higher scores on AISS Novelty and AISS Intensity compared to women.

CONCLUSIONS
We found gender differences and a negative association between sensory processing sensitivity and the intensity dimension of sensation seeking. The results confirm that HSPS captures the intensity of complex sensory stimulation. Sensory processing sensitivity and sensation seeking could be seen as theoretically connected and overlapping phenomena.

KEY WORDS
gender; sensory processing sensitivity; Highly Sensitive Person Scale; sensation seeking; AISS

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BACKGROUND

Sensory processing sensitivity refers to an innate psychobiological trait encompassing heightened responsiveness to various external, internal, emotional, and cognitive stimuli. It includes emotional reactivity, perception of social and environmental subtleties, reflective thinking, and empathy (Acevedo et al., 2021; Aron & Aron, 1997; Pluess, 2015). Research has identified associations between sensory processing sensitivity, personality traits, and gender differences. Sensory processing sensitivity correlates positively with neuroticism, openness, and agreeableness, with women generally displaying higher scores compared to men, even when controlling for personality traits associated with gender (Trå et al., 2022). Additionally, sensory processing sensitivity has been observed across species such as dogs, primates, and other animals (Braem et al., 2017), implying its potential adaptive significance for both humans and animals (Greven et al., 2019).

Measurement of sensory processing sensitivity typically employs the Highly Sensitive Person Scale (HSPS; Aron & Aron, 1997). The HSPS has a multifactorial structure (Baryła-Matejczuk et al., 2023; Trå et al., 2022), but it is debated whether the HSPS accurately captures sensory sensitivity. Some argue that the HSPS primarily reflects negative affectivity and orientation sensitivity rather than sensory sensitivity. For instance, Evans and Rothbart (2008) suggested that the HSPS primarily reflected negative affectivity and orientation sensitivity, rather than sensory sensitivity. Conversely, others contend that sensory processing sensitivity involves various forms of sensory stimulation, including its intensity. Highly sensitive individuals appear prone to overstimulation, leading them to seek reduced amounts and intensity of stimulation (Aron et al., 2012). This conflicting evidence underscores the need for further exploration into the relationship between sensory processing sensitivity and sensory stimulation.

Sensory stimulation includes all sensory modalities, and not only exteroceptive stimuli (visual, auditory, taste and smell, etc.), but also more complex interoceptive stimulation created by the individuals themselves (arousal, emotions, cognition, bodily reactions). This variety and complexity of stimulation is reflected in behavioural styles such as sensation seeking. It is related to arousing music, increased intake of caffeine, drinking and substance use, speeding, and preference for more intense and varied aromas (Nater et al., 2005; Penolazzi et al., 2012). Thus, to register the complexity and especially intensity of sensory stimulation in a variety of areas, assessment of sensation seeking seems to be a relevant approach.

Only Acevedo et al. (2023) have so far investigated the relationship between sensation seeking and sensory processing sensitivity. They used the Zuckerman-Kuhlman-Aluja Personality Questionnaire (ZKA-PQ) and other inventories, including a new scale without items mapping risk-taking and high impulsivity. They found that sensory processing sensitivity was negatively correlated with ZKA-PQ, risk-taking and impulsivity, but positively associated with negative urgency.

Risk-taking and impulsivity were not issues in our study. There were only two main aspects of sensation seeking, novelty and intensity of sensory stimulation. We therefore used the Arnett Inventory of Sensation Seeking (AISS), which was developed to measure these two dimensions (Arnett, 1994). The AISS was developed as an alternative to Zuckerman's Sensation Seeking Scale (SSS-V), which had psychometric weaknesses according to Arnett (Arnett, 1994; Mallet & Vignoli, 2007).

We also wanted to investigate more closely the issue of low sensitives vs. high sensitives and sensation seeking. Sensory processing sensitivity and sensation seeking could be theoretically connected as suggested by further developments of arousal theories with integration of biochemical, psychopharmacological, neuropsychological, personality, clinical and sociopsychological factors (Acevedo et al., 2023; Zuckerman, 2014). Low sensitives could prefer higher levels of stimulus intensity than high sensitives, and actively seek to increase sensory stimulation. This issue should be further investigated, and one approach is to look at gender differences. Men seem to be more sensation seekers than women (Cross et al., 2011), but less sensitive (Trå et al., 2022). Hence, they also should have lower sensitivity scores. Low sensitives also seem to receive less research interest than high sensitives (Homberg et al., 2016).The aim of the present study was to explore the association between sensation seeking and sensory processing sensitivity with two hypotheses:

1. The two dimensions of AISS, novelty and intensity, are anticipated to exhibit negative associations with sensory processing sensitivity, but AISS Intensity will be more strongly associated with sensory processing sensitivity than AISS Novelty.
2. In comparison to women, men are predicted to have lower sensory processing sensitivity scores and higher scores on sensation seeking.

PARTICIPANTS AND PROCEDURE

PARTICIPANTS

The current study is part of an ongoing project on sensory processing sensitivity previously described in more detail by Trå et al. (2022). The sample consisted originally of 633 subjects; 8 were excluded due to incomplete reports. Thus, the final sample consisted of 625 subjects, 400 men (64%) and 225 wom-

en (36%), mostly Caucasians in these age groups: 18-24 years (21.5%), 25-34 years (41.6%), 35-44 years (12.8%), 45-54 years (10.6%), 55-64 years (10.1%), and 65+ (3.1%). The participants were recruited from a university and community population and the level of education was rather high: 1) college (17%), 2) bachelor degrees (46.6%), 3) master degrees (32.7%) and 4) Ph.D. (3.7%).

The tool Nettskjema (https://nettskjema.no), developed and run by the University of Oslo, was used for questionnaire development and data collection. The questionnaire was distributed through master's students enrolled in a course in scientific methodology. Each student was given the task to recruit 15 respondents from their network in addition to answering the survey themselves. They were instructed that invitations were to be personal. The responses were anonymous, as the participants who were recruited never had access to responses from the participants they recruited, and no direct or indirect identifying data were recorded.

The participants did not know beforehand that the topic of the study was sensory processing sensitivity and sensation seeking.

MEASURES

Sensory processing sensitivity. We used the Highly Sensitive Person Scale (HSPS; Aron & Aron, 1997) to measure sensory processing sensitivity. The HSPS consists of 27 items and the answers were registered on a 7-point Likert scale from 1 (*not at all*) to 7 (*extremely*). Examples of questions: "Are you deeply moved by the arts or music?", "Do you startle easily?", "Do you get rattled when you have a lot to do in a short amount of time?". Cronbach's α of the HSPS in the current sample was .90.

Sensation seeking. The Arnett Inventory of Sensation Seeking (AISS; Arnett, 1994) was used to measure sensation seeking. The AISS consists of 20 items with two subscales, novelty (AISS N) and intensity (AISS I), each containing ten items. We calculated the mean values by dividing the sum scores by the number of items on each scale. The novelty scale taps the need for experiences and novelty, whereas the intensity scale registers the need for intensity of sensory stimulation and thrilling experiences. Examples of novelty and intensity, respectively: "I can see how it would be interesting to marry someone from a foreign country"; "When I listen to music, I like it to be loud". The response formats are a Likert type (1 – *does not apply*; 4 – *applies completely*). Cronbach's α of the AISS was found to be .70.

The study was carried out in accordance with the ethical guidelines of the Norwegian University of Technology and Science for conducting surveys (NTNU, 2023).

STATISTICAL ANALYSES

In addition to descriptive statistics and correlations, we carried out linear regression analyses with HSPS as the dependent variable and AISS N, AISS I and gender as predictor variables. The dependent and independent variables showed a good parametric distribution as indicated by skewness and kurtosis – HSPS: .16 and .24; AISS N: –.09 and .05; AISS I: –.08 and –.05. The predictor variables were entered stepwise: in the first block AISS N and AISS I and in block 2 gender. In addition to regression coefficients, we registered model fit, confidence intervals, and R^2 change. Furthermore, gender differences in AISS and HSPS were tested using univariate analyses of variance (ANOVA) with HSPS, AISS N and AISS I as dependent variables and gender as the independent variable. All the analyses were carried out using SPSS version 28.

RESULTS

Table 1 presents the descriptive statistics and correlations among major study variables, HSPS, AISS N, and AISS I. There were significant negative correlations between the two AISS scales and HSPS, weak for AISS N (–.17) and moderate for AISS I (–.34). The AISS scales had a moderate positive intercorrelation (.45).

In Table 2 we present the statistics of the final regression model. The first model showed a significant association between HSPS and AISS N, adjusted $R^2 = .03$, $t = -4.32$, $p < .001$. Including AISS I in the regression model increased explained variance by 9.4%, adjusted $R^2 = .11$, $t = -7.70$, $p < .001$, F change (1, 622) = 39.79, $p < .001$. However, the association between HSPS and AISS N was no longer significant when the shared variance between the two variables was removed, $t = -0.60$, $p = .550$. Adding gender increased explained variance by 4.2%, totally 15.3%; adjusted $R^2 = .15$, $t = 5.70$, F change (1, 621) = 32.52, $p < .001$. The collinearity tests (VIF, tolerance) were negative.

Table 1

Descriptives statistics and zero-order correlations among major study variables

Variable	*M*	*SD*	1.	2.	3.
1. HSPS	3.84	0.83			
2. AISS N	2.55	0.32	–.17**		
3. AISS I	2.41	0.46	–.34**	.45**	

Note. $N = 625$; HSPS – Highly Sensitive Person Scale; AISS N – Arnett Inventory of Sensation Seeking Novelty; AISS I – Arnett Inventory of Sensation Seeking Intensity; $^{**}p < .01$.

Table 2

Linear regression analyses predicting HSPS scores from sensation seeking and gender

Measure	B	*SE* B	β	*t*	*p*	95% CI	VIF	Tolerance
AISS N	.01	.09	.00	0.01	.994	[−.17; 17]	1.27	.79
AISS I	.44	.08	−.25	−5.69	< .001	[−.60; −.29]	1.39	.72
Gender	.40	.07	.23	5.70	< .001	[.26; .53]	1.19	.84

Note. $N = 625$; HSPS – Highly Sensitive Person Scale; AISS N – Arnett Inventory of Sensation Seeking Novelty; AISS I – Arnett Inventory of Sensation Seeking Intensity; gender: 1 – men; 2 – women; B – unstandardized regression coefficient; β – standardized regression coefficient; VIF – variance inflation factor.

Table 3

Gender differences in sensation seeking and HSPS. Univariate analyses of variance (ANOVA)

Measure	Women ($N = 225$)			Men ($N = 400$)			
	M	*SD*	95% CI	*M*	*SD*	95% CI	*p*
AISS N	2.41	0.40	[2.36; 2.46]	2.63	0.37	[2.59; 2.66]	< .001
AISS I	2.17	0.43	[2.11; 2.22]	2.54	0.43	[2.50; 2.58]	< .001
HSPS	4.20	0.79	[4.09; 4.30]	3.64	0.78	[3.56; 3.71]	< .001

Note. HSPS – Highly Sensitive Person Scale; AISS N – Arnett Inventory of Sensation Seeking Novelty; AISS I – Arnett Inventory of Sensation Seeking Intensity.

Table 3 presents the ANOVA results on gender differences in sensation seeking and sensory processing sensitivity. Men had significantly higher AISS N and AISS I scores than women, $F(1, 623) = 46.31$, $p < .001$ and $F(1, 623) = 111.05$, $p < .001$, respectively, but a lower HSPS score, $F(1, 623) = 73.74$, $p < .001$.

DISCUSSION

The results show that only the intensity dimension of AISS and gender were significantly associated with HSPS; women had higher HSPS scores than men. The novelty dimension was not associated with HSPS.

Our findings confirm that highly sensitive persons seem to avoid strong sensory stimulation. The main characteristics of the highly sensitive person are generally increased sensitivity, a tendency to be easily overstimulated, a low sensory threshold, awareness of the environment and a preference for observing and reflecting before acting (Aron & Aron, 1997; Lionetti et al., 2018). High sensitives typically "pause and check" to gather and analyse more information before acting. As an adaptive strategy they will seek to avoid environmental stressors and diminish the amount and intensity of sensory input (Setti et al., 2022), behaviours that are reflected in lower scores on the intensity dimension of the AISS. Our results support the view of Aron et al. (2012) that the HSPS scale seems to capture perceived intensity of sensory stimulation.

The results on gender clearly show that men had higher AISS N and AISS I scores than women, but they had lower HSPS values. Thus, men tend to be low sensitives, which again could lead them to actively increase the intensity and amount of sensory stimulation. Hence, sensory processing sensitivity and sensation seeking could be seen as empirically and theoretically connected. Gender roles could also have an impact. Individuals considering themselves more masculine report lower sensitivity to pain (Alabas et al., 2012). The issue should be further investigated and the new theory of sensation seeking going beyond optimal level of stimulation is a promising perspective (Zuckerman, 2014).

CONCLUSIONS

We found a negative association between sensory processing sensitivity and the intensity dimension of the AISS. Women had higher sensitivity scores than men. The results confirm that HSPS captures the intensity of complex sensory stimulation. Sensory processing sensitivity and sensation seeking could be seen as theoretically connected and overlapping phenomena.

Disclosure

The authors declare no conflict of interest.

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