



Sensory processing sensitivity and its relation to sensation seeking

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ABSTRACT

Sensory processing sensitivity (SPS) is a trait associated with enhanced responsivity to environmental stimuli and the tendency to pause before acting. However, qualitative data suggest that some who are high in SPS may also be high in sensation seeking (SS), a trait characterized by the seeking of novel and intense experiences. Thus, this online study examined SPS and SS among 214 individuals (mean age, 30), using the Highly Sensitive Person Scale (the standard SPS measure), a standard measure of sensation seeking (ZKA-PQ); and the newly developed Sensation-Seeking Scale for Highly Sensitive Persons (SSS/HSP). We also measured risk-taking, impulsivity, and neuroticism, as control variables. Results showed that SPS (controlling or not controlling for neuroticism) was moderately negatively correlated with the ZKA-PQ, risk-taking and impulsivity; but positively associated with negative urgency—the tendency to act impulsively due to negative affect. Also, the validity of the SSS/HSP was supported, as it showed a strong positive correlation with standard measures of SS and risk-taking, a moderate association with impulsivity, and (as it was designed to do) a near zero correlation with SPS. In conclusion, although some individuals with SPS may express high SS, the two traits are largely separate; and the SSS/HSP is a reliable measure of SS, having items better-suited for the highly sensitive.

1. Introduction

Sensory processing sensitivity (SPS), also referred to as environmental sensitivity, is a biologically based trait associated with greater depth of processing, awareness of subtleties, and responsivity to stimuli (Acevedo et al., 2014; Aron and Aron, 1997; Pluess, 2015). SPS-like behaviors have been observed in over 100 species, and the trait is thought to provide an advantage when the payoffs are sufficient and not too many individuals have the trait (Wolf et al., 2008).

Behaviorally, individuals with high SPS tend to express caution and pause to observe before acting (Lionetti et al., 2018). It seems that this may be due to a more active behavioral inhibition system (BIS), which assesses whether a stimulus should be approached or avoided; and provides the organism with time to suppress behaviors that may lead to negative outcomes, or avoid threatening or non-rewarding stimuli (Amodio et al., 2008; McNaughton and Gray, 2000). This facilitates greater conscientiousness and a deeper cognitive processing of information, which are characteristics of SPS, and require longer inhibition times in response to stimuli (Aron et al., 2012; Nachmias et al., 1996). However, taking time to reflect before acting does not suggest a lack of curiosity or an aversion to new experiences for those with high SPS.

Thus, it is possible that some individuals with high SPS may also be high on Sensation Seeking (SS) — a trait associated with the seeking of varied, complex, and intense internal or external experiences; rather than routine, mundane, or common experiences. For some individuals, SS also involves the willingness to take physical, social, legal, and financial risks for the sake of such experiences (Zuckerman, 1994). However, SS does not require high-risk behaviors (Zuckerman, 1996, 2006). For example, listening to arousing music or attending a performing arts show may be consistent with high SS. Thus, by removing risk-taking, the core aspects of SS are consistent with attitudes that individuals with high SPS could also endorse, such as the seeking of positive and complex experiences.

As SPS is characterized by a deeper cognitive processing and inhibition before acting, it would seem unlikely that those with SPS would engage in *impulsive* risk-taking behaviors, which involves acting without considering negative consequences. However, this would not rule out, for example, enjoying emotionally arousing experiences evoked by art, music, media or through physical intimacy. These types of behaviors are often favored by individuals with high SPS, as evidenced by the aesthetic sensitivity items (Smolewska et al., 2006) of the Highly Sensitive Person (HSP) Scale (Aron and Aron, 1997).

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Indeed, results of two studies (Cooper, 2015; 2016) provided initial evidence that some individuals with high SPS might also prefer high SS behaviors, involving calculated, rather than impulsive risks. The survey of 1,412 participants, who were recruited as part of a study on careers and sensitivity (Cooper, 2015), showed that some individuals with high SPS endorsed behaviors indicating high levels of curiosity and seeking new experiences; yet almost all disagreed, as expected, with items related to disinhibition, impulsivity, and high-risk behaviors. Results from the qualitative study (Cooper, 2016) involving semi-structured interviews with 35 participants also supported these findings. For example, individuals self-identifying as having both high SS and high SPS reported engaging in activities such as cliff climbing, swinging from trees in the jungle over 30-foot ravines, hang gliding, and motorcycle riding. One participant stated, for example, that she was a "huge rollercoaster junkie," while another mentioned visiting Las Vegas with her boyfriend and choosing to make small bets on games they did not know well, "smart risks," as she stated. One commonality was that all who reported engaging in these somewhat risky behaviors, did so in ways that they considered safe.

Somewhat differently, impulsivity is defined as a personality trait associated with the urge to act spontaneously, without thinking or planning ahead (Coutlee et al., 2014). High impulsivity has been associated with attention deficit disorder, hyperactivity, excessive gambling, risk-taking, drug use, and alcoholism (Bakhshani, 2014; Kozak et al., 2019). Various researchers have attempted to measure impulsivity with multifaceted self-report measures. Zuckerman (1994) measured "impulsive, unsocialized sensation seeking," with a scale which included general sensation-seeking, autonomy and impulsivity subscales. In the present study, impulsivity was measured using the UPPS-P impulsive behavior scale (Whiteside and Lynam, 2001), which assesses five dimensions of impulsivity: Negative Urgency, Lack of Premeditation, Lack of Perseverance, Sensation Seeking, and Positive Urgency.

Besides impulsivity, another construct we considered important to control for, given the interview results, was risk-taking. Risk-taking is a broad concept encompassing risk-taking tendency, risk-taking propensity, risk attitudes, risk preferences, risk aversion, risk perception, and risk appraisal (e.g. Holt and Laury, 2002; Horvath and Zuckerman, 1993). Research has shown that it is possible to be risk-seeking in some areas of one's life and risk-averse in others, while still having a relatively consistent view of risk (e.g., Fagley and Miller, 1997; Weber and Milliman, 1997). The stable view of risk is an individual's risk propensity, which we measured in this study with the General Risk Propensity Scale (GRiPS; Zhang et al., 2019).

Thus, this study involved an online survey including a standard measure of SPS, two measures of SS, plus measures of impulsivity and risk-taking. We predicted that SPS would be only moderately negatively correlated with SS as generally measured, including when controlling SPS for neuroticism. Second, we predicted that when controlling the standard measure of SS for impulsivity and risk-taking, the negative correlation between SPS and SS would change to near zero. Third, we predicted that SPS would be strongly negatively correlated with impulsivity and risk-taking. Finally, we sought to test the validity of the newly developed Sensation-Seeking Scale for Highly Sensitive Persons (SSS/HSP), which was designed to exclude items that would relate to high levels of impulsivity and risk-taking, thus clarifying the relationship between SS and high SPS. We hypothesized that the SSS/HSP would be uncorrelated with SPS while showing a significant, strong positive correlation with the standard SS measure.

2. Material and methods

2.1. Participants

Participants were recruited via advertisements, flyers, listservs, social media, and by the University of California, Santa Barbara's (UCSB) Subject Pool to participate in a 30-minute online survey. Participants

provided informed consent in accordance with UCSB IRB procedures. The final sample (after excluding those who were clearly inattentive as described below) included 214 (61% women, 38% men, and 1% gender neutral) individuals, ages 18 to 77 ($M = 30.33$; $SD = 11.76$). At the time of data collection, approximately 30% of respondents were students and 44% were currently employed. The majority of the sample was college educated: 38% had some college education, 16% had an Associate's degree, 18% a Bachelor's degree, 13% a Master's degree, 1% a professional degree, and 2% a Doctorate; and about 11% of had only completed high school. Our sample was diverse, including 27% Black/African-Americans, 12% Latino/Hispanics, 39% Caucasians, 7% Asians, 6% native Americans, and 5% replied "Other".

2.2. Measures

2.2.1. Sensory-processing sensitivity

We measured SPS with the standard 27-item HSP Scale (Aron and Aron, 1997). The HSP Scale includes items which measure attentiveness to subtleties in the environment, including others' moods, and a tendency to become overwhelmed by intense stimuli (e.g., strong scents, loud noises, bright lights, and harsh fabrics). Example items include: "Do you seem to be aware of subtleties in your environment?"; "I am easily overwhelmed by strong sensory input."; "I have a rich, complex inner life."; "I notice and enjoy delicate or fine scents, tastes, sounds, works of art." Studies have provided support for the validity and reliability of the HSP Scale in a variety of languages and cultural contexts (e.g., Ershova et al., 2018). All items were answered on a 7-step Likert-scale ($\alpha = 0.90$).

As the HSP scale has many negatively worded items, it tends to have a moderate to high correlation with Neuroticism. Thus, previous SPS studies often control for neuroticism with two-items: "Are you prone to fears?" and "Are you prone to depression?" Herein, the alpha for neuroticism was $\alpha = 0.84$. We conducted all analyses involving the HSP scale both controlling for and not controlling for neuroticism.

2.2.2. Sensation-seeking

The Zuckerman-Kuhlman-Aluja personality questionnaire (ZKA-PQ). We measured sensation-seeking with the 40-item ZKA-PQ Scale (Aluja et al., 2010; Zuckerman, 2002), which measures four facets of sensation-seeking: thrill and adventure seeking (sample: "I enjoy the sensation of a speeding car"; $\alpha = 0.83$), experience-seeking ("I would like to take off on a trip with no pre-planned or definite routes or timetables"; $\alpha = 0.75$), disinhibition ("I go to parties to meet exciting and stimulating people"; $\alpha = 0.74$), and boredom susceptibility ("I prefer friends who are excitingly unpredictable"; $\alpha = 0.74$). All items were measured with a 7-step Likert scale (for the entire scale $\alpha = 0.91$).

Sensation-seeking scale for highly sensitive persons (SSS/HSP). SS was also measured with the SSS/HSP (Aron, 2000), which was designed to capture SS without high impulsivity and risk-taking items, as it was assumed that individuals with the SPS trait would tend not to endorse them. The scale consists of 20-items, including, "I can become almost painfully bored in some conversations" and "If I see something unusual, I will go out of my way to check it out." Items were rated on a 7-point Likert scale ($\alpha = 0.86$). See "Supplementary Materials" for the scale.

2.2.3. Impulsivity

We measured impulsivity with the UPPS-P Scale (Whiteside and Lynam, 2001) to measure important factors that could result in impulsive behaviors including: Positive Urgency, Negative Urgency, Lack of Premeditation, Lack of Perseverance, and Sensation Seeking. Negative Urgency measures the tendency to act impulsively due to negative affect (Sample item: "When I feel bad, I will often do things I later regret in order to make myself feel better now"; $\alpha = 0.77$). Lack of Pre-

meditation refers to the tendency to act rashly without first reflecting upon the decision to act (Sample item: reverse-scored “My thinking is usually careful and purposeful”; $\alpha = 0.85$). Lack of Perseverance involves a tendency not to complete projects (Sample item: reverse-scored: “I generally like to see things through to the end”; $\alpha = 0.83$). Positive Urgency measures the tendency to act impulsively due to positive affect (Sample item: “When I am in a great mood, I tend to get into situations that could cause me problems”; $\alpha = 0.88$). We used the short, 20-item version of the scale (Dugré et al., 2019) excluding the general sensation-seeking subscale, using a 7-step Likert-scale ($\alpha = 0.81$).

2.2.4. Risk-taking

Risk-taking was measured with the GriPs Scale (Zhang et al. 2019). The GRiPS is an eight-item unidimensional, self-report measure of general risk propensity with good construct validity. Sample items include: “Taking risks makes life more fun”, and “I would take a risk even if it meant I might get hurt.” We used a 7-step Likert-scale ($\alpha = 0.91$).

2.3. Data analysis

2.3.1. Inattentive responders

Given the nature of online surveys, data screening required identifying careless or unmotivated responses prior to performing data analyses (Dunn et al., 2018; Meade and Craig, 2012). First, we included a direct assessment of careless responses in our survey, where participants were asked three self-report questions: (a) I enjoyed participating in this survey, (b) I worked to the best of my ability on this survey, and (c) I gave this survey my full attention (rated on a 7-point Likert scale). We excluded all cases that were two standard deviations below the mean of the three attention items ($M = 5.58$, $SD = 1.22$). Second, following procedures outlined by Dunn et al. (2018), for each respondent we calculated the intra-individual variability (IRV) index across all items, and in a second step only for items of scales which included reverse-scored items (e.g., the ZKA-PQ). Respondents with extremely low IRV values across different constructs and negatively worded items were excluded from analyses. Third, we excluded respondents that took 10 minutes or less to complete the survey, as our piloting suggested that the average time to complete the survey was about 25-minutes. As a result of this two-part process, we excluded 118 participants from the original sample of 332, resulting in our final sample of 214 participants.

2.3.2. Correlations and partial correlations

We examined the associations between the different constructs with a series of correlations and partial correlations. See Tables 1, 2 for descriptive statistics and correlations. Results of partial correlations con-

Table 1
Descriptive statistics of major study variables.

	<i>M</i>	<i>SD</i>	<i>Alpha</i>
HSP Scale	4.64	0.82	0.90
Neuroticism	4.00	1.28	0.84
SS/R-HSP	4.15	0.85	0.86
SS-ZKA_PQ	3.66	0.75	0.77
Thrill and adventure-seeking	3.66	1.06	
Experience-seeking	3.97	0.87	
Disinhibition	3.82	0.91	
Boredom susceptibility	3.17	0.78	
Non-reverse scored items	4.00	1.00	
Reverse-scored items	4.67	0.77	
Impulsivity	3.31	0.76	0.78
Negative urgency	3.99	1.23	
Lack of Perseverance	3.12	1.16	
Lack of Premeditation	3.01	1.12	
Positive Urgency	3.10	1.39	
Risk-Taking	3.72	1.27	0.91

trolling for age and gender showed nearly identical results (See Supplementary Tables 1 and 2), with the exception that (although we did not expect this), when controlling for age and gender, SPS and impulsivity were no longer significantly associated (the correlations were still negative, but not significant).

2.3.3. Proportion of high SS HSPs

Using classifications delineated by Lionetti et al. (2018) for the HSP Scale, we created categorical SPS groups as follows: low SPS ($n=59$, 28%; HSP score $M = 3.65$), medium ($n=83$, 39%; HSP score $M = 4.54$), and high SPS ($n=72$, 34%; HSP score $M=5.54$). We examined the high SPS group who also placed in the top 50% of the ZKA-PQ SS Scale and found that of individuals who scored in the top 50% of SS, 25 % (21 of 72) placed in the high SPS group.

3. Results

We predicted that SPS would be moderately negatively correlated with the ZKA-PQ Scale, as some items on the latter scale measure high-risk and impulsive behaviors. We also predicted that the negative association between the two constructs would be largely explained by SPS being negatively correlated with impulsivity and risk-taking, due to those with high SPS exhibiting greater caution and reflection before acting. Results showed a moderate negative correlation between SPS with SS ($r = -0.43$, $p < 0.001$), and also when controlling SPS for neuroticism ($r = -0.39$, $p < 0.001$). Thus, although there is some negative correlation between the two traits, it is low enough that SPS and SS do not appear to be simply opposite traits.

However, because the negative correlation was a bit larger than expected, we examined the correlations of SPS and the individual items of the ZKA-PQ SS Scale (with reverse and non-reverse scored items). We conducted the correlation of SPS with two separate groups of scores from the ZKA-PQ: The mean of the set of 20 non reverse-scored and the mean of the set of 20 reverse-scored items. Consistent with our thinking, the negative correlation with the non-reverse-scored set of items ($r = -0.27$; controlling for neuroticism, $r = -0.22$), was considerably lower than the correlation with the reverse scored item set ($r = 0.48$; controlling for neuroticism, $r = 0.47$). This result suggests that individuals with high SPS were, as found in studies of sensory discrimination (e.g. Gerstenberg, 2012; Williams et al., 2021), more careful and attentive in answering the “tricky” reverse-scored items. In contrast, those with low SPS, presumably because they did not answer the reverse scored items as carefully, were likely to have a lower correlation than they should with SS.

Our second prediction was that, when controlling the ZKA-PQ for impulsivity and risk-taking, the correlation between SPS and SS would drop to near zero. Results showed that the negative correlation between SPS and SS was minimally reduced ($r = -0.35$, $p < 0.001$), (controlling SPS for neuroticism: $r = -0.37$, $p < 0.001$). However, when we considered only the non-reverse scored SS items, the correlation with SPS did reduce to near zero ($r = -0.10$, $p = 0.17$), and also when controlling SPS for neuroticism ($r = -0.07$, $p = 0.30$).

Our third prediction was that SPS would be negatively correlated with impulsivity and risk-taking. SPS showed a small to moderate significant negative correlation with risk-taking ($r = -0.29$, $p < 0.001$), and it made little difference when controlling SPS for neuroticism ($r = -0.22$, $p = 0.001$). As for impulsivity, when controlling SPS for neuroticism, the HSP Scale scores had a low but significant negative correlation with impulsivity ($r = -0.14$, $p < 0.05$). However, when not controlling for neuroticism, SPS showed a near zero, non-significant correlation with impulsivity ($r = -0.07$, $p = ns$). Thus, we inspected the correlations of each HSP Scale item with the impulsivity UPPS-P Scale and subscales and indeed found three SPS items, all involving over-arousal, that were positively correlated with the overall impulsivity measure: “I am easily overwhelmed by things like bright lights, strong smells, coarse fabrics, or sirens close by”; “My nervous system sometimes feels so frazzled that

Table 2
Correlations among major study variables.

	1	2	3	3.1	3.2	3.3	3.4	3.5	3.6	4	4.1	4.2	4.3	4.4	5
1 SSS-HSP	(0.86)														
2 HSP (control N)	0.01	(0.90)													
3 SS-ZKA_PQ	0.66^b	-0.39^b	(0.91)												
3.1 Thrill & adventure seeking	0.54 ^b	-0.40 ^b	0.86 ^b	(0.83)											
3.2 Experience seeking	0.63 ^b	-0.19 ^b	0.82 ^b	0.61 ^b	(0.75)										
3.3 Disinhibition	0.64 ^b	-0.25 ^b	0.87 ^b	0.63 ^b	0.66 ^b	(0.74)									
3.4 Boredom susceptibility	0.36 ^b	-0.46 ^b	0.76 ^b	0.53 ^b	0.46 ^b	0.61 ^b	(0.74)								
3.5 Reverse-scored items	0.26 ^b	-0.47 ^b	0.79 ^b	0.64 ^b	0.58 ^b	0.62 ^b	0.82 ^b	(0.85)							
3.6 Non-reverse scored items	0.78 ^b	-0.22 ^b	0.89 ^b	0.79 ^b	0.79 ^b	0.82 ^b	0.51 ^b	0.42 ^b	(0.91)						
4 Impulsivity	0.30^b	-0.14^a	0.40^b	0.28^b	0.19^a	0.44^b	0.46^b	0.26^b	0.40^b	(0.81)					
4.1 Negative Urgency	0.15	0.17	-0.02	-0.10	0.02	0.11	-0.10	-0.11	0.06	0.46 ^b	(0.77)				
4.2 Lack of Perseverance	0.11	-0.30 ^b	0.30 ^b	0.26 ^b	0.10	0.24 ^b	0.42 ^b	0.30 ^b	0.22 ^b	0.63 ^b	-0.10	(0.83)			
4.3 Lack of Premeditation	0.18 ^a	-0.35 ^b	0.42 ^b	0.30 ^b	0.18 ^a	0.37 ^b	0.59 ^b	0.40 ^b	0.32 ^b	0.65 ^b	-0.15	0.63 ^b	(0.85)		
4.4 Positive Urgency	0.30 ^b	0.07	0.30 ^b	0.23 ^a	0.16	0.35 ^b	0.26 ^b	0.10	0.37 ^b	0.72 ^b	0.32 ^b	0.11	0.22 ^a	(0.88)	
5 Risk-Taking	0.60^b	-0.22^a	0.77^b	0.70^b	0.63^b	0.68^b	0.52^b	0.52^b	0.74^b	0.32^b	0.11	0.07	0.19^a	0.40^b	(0.91)
6 Age	-0.22 ^a	0.15	-0.33 ^a	-0.31 ^a	-0.13	-0.40 ^a	-0.25 ^a	-0.24 ^a	-0.31 ^a	0.26 ^a	0.12	0.16	0.17	0.19 ^a	-0.27 ^a
7 Gender	0.32 ^a	-0.09	0.28 ^a	0.26 ^a	0.12	0.20 ^a	0.27 ^a	0.08	0.32 ^a	-0.27 ^a	0.14	-0.27 ^a	-0.37 ^a	-0.26 ^a	0.18 ^a

Note. HSP: Highly Sensitive Person Scale; SSS-HSP: Sensation-seeking Scale for Highly Sensitive Persons; ZKA-PQ: Zukerman Sensation-Seeking Scale; N: Neuroticism; SS-ZKA_PQ: Sensation Seeking. Gender was coded as 1 = female, 2 = male; Other sexual orientations were excluded from all analyses regarding gender. Cronbach's alphas are shown in the diagonal.

^a $p < 0.01$
^b $p < 0.001$

I just have to go off by myself”; and “I make a point to avoid violent movies and TV shows”. There were many similar SPS items (roughly half of the scale) that were positively associated specifically with the negative urgency subscale. These items also express the over-arousal and ease-of-excitation characteristic of SPS. Thus, the positive correlation that we observed between SPS and impulsivity appears to be largely related to negative urgency—the tendency to act impulsively due to negative affect—which may reflect a coping mechanism for those with high SPS in response to over-arousal (e.g., “I’ll do anything to escape over-arousal”).

Finally, we sought to test the validity of the new SSS/HSP. We predicted that the SSS/HSP would show a near-zero correlation with SPS—that is, we predicted that the two traits (SPS and SS) are independent when SS is measured with items appropriate for highly sensitive individuals (low impulsivity and risk taking). Results showed that SPS was indeed uncorrelated with the SSS/HSP ($r = -0.05, p = ns$); and also when controlling SPS for neuroticism, ($r = 0.01, p = ns$).

To support the validity of the SSS/HSP, we correlated it with the standard SS measure and the ZKA-PQ, and found that the SSS/HSP was strongly and positively correlated with SS ($r = 0.66, p < 0.001$); and even more strongly when considering only the non-reverse scored items of the ZKA-PQ ($r = 0.78, p < 0.001$). The SSS/HSP was also strongly and positively correlated with each of the ZKA-PQ scale’s four subfactors: thrill and adventure seeking ($r = 0.54, p < 0.001$), experience-seeking ($r = 0.63, p < 0.001$), disinhibition ($r = 0.63, p < 0.001$), and boredom susceptibility ($r = 0.36, p < .001$); and also when controlling for risk-taking ($r = 0.40, p < 0.001$) and impulsivity ($r = 0.62, p < 0.001$). When considering only the non-reverse scored items of the ZKA-PQ, the correlations with each of its subfactors and the SSS/HSP were as follows: thrill and adventure seeking ($r = 0.63, p < 0.001$), experience-seeking ($r = 0.68, p < 0.001$), disinhibition ($r = 0.70, p < 0.001$), and boredom susceptibility ($r = 0.62, p < 0.001$). Interestingly, although we had not predicted it, the SSS/HSP also showed significant positive correlations with impulsivity ($r = 0.31, p < 0.001$) and risk-taking ($r = 0.60, p < 0.001$) as measured by the UPPS and GRiPS measures, respectively. With respect to impulsivity, the SSS/HSP showed significant and positive correlations with most of the subscales of the UPPS-P: negative urgency ($r = 0.15, p < 0.05$), lack of premeditation ($r = 0.18, p < 0.01$), and positive urgency ($r = 0.30, p < 0.01$). The lack of perseverance (the tendency not to complete projects/tasks) was not quite significant ($r = 0.11, p = 0.11$)

4. Discussion

In the present study, we examined the relationship between sensory processing sensitivity (SPS) and sensation-seeking (SS). Because SPS is characterized by the tendency to be cautious and to pause and observe situations before acting, originally we were surprised to find that some individuals with high SPS also endorsed high SS behaviors. However, we were aware that the standard measurements of SS also included items about high levels of risk-taking and impulsivity, which are not characteristic of individuals with high SPS.

Our first prediction, that SPS would be moderately negatively correlated with the established measure of SS (the ZKA-PQ sensation-seeking subscale), was confirmed. Results from the online survey revealed a negative correlation between SPS (with or without controlling for neuroticism) and SS (measured with the ZKA-PQ Scale). Although in the moderate range, these correlations were nevertheless somewhat higher than expected. Interestingly, when we examined correlations between the HSP Scale and the standard SS scale, we found that the large negative correlation was mostly carried by to the reverse-scored items of the SS scale. When considering only the set of non-reverse scored items, the correlation was less negative. Perhaps this was a result of those with high SPS paying more attention to the questions, and responding more carefully to the reverse-scored items, than those with low SPS.

Second, we hypothesized that the correlation between SPS and SS would drop to near zero when controlling SS for impulsivity and risk-taking. However, we were surprised to find that this made little difference. But again, when considering only the set of non-reverse scored items, the correlation between SPS and SS did drop to near zero.

Our third prediction, that SPS would be negatively correlated risk-taking was supported, as SPS showed a small significant negative correlation with general risk-taking propensity (with or without controlling neuroticism), as one might predict given that SPS is characterized by reflection, inhibition, and pausing before acting. However, contrary to our predictions regarding impulsivity, there was no significant correlation between SPS and impulsivity (and a small negative correlation when controlling SPS for neuroticism, $r = -0.14, p < 0.05$). Upon further inspection we found that SPS (when controlling for neuroticism) was positively associated with negative urgency. Thus, we carried out item analyses and indeed found that numerous HSP Scale items that measure over-arousal and ease of excitation, were positively associated with negative urgency—the tendency to act impulsively due to nega-

tive arousal. Acting impulsively due to negative affect may be a coping mechanism that those with high SPS use to cope with over-arousal, but this remains to be investigated in future studies.

Finally, we sought to support the validity of the new SSS/HSP, developed to assess SS among highly sensitive individuals, who tend to respond negatively to questions involving very high risk or impulsivity. Results showed that the SSS/HSP Scale was, as predicted, uncorrelated with SPS (with or without controlling for neuroticism); but also as predicted, the SSS/HSP Scale was significantly correlated with the standard measure of SS and each of the subfactors (thrill-seeking, experience-seeking, disinhibition, and boredom susceptibility). These results were even stronger when using only the set of non-reverse scored items of the standard SS scale. Thus, the SSS/HSP Scale appears to be a valid measure of SS, appropriate for use when studying the relation of SS to SPS. Also, the SSS/HSP showed positive correlations with the standard SS measure, which remained positively associated even when controlling for impulsivity and risk-taking; thus, supporting validity of the SSS/HSP.

These results have important implications for the study of personality and individual differences, as they confirmed that SPS and SS appear to be relatively independent traits when appropriately measured. That is, individuals who endorse high SS may also be highly sensitive, and vice versa. This is the first study to test this quantitatively. Interestingly, this study also found that among individuals who placed in the top 50% of the standard SS measure (the ZKA-PQ SS Scale), 25 % also measured high in SPS. The finding that some individuals with high SPS may also have high SS is consistent with studies showing that individuals with the SPS trait respond more favorably to pleasant aesthetic experiences (Sobocko and Zelenski, 2015).

Future studies may examine whether the seeking of pleasant, novel, and sensory experiences are for example coordinated by the behavioral activation system (BAS) without necessarily involving any initial impulsivity. Indeed, highly sensitive individuals tend to engage in retrospective reflection, which could contribute to subsequent associations between pleasure-inducing behaviors and their positive consequences, leading to greater BAS activation in the presence of a stimulus; while impulsivity or disinhibition could interfere with this associative process (Patterson and Newman, 1993). Thus, the present results have initial theoretical implications for the study of sensitivity, sensation-seeking, and the BIS/BAS systems, which could be further explored in future studies. Also, our finding of clearer results for those with high SPS by not including reverse-scored items, suggests that in future research examining correlations with SPS, it may be valuable to check whether results are affected by including the reverse-scored items.

There are also practical implications of these results since many individuals with the SPS trait, and the educators and clinicians working with them, have no doubt failed to recognize high SPS, when high SS was also present. If one assumes, even though wrongly, that those high in SPS would prefer low levels of stimulation, then one would assume that high sensation-seekers cannot be HSPs, and vice versa. Hence many of each group may have been misunderstood, and may have failed to develop the self-awareness to harness (and regulate) these seemingly opposing traits optimally.

Another practical issue is that we have anecdotally observed that those with both the SPS and SS traits often report that they are aware of considerable inner conflict about which motivational demands to meet. These individuals often struggle with finding friends, partners, jobs, and careers that meet their need for novelty, tempered with a heightened sensitivity to be discerning and needing to withdraw for periodic rest, which is thought to be essential for the deeper processing of information characteristic of SPS (Acevedo et al., 2021). Many individuals with high SPS may ignore their sensitivity in order to pursue more exciting, stimulating experiences, which is simply doing what those around them who are not highly sensitive, but high in SS, are doing. However, over time, if those with high SPS do not learn to manage the physiological requirements of the trait (Acevedo, 2020), they may experience burn out, for example (e.g., Meyerson et al., 2020, Pérez-Chacón et al., 2021).

4.1. Future directions and limitations

In the future it would be helpful to have additional, more detailed quantitative research to better understand the types of activities that individuals who are high on both SPS and SS engage in that result in positive experiences. A preliminary qualitative study found that individuals with both high SPS and high SS experience greater success and a more rewarding life when they engage in activities that express both traits (such as enjoying subtleties in nature from a novel perspective and scuba diving). Also, having like-minded friends, and by having an awareness that they have both traits and the need to balance the two, for example by not taking on too many things at once or getting over-excited about plans, are other factors that help those with both traits (Cooper, 2016).

As for the limitations of this study, it is important to note that although we took the usual measures to ascertain the quality of the data, this was an online study. Thus, it is possible (and indeed appeared to be true) that some of our respondents may have been careless in responding to the survey. Also, although our study was not restricted geographically, the majority of our participants were from the USA. However, in an effort to move away from only sampling WEIRD (White, Educated, Industrialized, Rich, and Democratic) populations (Rad et al., 2018), our sample included 60% of individuals from non-Caucasian ethnic groups. Nevertheless, future studies should focus on expanding the current work to other cultures to confirm the current findings and understand how high SS combined with high SPS might be expressed and managed effectively.

5. Conclusions

The present study examined the relationship between sensory processing sensitivity (SPS) and sensation-seeking (SS). Findings showed that the two traits may both exist at high levels in some individuals, and when correctly measured, are largely independent. Also, we were surprised to find that SPS was positively associated with negative urgency, a subfactor of impulsivity associated with the tendency to act rashly when distressed. Perhaps this reflects a mechanism for coping with overarousal, a notable negative issue for those high in SPS. Finally, we found evidence for the reliability and construct validity of the SSS/HSP, designed to measure SS accounting for SPS, suggesting that this may be a useful measure of SS for highly sensitive individuals.

Author note

No analyses in the present research are redundant with any published findings.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.crbeha.2023.100100.

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