



ARTICLE



<https://doi.org/10.1057/s41599-024-02738-7>

OPEN

Sensory processing sensitivity is associated with religiosity and spirituality

Marie Buchtova ^{1✉}, Klara Malinakova¹, Jitse P. van Dijk^{1,2,3}, Vit Husek¹ & Peter Tavel¹

Sensory processing sensitivity (SPS) has recently been gaining public as well as scientific interest. Evidence is lacking on the relationship between SPS and different dimensions of religiosity and spirituality (R/S). We investigated the associations between SPS and R/S in the Czech Republic. Two samples of Czech adults (N1 = 1406; 48.1 ± 16.4 years; 49.4% women, N2 = 1494; 50.7 ± 15.8 years; 44.1% women) participated in the online survey. We measured SPS, religious attendance, religiosity, spirituality, images of God, negative religious coping (NRC) and religious conspiracy theories (RCT). Results of binary logistic regression found SPS significantly associated with religiosity, spirituality, and NRC with odds ratios (ORs) of 1.38 (95% confidence interval [CI] 1.22-1.56), 1.61 (95% CI 1.33-1.96) and 1.25 (95% CI 1.02-1.52), respectively. Higher SPS indicated a greater likelihood of perceiving God as ever-present, fatherly, forgiving, gentle, loving, motherly, punishing, just, and absolute, with ORs ranging from 1.14 to 1.26. No significant association was found between SPS and RCT. Results revealed associations between SPS and various aspects of R/S. The study highlights the relevance of considering SPS in clinical contexts involving religious and spiritual issues. Further research might be aimed at comparing the results with countries with different religious backgrounds, or at exploring the links with other variables that may play a role in these relationships.

¹Olomouc University Social Health Institute, Palacký University Olomouc, Olomouc, Czechia. ²Department of Community and Occupational Medicine, University Medical Center Groningen, University of Groningen, Groningen, The Netherlands. ³Graduate School Kosice Institute for Society and Health, Pavol Jozef Šafárik University in Košice, Košice, Slovakia. ✉email: marie.buchtova@oushi.upol.cz

Introduction

Sensory processing sensitivity (SPS) is defined as a personal predisposition to be more sensitive to subtle stimuli and easily aroused by external stimuli (Aron and Aron 1997). This trait is associated with higher activity in brain regions associated with awareness, self-other processing, memory, and empathy (Acevedo 2020). SPS is a hereditary trait occurring in about 15–20% of the population (Aron 2013; Assary et al. 2021).

Individuals with increased central nervous system sensitivity are able to process information more deeply than usual (Boterberg and Warreyn, 2016). On the other hand, they are more easily overwhelmed when they are in a highly stimulating environment for too long (Aron 2013). SPS has been linked to higher levels of stress, anxiety, depression, and neurotic personality traits (Ahadi and Basharpour, 2010; Liss et al. 2005; Malinakova et al. 2021). Research also suggests that SPS is associated with emotional regulation difficulties (Brindle et al. 2015) and poorer social functioning, especially under demanding conditions like the COVID-19 pandemic (Ahadi and Basharpour 2010; Malinakova et al. 2021). Moreover, adverse childhood experiences and poor upbringing may be related to more psychological symptoms in individuals with high SPS (Karaca Dinç et al. 2021; Liss et al. 2005). However, SPS also has a number of advantages, given that highly sensitive persons (HSPs) are aware of subtle nuances in their environment (Rizzo-Sierra et al. 2012). When HSPs adapt to the environment they possess better perception, ingenuity, and imagination (Aron, 2013), are more creative and sensitive to the arts (Bridges and Schendan, 2019), and make better decisions and engage in meaningful work (Aron et al. 2012). These people are often characterized by empathy, caring for others, and are more intuitive (Acevedo, 2020; Acevedo et al. 2018). It could be concluded that SPS provides greater benefits from a positive and supportive environment but increases the risk of stress-related problems in response to negative experiences (Greven et al. 2019; Jagiellowicz et al. 2020).

Currently, there is a lot of public and media interest in the SPS concept. So far, SPS has attracted increasing research interest in various areas of psychology, such as temperament and personality traits and mental health issues (Lionetti et al. 2019). The theory (Aron and Aron, 1997) as well as recent research (Malinakova et al. 2021) also suggests a possible link between SPS and the domains of religiosity and spirituality (R/S). Although the scientific knowledge about this association is still scarce, some facts suggest that these concepts may be related. First, topics such as the soul, spiritual life, relationship to religion or spiritual practice are often observed by psychotherapists when speaking with HSPs (Aron 2010, 2013). Second, a high level of sensory sensitivity appears to be a definite prerequisite for a deeper/more intense spiritual experience (Aron 2013; Wahbeh and Butzer 2020). Some authors (Acevedo 2020; Aron 2010; Rappaport and Corbally, 2018) even report sensitivity as a trait conditioning religious competence. Finally, at the same time, spiritual activity can increase sensitivity through changes in brain regions important for sensory processing as a result of extensive meditation practice (Acevedo 2020).

Both religiosity and spirituality are highly complex and multidimensional constructs involving attitudes, experiences, and behaviors that refer to a sacred, transcendent, and ultimate domain of existence (Hill and Pargament 2003; Hooker et al. 2014). Because of their overlap in the literature (Koenig 2012a) and the consequent potentially biased results due to difficulties in measuring them (Malinakova et al. 2020), an approach that includes both internal and external aspects of R/S is appropriate for capturing the association of SPS with the heterogeneous nature of R/S. E.g., regarding religiosity, although participation in organized religious activities seems to be a basic criterion for

measuring religiosity, it is only one of several aspects of religiosity (Koenig et al. 2015). Other important dimensions may include, for example, belief, attachment to God, or religious coping (Koenig 2012b).

Attachment relationship with God involves a spectrum of emotions, from closeness, love, and affection towards a supportive and protective God to fear of rejection or punishment from a judgmental and powerful God. It may also encompass feelings of anger and disappointment due to the perception of an indifferent God, leaving individuals to navigate their lives independently (Schaap-Jonker 2018). The way people perceive God is related to mental health outcomes (e.g., Jonker et al. 2008; Silton et al. 2014; Stauner et al. 2016) and is supposed to reflect one's attachment (Granqvist et al. 2020), as described by the correspondence and compensation theories. According to the correspondence theory (Granqvist and Hagekull 1999), a secure attachment corresponds to perceiving God as loving and supportive, whereas an insecure attachment is related to perceiving God as strict and distant. However, the compensation theory (Kirkpatrick and Shaver, 1990) goes beyond this explanation and suggests that insecure attachment to significant others can be compensated for by developing a secure attachment to God.

Religious coping includes positive religious coping (PRC) and negative religious coping (NRC) (Pargament et al. 1998). Whereas PRC involves a secure connection with God, spiritual interconnectedness, and a sense of life's meaning, NRC is marked by spiritual tension, negatively perceived relationship with God and conflicts with fellow community members (Pargament et al. 2011). The significance of investigating NRC stems from its negative impact on health, as numerous studies have demonstrated that NRC is associated with adverse effects on mental well-being, including increased stress, depression, and anxiety (Holloway-Friesen 2023; Pargament et al. 2004).

Taken together, it is evident that R/S factors can have both positive and negative impacts on health (Koenig 2012a). However, certain associations within the domain of R/S exhibit inconsistency, which may not necessarily be attributed to conceptual ambiguity but could be indicative of confounding variables. These factors may involve overlaps with personality traits or other characteristics that are not yet adequately explored. Among these unexplored dimensions, SPS emerges as a potential area of interest. Despite its potential relevance, there is a scarcity of research addressing the interplay between SPS and R/S factors. Moreover, given the above-mentioned dual influence of R/S on health, our aim was to comprehensively examine both the positive and negative facets of R/S, including, for example, NRC and negative God images. Therefore, we decided to assess the associations between SPS and religious attendance, faith, NRC, God image, spirituality, and religious conspiracy beliefs.

Methods

Participants and procedure. For this study, we used data from two online surveys of the Czech population aged 18 to 97 (respectively 92). The first data sample was collected in April 2020, and data for the second sample was collected in April 2021. Both data collections were carried out by a specialized agency (The Czech National Panel, Prague, Czech Republic) to achieve a balanced sample close to national characteristics regarding age and gender. In the second data collection, we applied the following exclusion criteria to ensure high data quality: 1) a very short period filling in the survey and 2) a uniform response pattern, i.e., responding to most of the items in the survey in the same way. We excluded 166 problematic subjects based on these criteria. Thus, the final first sample comprised 1406 Czech

respondents (age 18 years and over, mean age = 48.05, SD = 16.42, 49.4% female), the final second sample comprised 1494 Czech respondents (age 18 years and over, mean age = 50.67, SD = 15.79, 44.1% female).

At the beginning of each survey, participants received written information on the purpose of the study and the anonymous and confidential treatment of the data and were made familiar with the system. Participation in the survey was completely voluntary, with the option to leave the study at any time before or during the survey without giving any reason. Respondents had to explicitly give their informed consent to participate in the survey before the study began. The study design was approved by the local Ethics Committee of the Faculty of Theology, Palacký University in Olomouc (No. 2020/06).

Measures. *Religiosity* was measured by the question: “Would you call yourself a believer?” with possible answers: Yes, I am a member of a church or religious organization/Yes, but I am not a member of a church or religious organization/No/No, I am convinced atheist. Respondents who had reported “Yes” were classified as religious; others were considered non-religious.

Religious attendance was assessed by the question: “How often do you go to church or religious sessions?” Possible answers were: I don’t visit at all/Occasionally/Often, but not every week/I try once a week/More than once a week. Participants reporting at least one religious meeting a week were dichotomized as attending, as used in previous studies in the Czech environment (Buchtova et al. 2020).

Spirituality was measured using the Daily Spiritual Experience Scale (DSES) (Underwood and Teresi 2002), which measures the frequency of everyday experiences of connection with transcendence. In this study, we used an adapted 15-item version of the scale validated for a Czech environment (Malinakova et al. 2018). For the first 14 items, respondents were given the option of answering on a Likert scale graded according to the intensity of their experience of the phenomenon, ranging from “never” (1) to “many times a day” (6). Response possibilities for the last item regarded a 4-point scale that ranged from “not close at all” (1) to “as close as possible” (4). Higher DSES scores indicate higher spiritual experience. The total score of DSES ranged from 15 to 88 points. For the purposes of our analysis, the score was dichotomized: the respondents with a score of 51 (the middle of the total score) or higher were considered spiritual, and the rest as non-spiritual.

Images of God were assessed both in religious and non-religious respondents by the question “How well do you feel that each of the following words describes God?” followed by 12 adjectives (critical, distant, ever-present, fatherly, forgiving, gentle, loving, motherly, punishing, wrathful, just, absolute) adapted from the Baylor Religion Survey (Baylor University 2005). Respondents chose from four possible answers: “very well” (1); “somewhat well” (2); “not very well” (3); “not at all” (4). Religious respondents (those who identified themselves as believers) were asked how well they thought the adjectives described God. Non-religious participants (not identifying themselves as believers) described how well they thought the adjectives described the religious respondents’ views. For the purpose of statistical analysis, we dichotomized each item as follows: those who answered “very well” and “somewhat well” were considered to perceive God in this way.

Negative religious coping was measured using the Czech version (Janu et al. 2019) of the NRC subscale of the Brief RCOPE (Pargament et al. 2011). It is composed of seven items reflecting a religious struggle that grows from a less secure relationship with God. Examples of these items include statements such as “I’m

wondering whether God had abandoned me” or “I feel that God is punishing me for my lack of devotion”. Each item is rated on a four-point scale with possible answers ranging from “not at all” (1) to “a great deal” (4), leading to a total score ranging from 7 to 28. Since the NRC was assessed as a dependent variable in the analysis, each of the item scores was dichotomized. Responses of 1 or 2 were recoded to “0” (did not use NRC) and responses of 3 and 4 were recoded to “1” (used NRC). To determine the NRC summary, a dichotomous variable was created with a value of “1” if any of the seven NRC items had a value of “1”, as recently used in the Czech environment (Kosarkova et al. 2020, 2022).

Religious conspiracy theories were assessed using six statements capturing common religious beliefs about the COVID-19 pandemic and related vaccinations. These statements were retrieved by searching the Internet and social media in the first weeks of the COVID-19 pandemic to identify the most commonly held views. While our approach may not be entirely comprehensive, our goal was to encompass the most prevalent theories related to religious themes during a given time. The assessed statements were: “Rejection of the COVID-19 vaccine is an act of true faith and trust in God”; “Some of the vaccines contain modified RNA that changes the human genome, which is a crime against the human race and its Creator”; “Vaccination is a sign of the end of the world”; “The pope and false church prophets are fulfilling the intentions of world elites and spreading the ideas of modernism, which contradicts true tradition”; “The current coronavirus pandemic is God’s punishment”; “Vaccination with the COVID-19 vaccine is morally unacceptable because tissues from aborted fetuses were used for its development”. Participants were asked to rate the extent to which, in their opinion and available information, the following statements correspond to the truth. Respondents chose from five possible answers: “does not correspond at all” (0); “somewhat do not correspond” (1); “I do not know” (2); “somewhat corresponds” (3); “completely corresponds” (4). When any of the statements were marked as “3” or “4”, the respondent was classified as believing in the religious conspiracy theory (RCT). Consequently, to determine the RCT Summary, a dichotomous variable was created with a value of “1” if any of the six RCT items had a value of “3” or “4”.

To assess *sensory processing sensitivity*, we used the Sensory Processing Sensitivity Questionnaire (SPSQ), a tool recently developed and validated in Czech settings (Malinakova et al. 2021). It has been demonstrated that in the Czech environment, the SPSQ scale exhibits a high positive correlation ($r_s = 0.61$, $p < 0.001$) with the Highly Sensitive Person Scale (HSPS), an established instrument for measuring SPS (Malinakova et al. 2021). The initial question was worded as follows: “Please indicate to what extent you think that compared to other people you are sensitive to the following stimuli”. Each item was rated on an eleven-point scale with possible answers ranging from “compared to others, I am not sensitive to them at all” (0), through “about the same as the people around me” (5) to “much more sensitive than the people around me” (10). This initial question was followed by a set of 8 sensory items (light; sounds; smells; taste; tactile stimuli – touch, clothing, etc.; hunger; heat; and cold) and a set of 8 other sensitivity items (your emotions; emotions of other people; sudden changes; your inner world; the need to do many things at once; criticism; the need for harmony in life; and the need to make decisions). This led to total scores from 0 to 160. A higher score of SPSQ represents higher sensitivity. In the same way, we also used the Sensory Sensitivity subscale (Malinakova et al. 2021) of the SPSQ questionnaire.

Sociodemographic characteristics, such as age, gender, education level, marital and economical status, were obtained from the questionnaire.

Statistical analyses. As the first step, we described the background characteristics of both samples. Second, based on the Shapiro–Wilk test, we rejected the assumption of normal data distribution. Then we assessed the associations of SPS and its sensory subscale (both standardized to Z-scores) with religious attendance, religiosity, spirituality, and NRC using binary logistic regression models. All models were adjusted for age, gender, and education level. In the next step, the dependent variables were replaced by 12 images of God, and the described steps were

repeated. Finally, variables assessing a belief in RCT were regressed on the sensory subscale of the SPSQ. All analyses were performed using the statistical software package IBM SPSS version 21 (IBM Corp., Armonk, NY, USA). All the data files are available at <https://osf.io/z8pfv/>.

Results

Description of the sample. The sociodemographic characteristics of the samples (the first sample mean age 48.1; SD = 16.4; 50.6% men, the second sample mean age 50.7; SD = 15.8; 55.9% men) are presented in Table 1. Approximately one-third of respondents (exactly 34.1% in the first sample and 31% in the second sample) were considered religious.

Sensory processing sensitivity, religious attendance, religiosity, spirituality, and negative religious coping. Table 2 shows the associations between SPS and religious attendance, religiosity, spirituality, and NRC. Both the total SPSQ score and the sensory SPSQ subscale score were used. In our sample, we found no significant association of SPS (as measured by both the total SPSQ score and the sensory SPSQ subscale score) with religious attendance. The results indicate that with one standard deviation increase in the SPSQ total score, the odds of being religious or spiritual increased by 38% and by 61%. A similar but weaker relationship was found between religiosity and spirituality and the sensory SPSQ subscale scores: 29% (respectively 57%). Moreover, one standard deviation increase in the SPSQ total score increased the risks of NRC by 25%.

Sensory processing sensitivity and images of God. The results of regression analysis assessing the associations of SPS with the specific images of God are presented in Table 3. We found that SPS (as measured by the total SPSQ score) was associated with ever-present, fatherly, forgiving, gentle, loving, motherly, just, absolute, and punishing images of God. The strongest adjusted associations (standardized to Z-scores) of the SPSQ total score were found for forgiving, gentle and loving images of God, with odds ratios (ORs) ranging from 1.22 (95% confidence interval, CI, 1.10–1.37) to 1.26 (95% CI 1.13–1.42). One standard deviation increase in the SPSQ total score increased the likelihood of perceiving God as ever-present (by 19%), motherly (by 18%), and fatherly, just, and absolute (by 17%). Moreover, SPS (as measured by the total SPSQ score) was positively associated with perceiving God as punishing, with an OR of 1.14 (95% CI 1.02–1.27). Similar but weaker relationships were found between these images of God (except for the punishing image of God) and the sensory SPSQ subscale score, with ORs ranging from 1.13 to 1.22.

Sensory processing sensitivity and religious conspiracy theories. Table 4 depicts the results of the binary logistic regression

Table 1 Demographic characteristics of the study samples.

Demographic characteristics	First sample		Second sample	
	N	%	N	%
Gender				
Male	712	50.6	835	55.9
Female	694	49.4	659	44.1
Age				
18–34 years	349	24.8	266	17.8
35–49 years	407	28.9	493	33.0
50–65 years	372	26.5	370	24.8
66–99 years	278	19.8	365	24.4
Marital status				
In a partnership	926	65.9	950	63.6
Not in a partnership	480	34.1	544	36.4
Highest education achieved				
Elementary	118	8.4	91	6.1
Secondary vocational	636	45.2	572	38.3
Secondary with graduation	439	31.2	451	30.2
College	213	15.1	380	25.4
Economical status ^a				
Employee	698	49.6	720	48.2
Entrepreneur	70	5.0	89	6.0
In household ^b /without work	125	8.9	117	7.8
Student	78	5.5	55	3.7
Disabled/old-age pensioner	435	30.9	503	33.7
Religiosity ^a				
Religious, member of a church/religious society	121	8.6	132	8.8
Religious, not a member of a church/religious society	358	25.5	331	22.2
Non-religious	746	53.1	680	45.5
Non-religious, convinced atheist	181	12.9	262	17.5
Religious attendance ^a				
Attending	53	3.8	44	2.9
Non-attending	426	30.3	413	27.6
Total	1406	100	1494	100

^aNumber of missing cases per variable in the first sample: Religious attendance: 927, number of missing cases per variable in the second sample: Economical status: 10, Religiosity: 89, Religious attendance: 1037.

^bIncluding maternity leave.

Table 2 Associations of sensory processing sensitivity (standardized to Z-scores) with religious attendance, religiosity, spirituality and negative religious coping, crude, and adjusted for age, gender, and education level (odds ratios and 95% confidence intervals).

Variable		Religious attendance	Religiosity	Spirituality	NRC Summary
SPSQ	Crude	1.14 (0.85, 1.53)	1.43*** (1.27, 1.62)	1.59*** (1.32, 1.92)	1.19 (0.98, 1.45)
	Adjusted	1.06 (0.78, 1.43)	1.38*** (1.22, 1.56)	1.61*** (1.33, 1.96)	1.25* (1.02, 1.52)
SPSQ-S	Crude	1.13 (0.84, 1.51)	1.34*** (1.18, 1.51)	1.56*** (1.29, 1.90)	1.20 (0.98, 1.46)
	Adjusted	1.07 (0.79, 1.45)	1.29*** (1.14, 1.45)	1.57*** (1.29, 1.92)	1.25* (1.02, 1.53)

SPSQ Sensory Processing Sensitivity total score, SPSQ-S Sensory Subscale score of Sensory Processing Sensitivity Questionnaire, NRC negative religious coping.

*p < 0.05; **p < 0.01; ***p < 0.001.

Table 3 Associations of sensory processing sensitivity (standardized to Z-scores) with different images of God, crude and adjusted for age, gender, and education level (odds ratios and 95% confidence intervals).

Variable	Images of God						
		Critical	Distant	Ever-present	Fatherly	Forgiving	Gentle
SPSQ	Crude	1.07 (0.96, 1.19)	1.06 (0.96, 1.18)	1.24*** (1.12, 1.39)	1.22*** (1.09, 1.35)	1.34*** (1.20, 1.50)	1.26*** (1.13, 1.40)
	Adjusted	1.07 (0.96, 1.20)	1.06 (0.96, 1.18)	1.19** (1.07, 1.33)	1.17** (1.05, 1.31)	1.26*** (1.13, 1.41)	1.22*** (1.10, 1.37)
SPSQ-S	Crude	1.08 (0.97, 1.20)	1.07 (0.96, 1.19)	1.20** (1.08, 1.34)	1.17** (1.05, 1.30)	1.29*** (1.15, 1.45)	1.21** (1.08, 1.35)
	Adjusted	1.09 (0.97, 1.21)	1.07 (0.96, 1.20)	1.16* (1.03, 1.29)	1.13* (1.01, 1.26)	1.22** (1.09, 1.37)	1.17** (1.04, 1.31)
		Loving	Motherly	Punishing	Wrathful	Just	Absolute
SPSQ	Crude	1.33*** (1.19, 1.49)	1.21*** (1.09, 1.35)	1.12* (1.01, 1.25)	1.03 (0.92, 1.16)	1.22*** (1.10, 1.36)	1.21*** (1.09, 1.34)
	Adjusted	1.26*** (1.13, 1.42)	1.18** (1.05, 1.32)	1.14* (1.02, 1.27)	1.08 (0.96, 1.21)	1.17** (1.05, 1.30)	1.17** (1.05, 1.31)
SPSQ-S	Crude	1.26*** (1.13, 1.42)	1.17** (1.05, 1.30)	1.10 (1.00, 1.23)	1.05 (0.93, 1.18)	1.21** (1.08, 1.35)	1.17** (1.05, 1.31)
	Adjusted	1.20** (1.07, 1.35)	1.13* (1.01, 1.27)	1.12 (1.00, 1.25)	1.09 (0.97, 1.23)	1.16** (1.04, 1.30)	1.14* (1.02, 1.27)

SPSQ Sensory Processing Sensitivity total score, SPSSQ-S Sensory Subscale score of Sensory Processing Sensitivity Questionnaire.
p* < 0.05; *p* < 0.01; ****p* < 0.001.

Table 4 Associations of sensory processing sensitivity (standardized to Z-scores) with religious conspiracy theories, crude and adjusted for age, gender, and education level (odds ratios and 95% confidence intervals).

Variable	RCT summary	RCT 1	RCT 2	RCT 3	RCT 4	RCT 5	RCT 6	
SPSQ- S ^a	Crude	1.06 (0.90, 1.25)	1.23 (0.78, 1.94)	0.98 (0.70, 1.39)	1.19 (0.75, 1.87)	1.17 (0.88, 1.55)	1.01 (0.74, 1.37)	0.92 (0.75, 1.13)
	Adjusted	1.07 (0.91, 1.26)	1.29 (0.83, 2.00)	1.03 (0.73, 1.46)	1.23 (0.80, 1.90)	1.27 (0.95, 1.70)	1.02 (0.75, 1.40)	0.94 (0.77, 1.15)

^aOnly the sensory subscale of the SPSSQ questionnaire was included in the data collection.

assessing the associations of the sensory SPSSQ subscale score with RCT beliefs. The results revealed that SPS was not significantly associated with RCT beliefs around COVID-19.

Discussion

This study aimed to assess the associations between SPS and R/S, i.e., religious attendance, religiosity, spirituality, NRC, God image, and religious conspiracy beliefs in the secular environment of the Czech Republic. The results, adjusted for age, gender, and education level, showed that SPS was associated with religiosity and spirituality, or rather with some of their domains. Higher SPS predicted higher religiosity and spirituality, but not regular religious attendance. SPS was also associated with a higher proneness to NRC but did not appear to affect belief in RCT. HSPs were also more likely to see God in a positive way, for example, as forgiving, loving and ever-present.

We found strong associations between SPS and R/S. The findings of higher religious and spiritual attitudes in association with increasing SPS are in line with the theory and previous research (Acevedo 2020; Aron and Aron 1997). HSPs are more sensitive to their environment, situations, and feelings of other people (Acevedo et al. 2017; Jagiellowicz et al. 2011), and thus tend to be overstimulated by their surroundings (Acevedo 2020; Aron and Aron 1997; Malinakova et al. 2021). Many studies have already reported that spirituality-based techniques, e.g., meditation or mindfulness, could alleviate stress (e.g., Hartwick and Kang 2013; McClintock et al. 2019). Thus, we can presume that HSPs may benefit from R/S practices, especially those focusing on reflection and awareness and that these practices may help them deal with overstimulation. Another explanation may lie in the deeper thinking (Aron, 2013; Aron et al. 2012; Li et al. 2022) and search for meaning (Acevedo 2020; Aron and Aron 1997) among HSPs, which is often considered an aspect of spirituality. By seeking a deeper meaning in life, HSPs may be more inclined to

spiritual experiences, and the search for something beyond themselves. Furthermore, previous research has indicated associations between SPS and poorer adaptation to adverse life events, including trauma (Karaca Dinç et al. 2021; Marshall et al. 2010). While our study did not specifically measure traumatic experiences, we hypothesize that spirituality might provide a source of support for HSPs facing adversity. Further research incorporating measures of trauma and spirituality is essential to validate this hypothesis.

However, we found no significant association between SPS and religious attendance. It is possible that highly sensitive individuals may experience spirituality and a relationship with the transcendent internally (Aron 2010), and they do not necessarily need to associate these experiences with participation in organized religion (Aron 2013). However, our findings also suggest a trend towards higher religious attendance among HSPs. Therefore, our results may be non-significant due to a generally low prevalence of attending respondents in secular environments, which may have affected our power to detect differences.

Our findings reveal an association between HSPs and an increased risk of employing NRC strategies. To the best of our knowledge, there is no research describing this relationship. However, previous studies showed that SPS is associated with poorer mental health, i.e., heightened levels of anxiety, depression, and neuroticism (Ahadi and Basharpour 2010; Benham 2006; Engel-Yeger and Dunn 2011; Liss et al. 2005). The same holds for NRC, which can furthermore both reflect one's mental health problems and contribute to their development or worsening (Ano and Vasconcelles 2005; Martínez de Pisón 2023; Pargament et al. 2004).

Furthermore, increasing levels of sensitivity were associated with a mostly positive perception of God as forgiving, gentle, loving, ever-present, motherly, fatherly, just and absolute, but less strongly also with an image of punishing God. Research shows that positive God-image characteristics are associated with better

psychological well-being as well as higher self-esteem (Gabova et al. 2021; Stanford et al. 2021), while negative God-image characteristics are related to greater psychological distress, poorer well-being, and worse mental health outcomes (Jonker et al. 2008; Siltan et al. 2014; Stauner et al. 2016). Because of the heightened sensitivity of HSPs to adverse life experiences (Karaca Dinç et al. 2021), their heightened interpersonal sensitivity (Acevedo 2020), and their higher prevalence of insecure attachment style (Kerley et al. 2023), we can also suppose that, in line with a compensation theory (Kirkpatrick and Shaver 1990), HSPs may tend to see God as a safe haven while facing life difficulties. Furthermore, these positive images of God may help them to deal with negative feelings about themselves and their perception of the world (Greenway et al. 2003). However, more research that would integrate the attachment style into the analysis is needed to support this hypothesis.

In our study, we did not observe any significant associations between SPS and belief in RCT. A possible explanation may lie in the tendency of HSPs to think more deeply about information and the world around them (Aron 2020; Aron et al. 2012). As a result, they may not be inclined to turn to the shortcuts and simple solutions that conspiracies offer (Goertzel 1994). At the same time, SPS does not appear to be a protective factor for belief in conspiracy theories either, given that a negative relationship between these constructs has not been demonstrated.

Strengths and limitations. This study has several important strengths. First, to the best of our knowledge, this is the first study to examine the relationship between SPS and the domains of R/S in such depth and extent. Second, we examine a wide range of aspects of R/S (including self-reported belief, spirituality, images of God, NRC, and RCTs), which is uncommon in studies. Third, the sample size is close to the characteristics of the national sample regarding age and gender. Despite the study's contribution to a deeper understanding of associations between SPS and R/S, it also has several limitations. One of these is the cross-sectional design of the study, which does not allow us to make any conclusions about causality. Another limitation may be information bias, as our data is self-reported and may be influenced by social desirability. Moreover, some bias is inevitably caused by the online nature of the questionnaire, which excluded respondents without internet access. Additionally, the data for this study were collected during the COVID-19 pandemic. The unique circumstances of this global health crisis may have increased respondents' predisposition towards R/S, as proposed by research suggesting that under the specific conditions of a secular environment, the psychological burden of a difficult life situation like the pandemic can contribute to heightened religious and spiritual inclinations (Malinakova et al. 2020).

Implications. We found that SPS was related to R/S. This information may be useful for psychologists, psychotherapists, social workers, and others in the helping professions, as well as in spiritual care. When working with people exhibiting high sensitivity, professionals in the aforementioned fields should take into account their greater tendency to think more deeply about topics of faith, spirituality, or the meaning of life, while also mitigating or eliminating the impact of stressful situations due to intense experience and overload. For HSPs, faith can represent inner security, a resource to rely on. Spirituality can help them in many life situations. Those who work with HSPs can assume that these people tend to be spiritual and engage more with themes of spirituality and the meaning of life. When working with spiritual HSPs, professionals can tailor therapeutic approaches by incorporating spiritual topics and encouraging

the use of spiritual practices, e.g., meditation or mindfulness. Additionally, our study underscores the importance of therapeutic work with NRC in order to guide HSPs toward healthier coping strategies. Moreover, the positive link between SPS and perceptions of God as loving, gentle, or forgiving suggests avenues for enhancing psychological well-being, with interventions focusing on fostering positive images of God that may bring feelings of security and peace.

Due to the specific character of the Czech Republic as a highly secular environment, it is appropriate to compare the results with research in prevalently religious countries. Further research is needed to investigate other concepts that may be related to the relationship between SPS and R/S, such as self-esteem, attachment style, or other personality traits, as well as variables related to emotions. For a deeper understanding of the association between SPS and R/S, it would also be useful to assess these concepts on the basis of neural correlates.

Conclusions

Our results suggest that SPS is related to aspects of R/S. An increase in sensory sensitivity scores was related to higher odds of self-reported religiosity and spirituality. On the other hand, we found no association of SPS with regular religious attendance. Increased sensitivity was related to perceiving God as ever-present, fatherly, forgiving, loving, motherly, just, absolute, and punishing. A slight trend can be seen in the association between SPS and increased odds of using NRC strategies. We found no significant association between SPS and belief in RCT about the COVID-19 pandemic.

Our results suggest that high sensitivity is associated with different dimensions of religiosity and spirituality, which may have both positive and negative consequences on the experience, well-being, and, to some extent, the overall health of HSPs. Religiosity and spirituality can play an important role in the lives of these individuals, and it seems that experiencing faith itself is more important than going to church. The study also offers suggestions on the possible risks and consequences of this trait in relation to R/S aspects.

Data availability

The datasets generated and/or analyzed during the current study are available in the Open Science Framework repository: <https://osf.io/z8pfv/>.

Received: 5 October 2023; Accepted: 25 January 2024;

Published online: 09 February 2024

References

- Acevedo BP (2020). Chapter 1—The basics of sensory processing sensitivity. In BP Acevedo (Ed.), *The Highly Sensitive Brain* (pp. 1–15). Academic Press. <https://doi.org/10.1016/B978-0-12-818251-2.00001-1>
- Acevedo BP, Aron E, Pospos S, Jessen D (2018) The functional highly sensitive brain: A review of the brain circuits underlying sensory processing sensitivity and seemingly related disorders. *Philos Trans R Soc B Biol Sci* 373(1744):20170161. <https://doi.org/10.1098/rstb.2017.0161>
- Acevedo BP, Jagiellowicz J, Aron E, Marhenke R, Aron A (2017) Sensory processing sensitivity and childhood quality's effects on neural responses to emotional stimuli. *Clin Neuropsychiatry* 14:359–373
- Ahadi B, Basharpour S (2010) Relationship Between Sensory Processing Sensitivity, Personality Dimensions and Mental Health. *J Appl Sci*, 10, <https://doi.org/10.3923/jas.2010.570.574>
- Ano GG, Vasconcelles EB (2005) Religious coping and psychological adjustment to stress: A meta-analysis. *J Clin Psychol* 61(4):461–480. <https://doi.org/10.1002/jclp.20049>

- Aron EN (2010) *Psychotherapy and the Highly Sensitive Person: Improving Outcomes for That Minority of People Who Are the Majority of Clients*. Routledge. <https://doi.org/10.4324/9780203879085>
- Aron EN (2013) *The Highly Sensitive Person: How to Thrive When the World Overwhelms You*. Kensington Publishing Corp, New York
- Aron EN (2020) Chapter 6—Clinical assessment of sensory processing sensitivity. In BP Acevedo (Ed.), *The Highly Sensitive Brain* (pp. 135–164). Academic Press. <https://doi.org/10.1016/B978-0-12-818251-2.00006-0>
- Aron EN, Aron A (1997) Sensory-processing sensitivity and its relation to introversion and emotionality. *J Personal Social Psychol* 73(2):345–368. <https://doi.org/10.1037/0022-3514.73.2.345>
- Aron EN, Aron A, Jagiellowicz J (2012) Sensory Processing Sensitivity: A Review in the Light of the Evolution of Biological Responsivity. *Personal Soc Psychol Rev* 16(3):262–282. <https://doi.org/10.1177/1088868311434213>
- Assary E, Zavos HMS, Krapohl E, Keers R, Pluess M (2021) Genetic architecture of Environmental Sensitivity reflects multiple heritable components: A twin study with adolescents. *Mol Psychiatry* 26(9):9. <https://doi.org/10.1038/s41380-020-0783-8>
- Baylor University (2005) *The Baylor Religion Survey*. Baylor Institute for Studies of Religion, Waco, TX, USA. <https://www.baylor.edu/baylorreligionsurvey/doc.php/288940.pdf>
- Benham G (2006) The Highly Sensitive Person: Stress and physical symptom reports. *Person Ind Differ* 40(7):1433–1440. <https://doi.org/10.1016/j.paid.2005.11.021>
- Boterberg S, Warreyn P (2016) Making sense of it all: The impact of sensory processing sensitivity on daily functioning of children. *Personal Ind Differ* 92:80–86. <https://doi.org/10.1016/j.paid.2015.12.022>
- Bridges D, Schendan HE (2019) Sensitive individuals are more creative. *Personal Ind Differ* 142:186–195. <https://doi.org/10.1016/j.paid.2018.09.015>
- Brindle K, Moulding R, Bakker K, Nedeljkovic M (2015) Is the relationship between sensory-processing sensitivity and negative affect mediated by emotional regulation? *Aust J Psychol* 67(4):214–221. <https://doi.org/10.1111/ajpy.12084>
- Buchtova M, Malinakova K, Kosarkova A, Husek V, van Dijk JP, Tavel P (2020) Religious Attendance in a Secular Country Protects Adolescents from Health-Risk Behavior Only in Combination with Participation in Church Activities. *Int J Environ Res Public Health* 17(24):9372. <https://doi.org/10.3390/ijerph17249372>
- Engel-Yeger B, Dunn W (2011) The Relationship between Sensory Processing Difficulties and Anxiety Level of Healthy Adults. *Brit J Occup Therapy* 74(5):210–216. <https://doi.org/10.4276/030802211X13046730116407>
- Gabova K, Malinakova K, Tavel P (2021) Associations of self-esteem with different aspects of religiosity and spirituality. *Ceskoslovenska Psychologie* 65(1):73–85. <https://doi.org/10.51561/cspsych.65.1.73>
- Goertzel T (1994) Belief in Conspiracy Theories. *Polit Psychol* 15(4):731–742. <https://doi.org/10.2307/3791630>
- Granqvist P, Hagekull B (1999) Religiousness and Perceived Childhood Attachment: Profiling Socialized Correspondence and Emotional Compensation. *J Sci Study Relig* 38(2):254–273. <https://doi.org/10.2307/1387793>
- Granqvist P, Mikulincer M, Shaver PR (2020) Chapter 13—An attachment theory perspective on religion and spirituality. In: Vail KE, Routledge C (Eds.) *The Science of Religion, Spirituality, and Existentialism*. Academic Press, 175–186. <https://doi.org/10.1016/B978-0-12-817204-9.00014-7>
- Greenway AP, Milne LC, Clarke V (2003) Personality variables, self-esteem and depression and an individual's perception of God. *Mental Health Relig Cult* 6(1):45–58. <https://doi.org/10.1080/1867467021000029381>
- Greven CU, Lionetti F, Booth C, Aron EN, Fox E, Schendan HE, Pluess M, Bruining H, Acevedo B, Bijttebier P, Homberg J (2019) Sensory Processing Sensitivity in the context of Environmental Sensitivity: A critical review and development of research agenda. *Neurosci Biobehav Rev* 98:287–305. <https://doi.org/10.1016/j.neubiorev.2019.01.009>
- Hartwick JMM, Kang SJ (2013) Spiritual Practices as a Means of Coping with and Ameliorating Stress to Reduce Teacher Attrition. *J Res Christian Educ* 22(2):165–188. <https://doi.org/10.1080/10656219.2013.808979>
- Hill PC, Pargament KI (2003) Advances in the conceptualization and measurement of religion and spirituality: Implications for physical and mental health research. *Am Psychologist* 58:64–74. <https://doi.org/10.1037/0003-066X.58.1.64>
- Holloway-Friesen H (2023) Is There Anybody Out There? Coping and Belonging Strategies: Correlations with Depression, Anxiety, and Stress among Latinx Undergraduates. *J Psychol Theol* 51(2):208–222. <https://doi.org/10.1177/00916471221144671>
- Hooker SA, Masters KS, Carey KB (2014) Multidimensional Assessment of Religiosity/Spirituality and Health Behaviors in College Students. *Int J Psychol Relig* 24(3):228–240. <https://doi.org/10.1080/10508619.2013.808870>
- Jagiellowicz J, Xu X, Aron A, Aron E, Cao G, Feng T, Weng X (2011) The trait of sensory processing sensitivity and neural responses to changes in visual scenes. *Soc Cognit Affect Neurosci* 6(1):38–47. <https://doi.org/10.1093/scan/nsq001>
- Jagiellowicz J, Zarinafsar S, Acevedo BP (2020) Chapter 4—Health and social outcomes in highly sensitive persons. In: Acevedo BP (Ed.) *The Highly Sensitive Brain*. Academic Press, 75–107. <https://doi.org/10.1016/B978-0-12-818251-2.00004-7>
- Janu A, Malinakova K, Kosarkova A, Furstova J, Tavel P (2019) Psychometric evaluation of the Negative Religious Coping (NRC) Scale of the Brief RCOPE in the Czech environment. *Mental Health Relig Cult* 22(6):614–625. <https://doi.org/10.1080/13674676.2019.1597033>
- Jonker HS, Eurelings-Bontekoe EHM, Zock H, Jonker E (2008) Development and validation of the Dutch Questionnaire God Image: Effects of mental health and religious culture. *Mental Health Relig Cult* 11(5):501–515. <https://doi.org/10.1080/13674670701581967>
- Karaca Dinç P, Oktay S, Durak Batgün A (2021) Mediation role of alexithymia, sensory processing sensitivity and emotional-mental processes between childhood trauma and adult psychopathology: A self-report study. *BMC Psychiatry* 21(1):508. <https://doi.org/10.1186/s12888-021-03532-4>
- Kerley LJ, Meredith PJ, Harnett PH (2023) The Relationship Between Sensory Processing and Attachment Patterns: A Scoping Review. *Can J Occup Therapy* 90(1):79–91. <https://doi.org/10.1177/00084174221102726>
- Kirkpatrick LA, Shaver PR (1990) Attachment Theory and Religion: Childhood Attachments, Religious Beliefs, and Conversion. *J Sci Study Relig* 29(3):315–334. <https://doi.org/10.2307/1386461>
- Koenig HG (2012a) Religion, Spirituality, and Health: The Research and Clinical Implications. *ISRN Psychiatry* 2012:1–33. <https://doi.org/10.5402/2012/278730>
- Koenig HG (2012b) *Spirituality and Health Research: Methods, Measurements, Statistics, and Resources*. Templeton Press, West Conshohocken
- Koenig HG, Al Zaben F, Khalifa DA, Al Shohaib S (2015) Chapter 19—Measures of Religiosity. In: Boyle GJ, Saklofske DH, Matthews G (Eds.) *Measures of Personality and Social Psychological Constructs*. Academic Press, 530–561. <https://doi.org/10.1016/B978-0-12-386915-9.00019-X>
- Kosarkova A, Malinakova K, Novak L, Van Dijk, JP, & Tavel, P (2022). Religious Conspiracy Theories About the COVID-19 Pandemic Are Associated With Negative Mental Health. *Int J Public Health*, 0. <https://doi.org/10.3389/ijph.2022.1604324>
- Kosarkova A, Malinakova K, van Dijk JP, Tavel P (2020) Anxiety and Avoidance in Adults and Childhood Trauma Are Associated with Negative Religious Coping. *Int J Environ Res Public Health* 17(14):14. <https://doi.org/10.3390/ijerph17145147>
- Li Z, Sturge-Apple ML, Jones-Gordils HR, Davies PT (2022) Sensory processing sensitivity behavior moderates the association between environmental harshness, unpredictability, and child socioemotional functioning. *Dev Psychopathol* 34(2):675–688. <https://doi.org/10.1017/S0954579421001188>
- Lionetti F, Pastore M, Moscardino U, Nocentini A, Pluess K, Pluess M (2019) Sensory Processing Sensitivity and its association with personality traits and affect: A meta-analysis. *J Res Personal* 81:138–152. <https://doi.org/10.1016/j.jrp.2019.05.013>
- Liss M, Timmel L, Baxley K, Killingsworth P (2005) Sensory processing sensitivity and its relation to parental bonding, anxiety, and depression. *Personal Ind Differ* 39(8):1429–1439. <https://doi.org/10.1016/j.paid.2005.05.007>
- Malinakova K, Novak L, Trnka R, Tavel P (2021) Sensory Processing Sensitivity Questionnaire: A Psychometric Evaluation and Associations with Experiencing the COVID-19 Pandemic. *Int J Environ Res Public Health* 18(24):24. <https://doi.org/10.3390/ijerph182412962>
- Malinakova K, Tavel P, Meier Z, van Dijk JP, Reijneveld SA (2020) Religiosity and Mental Health: A Contribution to Understanding the Heterogeneity of Research Findings. *Int J Environ Res Public Health* 17(2):2. <https://doi.org/10.3390/ijerph17020494>
- Malinakova K, Trnka R, Sarnikova G, Smekal V, Furstova J, Tavel P (2018) Psychometric evaluation of the Daily Spiritual Experience Scale (DSES) in the Czech environment. *Ceskoslovenska Psychologie* 62:100–113
- Marshall GN, Miles JNV, Stewart SH (2010) Anxiety sensitivity and PTSD symptom severity are reciprocally related: Evidence from a longitudinal study of physical trauma survivors. *J Abnorm Psychol* 119:143–150. <https://doi.org/10.1037/a0018009>
- Martínez de Pisón R (2023) Religion, spirituality and mental health: The role of guilt and shame. *J Spirit Mental Health* 25(4):261–276. <https://doi.org/10.1080/19349637.2022.2109241>
- McClintock CH, Worhunsky PD, Balodis IM, Sinha R, Miller L, Potenza MN (2019) How Spirituality May Mitigate Against Stress and Related Mental Disorders: A Review and Preliminary Neurobiological Evidence. *Curr Behav Neurosci Rep* 6(4):253–262. <https://doi.org/10.1007/s40473-019-00195-0>
- Pargament KI, Feuille M, Burdzy D (2011) The Brief RCOPE: Current Psychometric Status of a Short Measure of Religious Coping. *Religions* 2(1):1. <https://doi.org/10.3390/rel2010051>

- Pargament KI, Koenig HG, Tarakeshwar N, Hahn J (2004) Religious Coping Methods as Predictors of Psychological, Physical and Spiritual Outcomes among Medically Ill Elderly Patients: A Two-year Longitudinal Study. *J Health Psychol* 9(6):713–730. <https://doi.org/10.1177/1359105304045366>
- Pargament KI, Smith BW, Koenig HG, Perez L (1998) Patterns of Positive and Negative Religious Coping with Major Life Stressors. *J Sci Study Relig* 37(4):710–724. <https://doi.org/10.2307/1388152>
- Rappaport MB, Corbally C (2018) Evolution of Religious Capacity in the Genus Homo: Cognitive Time Sequence. *Zygon*® 53(1):159–197. <https://doi.org/10.1111/zygo.12387>
- Rizzo-Sierra CV, Leon-S ME, Leon-Sarmiento FE (2012) Higher sensory processing sensitivity, introversion and ectomorphism: New biomarkers for human creativity in developing rural areas. *J Neurosci Rural Pract* 03(02):159–162. <https://doi.org/10.4103/0976-3147.98314>
- Schaap-Jonker H (2018) God representations and mental health: Measurement, multiplicity and the meaning of religious culture. *Vrije Universiteit, Amsterdam*
- Silton NR, Flannelly KJ, Galek K, Ellison CG (2014) Beliefs about God and mental health among American adults. *J Relig Health* 53(5):1285–1296. <https://doi.org/10.1007/s10943-013-9712-3>
- Stanford MS, Oxhandler HK, Ellor JW (2021) Assessing the usefulness of the God Questionnaire. *Psychol Relig Spirit* 13:46–52. <https://doi.org/10.1037/rel0000292>
- Stauner N, Exline JJ, Pargament KI (2016) Religious and Spiritual Struggles as Concerns for Health and Well-Being. *HORIZONTE - Revista de Estudos de Teologia e Ciências Da Religião*, 48–75. <https://doi.org/10.5752/P.2175-5841.2016v14n41p48>
- Underwood LG, Teresi JA (2002) The daily spiritual experience scale: Development, theoretical description, reliability, exploratory factor analysis, and preliminary construct validity using health-related data. *Ann Behav Med* 24(1):22–33. https://doi.org/10.1207/S15324796ABM2401_04
- Wahbeh H, Butzer B (2020) Characteristics of English-speaking trance channelers. *Explore* 16(5):304–309. <https://doi.org/10.1016/j.explore.2020.02.002>

Acknowledgements

This study was supported by the Ministry of Education, Youth and Sports, project Sensory processing sensitivity and its associations with mental health (grant number DSGC-2021-0166), and by the ERDF/ESF project DigiWELL (No. CZ.02.01.01/00/22_008/0004583).

Author contributions

The co-authors of the manuscript contributed as follows: M.B., K.M., and J.P.v.D. conceptualized the study; M.B. wrote the original draft preparation; M.B., K.M., J.P.v.D., V.H., and P.T. reviewed and edited the paper; M.B. conducted statistical analyses under the

supervision of K.M., J.P.v.D. and P.T.; M.B. and K.M. interpreted results; V.H., J.P.v.D. and P.T. supervised the study; K.M., V.H. and P.T. secured funding and resources.

Competing interests

The authors declare no competing interests.

Ethical approval

The study design was approved by the local Ethics Committee of the Faculty of Theology, Palacký University in Olomouc (No. 2020/06).

Informed consent

Informed consent was obtained from all participants. Electronic informed consent was used because of the nature of the study (an online survey). Participants had to click on the appropriate button to indicate their willingness to participate in the survey.

Additional information

Correspondence and requests for materials should be addressed to Marie Buchtova.

Reprints and permission information is available at <http://www.nature.com/reprints>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this license, visit <http://creativecommons.org/licenses/by/4.0/>.

© The Author(s) 2024