



Sensory processing sensitivity, transliminality, and boundary-thinness as predictors of anomalous experiences, beliefs, and abilities

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Abstract

Individual differences are among the most studied correlates of anomalous experiences and beliefs (AEs), but few have focussed on personality measures specifically defined by sensitivity. Of interest in this study is the personality trait of Sensory Processing Sensitivity (SPS), characterised by aesthetic sensitivity, being easily overwhelmed by internal and external stimuli, emotional reactivity and empathy, and deeper processing. An online survey investigated the relationship between SPS, and other personality constructs, in part, defined by sensitivity (transliminality and boundary-thinness) with anomalous experiences, beliefs, and abilities. Two hundred participants (mean age = 32.23; 151 females, 41 males, 6 non-binary and 2 preferred not to say) completed the Revised Transliminality Scale, the Boundary Questionnaire Short-Form, the Highly Sensitive Person Scale - Brief Version (measuring SPS), the Anomalous Experiences Inventory, and open-ended questions on SPS and AEs. There were significant and positive correlations between all four variables. Both transliminality and boundary thinness positively predicted anomalous beliefs with transliminality being the stronger, however, only transliminality predicted anomalous experiences and abilities. The findings suggest a relationship between SPS and anomalous experience and belief, but this is mediated by transliminality and boundary thinness.

Keywords Anomalous experiences · Boundary-thinness · Highly sensitive person · Paranormal belief · Sensory processing sensitivity · Transliminality

Introduction

An anomalous experience (AE) has been defined as “an uncommon experience (e.g., synaesthesia), or one that, although it may be experienced by a significant number of persons (e.g., an experience interpreted as telepathic), is believed to deviate (significantly) from ordinary experience or from the usually accepted explanations of reality according to Western mainstream science” (Cardeña et al., 2014, p. 4). It should be noted here that the terms ‘anomalous experience’ and ‘paranormal experience’ are often used interchangeably in the literature (although see Dagnall et al., 2016, for discussion of this point). Further, although researchers in the area often refer to belief and experience

as if they, too, are interchangeable and part of the same construct (Rattet & Bursik, 2001), it is important to point out that experiences and beliefs are not the same and, in each case, it is possible to have one without the other. Surveys have shown that AEs are common in the general population, for example, Pechey and Halligan (2012) found that 48% of a British sample of 1000 individuals reported AEs. It is argued that AEs should be considered an important part of psychological inquiry as greater insight into their prevalence and phenomenology can further our understanding of human potential and the nature of reality (Cardeña et al., 2017).

It has been long debated why some people are more likely to report AEs than others. This has been linked to various personality factors, such as higher levels of openness to experiences (Chauvin & Mullet, 2018), absorption (Irwin, 1985), and fantasy-proneness (Kennedy, 2005) in people more likely to report AEs. Schizotypy has also been associated with reporting of AEs (Schofield & Claridge, 2007), with the idea that people with unusual and creative thoughts are more open to these types of experiences. However,

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this could also be linked to sensitivity to certain kinds of experience. Kennedy (2005) has suggested that absorption, fantasy-proneness, mystical experiences, and belief in the paranormal all encompass the concepts of transliminality (Thalbourne & Delin, 1999) and boundary thinness (Hartmann, 1991). Both concepts have been linked to ‘sensitivity’ to oneself (thought, affect and bodily process) and the environment (being more susceptible to outside stimuli), and to greater permeability of psychological material crossing into or out of consciousness. Therefore, it is proposed that a more sensitive person should be more likely to report an AE. Jawer (2005) hypothesises that hypersensitive individuals, characterised as imaginative thinkers who have intense emotional experiences, will be more likely to notice AEs, and states “to the extent that any anomalous influences exist in the external environment, certain individuals will register these more clearly versus others who see, hear, feel, and smell through a denser ‘veil’ of internal imagery” (p. 5). With this in mind, this study will focus on examining the relationship between a person’s sensitivity and their propensity to report AEs in terms of the personality constructs of boundary thinness and transliminality, which have previously been investigated in relation to AEs, but will also include the unique contribution of Sensory Processing Sensitivity (SPS; see Greven et al., 2019 for an overview); a personality trait that is yet to be thoroughly explored in relation to AEs

SPS is explained in relation to Environmental Sensitivity (Pluess et al., 2023), which proposes that some people exhibit greater responsivity to environmental subtleties and stimuli, such as physical (e.g., food), social (e.g., others’ moods and emotions, crowds), sensory (e.g., auditory, visual, tactile), and internal (e.g., pain, thoughts, feelings), and that this has an evolutionary advantage. Individuals with this trait are known as Highly Sensitive Persons (HSPs) and can be identified using the Highly Sensitive Person Scale (HSPS; Aron & Aron, 1997). The scale includes three subscales, measuring: a tendency to feel overwhelmed by internal and external stimuli (the Ease of Excitation [EOE] subscale); whether an individual experiences unpleasant sensory arousal to certain stimuli (Low Sensory Threshold [LST] subscale); and whether they tend to feel deeply moved by music and art (Aesthetic Sensitivity [AES] subscale). Lionetti et al. (2018) suggest that, in general, 31% of people would be classified as highly sensitive, 40% as medium, and 29% as low.

Initial research into SPS suggests that individuals who score higher on the HSPS may be more likely to report AEs given that they are more susceptible to environmental influences and are more responsive to subtle stimuli. In one of the few studies to use the HSPS to explore the relationship between SPS and AEs, Irwin et al. (2015) found an increased

proneness to AEs and an increased proneness to attribute AEs to paranormal phenomena on the Survey of Anomalous Experiences (SAE) in those with higher scores on the HSPS. In the only other two studies, to the authors’ knowledge, that have explored SPS and AEs, Jonsson et al. (2014) found that higher scores on the HSPS were associated with higher scores for absorption and mystical experiences and with more altered states of consciousness during sensory isolation in a flotation tank, and more recently, Williams et al. (2021), found that the number of AEs reported on the SAE was significantly associated with higher overall scores on the HSPS, but not with the three subscales of LST, EOE, and AES. Findings from these preliminary studies suggest that further research is warranted to establish what, if any, is the relationship between AEs and SPS. We also have limited information about how the subscales of the HSPS might factor in any relationship between AEs and SPS.

SPS shares features with other personality constructs, in part, defined by sensitivity, such as transliminality (Thalbourne & Delin, 1993) and boundary thinness (Hartmann, 1991), which have also been associated with anomalous experiences and beliefs (Simmonds-Moore, 2009). It has been suggested that some individuals experience high transliminality and are thus particularly sensitive to subtleties in their environment and/or unconscious cues (Thalbourne & Delin, 1999). Like those with high SPS, highly transliminal individuals tend to pay more attention to their internal processes and are particularly sensitive to thoughts, feelings, and images. They are also likely to demonstrate hyperesthesia (heightened sensitivity to sensory experiences). These experiences seem akin to high SPS, as reflected in the LST subscale of the HSPS. Further, studies have found an association between transliminality, schizotypy, and paranormal belief (Dagnall et al., 2010) and that transliminality and transpersonal self-expansiveness predicts paranormal belief (Rock et al., 2021), but have not yet explored transliminality alongside SPS in relation to anomalous experiences, beliefs, and ability.

Hartmann’s (1991) ‘boundary thinness’ is characterised by openness and ease of entering an altered state of consciousness, and significantly thinner boundaries have been identified in persons reporting AEs (Rabeyron & Watt, 2010). This suggests thin boundaries appear in groups of individuals that could be considered sensitive to AEs and that we might expect people scoring higher on SPS to have thinner boundaries given their sensitivity to external and internal stimuli. However, to date, neither transliminality nor the boundary dimension has been explored together with SPS in relation to anomalous experiences, beliefs, and ability. As such, this study will involve an online mixed methods survey including well validated measures of SPS, boundary-thinness and transliminality as independent

variables and anomalous experiences, beliefs, and ability as the dependent variable to predict whether sensitivity/personality variables contribute significantly to reporting of anomalous experiences, beliefs, and ability. Data will also be collected about participants' spiritual practice since this has been correlated with AEs (Schofield, 2012). Open-ended responses will be used to gather data from participants about their personal anomalous experiences and beliefs, and their experience of SPS if they identify as being highly sensitive. Previous research has explored personality variables in relation to AEs, but few have focused specifically on personality measures defined by sensitivity. Furthermore, no studies have used a measure of AEs that includes anomalous experiences, beliefs, and abilities, to explore the relationship with SPS using the newly validated short version of the HSPS (i.e., HSP-12; Pluess et al., 2023). We also do not know the extent to which transliminality and boundary thinness are conceptually similar to SPS, and it has been argued that SPS needs to be more strongly distinguished from existing constructs (Roth et al., 2023).

This was an exploratory study pre-registered with the Koestler Parapsychology Unit (ref#1064) and ethically approved by the Faculty of Science, Engineering, and Social Sciences Ethics Committee at Canterbury Christ Church University (ETH2122-0041). The main aim is to investigate the relationship between sensitivity and anomalous experiences, beliefs, and abilities. Initially, the relationships between SPS, transliminality, and boundary thinness will be examined in terms of how well they predict anomalous experiences, beliefs, and abilities, and whether any relationship is moderated by gender and spiritual practice. Finally, the mediating role of transliminality and boundary thinness between SPS and anomalous experiences, beliefs, and abilities will be explored. Investigating these personality factors can contribute to our understanding of why certain individuals report AEs or beliefs whereas others do not.

Method

Participants

Prior research assessing differences in sensitivity (i.e., SPS) has utilised sample sizes of 96 (Aron et al., 2005) and 201 (Liss et al., 2008). Hence, to ensure a sufficient sample size, this study aimed to remain active until 200 participants had completed all components. To facilitate this, separate survey links were distributed across different locations: Canterbury Christ Church University and the University of Derby; social media, Sensitivityresearch.com; and the Society for Psychological Research website. There were 151 (75.5%) females, 41 (20.5%) males, 6 (3%) non-binary and 2 (1%) preferred not

to say, with an age range of 18 to 80 years ($M=32.23$ years, $SD=15.28$ years). In terms of ethnicity, 145 (72.5%) participants classified themselves as 'English/Welsh/Scottish/Northern Irish', 37 (18.5%) as 'Other White background', 4 (2.0%) 'Caribbean', 3 (1.5%) 'Indian', 3 (1.5%) 'Irish', 2 (1.0%) 'Pakistani', 1 (0.5%) 'White Asian', 1 (0.5%) 'African', 1 (0.5%) as 'Other', and 3 (1.5%) as 'Prefer not to say'. Participants were entered into a prize draw to win online shopping vouchers; winners were selected at random and received either a first prize of £100, two second prizes of £50 each, and ten runner-up prizes of £10 each.

Measures

The study used Qualtrics software to present the various measures online. Participants were also asked to provide demographic information.

Highly sensitive person scale – brief version (HSP-12; Pluess et al., 2023)

This is a 12-item self-report measure of SPS, created by selecting items from the original 27-item HSPS (Aron & Aron, 1997) that loaded strongly on the bifactor structure detected in previous studies (Lionetti et al., 2018). Each of the 12 items is rated on a 7-point Likert scale. This scale has three subscales: Ease of Excitation (EOE, five items), Aesthetic Sensitivity (AES, four items), and Low Sensory Threshold (LST, three items). The items are then averaged to obtain a total mean score. The HSP-12 has shown good psychometric properties and correlation between the two scales is very high, with $r=.94$ (Pluess et al., 2023).

Anomalous experiences inventory (AEI; Gallagher et al., 1994)

This is a 70-item questionnaire designed to investigate anomalous experiences, beliefs and abilities, as well as including questions relating to drug and alcohol use and fear of the paranormal. It is scored by answering True or False to a number of statements. It has five subscales: anomalous/paranormal experiences (29 items), anomalous/paranormal ability (16 items), anomalous/paranormal belief (12 items), paranormal fear (6 items), and use of drugs/alcohol (7 items). It has adequate psychometric properties (Gallagher et al., 1994).

The revised transliminality scale (Lange et al., 2000)

A 17-item transliminality scale that corrects age and gender biases in the original scale, is unidimensional by a Rasch criterion, and has a reliability of 0.82. The scale defines a probabilistic hierarchy of items that address magical ideation,

mystical experience, absorption, hyperaesthesia, manic experience, dream interpretation, and fantasy proneness.

Boundary questionnaire (BQ-18), short-form (Kunzendorf et al., 1997)

Participants are asked to rate each of the 18 item statements from 0 to 4 (0 indicates “not at all true of me”; 4 indicates “very true of me”). An example of a thick boundaried statement is: “A good organization is one in which all the lines of responsibility are precise and clearly established”. An example of a thin boundaried statement is: “My feelings blend into one another”. The BQ-18 total score equals the sum of all the items, with higher scores indicating boundary thinness. It has demonstrated an alpha reliability of 0.93 and test-retest reliability of 0.77 (Hartmann et al., 2001).

Open-ended responses

Participants were first asked to identify whether they considered themselves to be highly sensitive: ‘Highly sensitive people are often those who are more strongly influenced by what they experience. Given this, would you consider yourself to be a highly sensitive person (HSP)? – (Yes/No). They were then presented with questions which allowed them to provide text based qualitative responses, for example, ‘Do you think being a HSP makes you more likely to have anomalous experiences?’ and ‘Please describe any anomalous experiences you have had’.

Procedure

All participants completed the survey online at a time and place convenient to them. The survey began by presenting participants with an information screen outlining what they would be required to do. This was followed by a consent screen where participants provided their informed consent to participate by confirming in the affirmative (i.e., ticking ‘Yes’) to a number of statements (i.e., they had read the participant information and they agreed to take part in the study voluntarily). The survey was completed anonymously, and participants were asked to

add a unique code to enable withdrawal of data from the study. Contact details were collected, should participants wish to be entered into the prize draw and participate in future research studies, and were stored separately to participant data. The next screen asked participants to enter information regarding a selection of demographic details (e.g., age, gender, ethnicity). This was followed by presentation of the four main questionnaires (i.e., HSPS-12, AEI, RTS and BQ-18) in a randomised order. Participants were then presented with a selection of qualitative questions on sensitivity and personal anomalous experience. They were then fully debriefed and given the opportunity to express an interest in participating in future research studies.

Data analysis

Multiple regression analyses utilising a forced entry approach explored whether scores on the personality measures (i.e., HSP-12 total score, BQ-18, and RTS) significantly predicted scores on anomalous experiences, beliefs, and abilities (i.e., AEI subscales). Correlational analyses were also used to examine possible relationships between scores on the HSP-12 (and subscales), RTS, BQ-18 with the AEI subscales. Three moderation analyses were carried out using HSP-12 as the predictor, gender (male, female), and spiritual practice (yes, no) as the moderators, then anomalous belief, anomalous experience, and anomalous ability were entered as the separate outcome variables. To further explore the interaction of the predictor variables, three post hoc mediation analyses were carried out, with HSP-12 as the predictor variable, RTS as the mediator and anomalous experience, belief and ability for each moderation.

Results

Reliabilities

The internal consistencies (Cronbach’s alpha) of the AEI subscales were, paranormal beliefs, $\alpha=0.81$; paranormal experiences, $\alpha=0.82$; paranormal abilities, $\alpha=0.84$; HSP-12: sensory processing sensitivity, $\alpha=0.86$; BQ-18: boundary thinness, $\alpha=0.77$; RTS: transliminality scale, $\alpha=0.83$.

Descriptive statistics

Table 1 displays the descriptive statistics for the variables: Highly Sensitive Person Scale-12 (HSP-12), HSP-12 dimensions Ease of Excitation (EOE), Aesthetic Sensitivity (AES), and Low Sensory Threshold (LST); Revised Transliminality Scale (RTS); Boundary Questionnaire Short Form (BQ-18); Anomalous Experiences Inventory subscales Experiences

Table 1 Descriptive statistics for study variables

	<i>M</i>	<i>SD</i>	Skewness	Kurtosis
HSP-12	4.83	1.08	-0.36	-0.19
HSP-AES	4.79	1.32	-0.48	-0.24
HSP-LST	4.30	1.60	-0.13	-0.93
HSP-EOE	5.17	1.20	-0.76	0.26
BQ	39.49	9.61	-0.29	0.74
RTS	23.55	4.64	0.17	0.30
AEI-Belief	6.56	3.07	-0.02	-1.1
AEI-Experiences	6.61	4.46	0.74	0.14
AEI-Abilities	1.53	1.81	1.32	1.05

Table 2 Correlations for study variables

	1. AEI-Belief	2. AEI-Experiences	3. AEI-Abilities	4. HSP-12	5. HSP-AES	6. HSP-LST	7. HSP-EOE	8. BQ-18
2. AEI-Experiences	0.58**							
3. AEI-Abilities	0.29**	0.60**						
4. HSP-12	0.33**	0.33**	0.34**					
5. HSP-AES	0.32**	0.37**	0.39**	0.79**				
6. HSP-LST	0.27**	0.28**	0.32*	0.86**	0.62**			
7. HSP-EOE	0.21*	0.17*	0.13	0.78**	0.32**	0.50**		
8. BQ-18	0.42**	0.41**	0.36*	0.65**	0.55**	0.46**	0.55**	
9. RTS	0.52**	0.66**	0.58*	0.57**	0.56**	0.48**	0.35**	0.58**

* $p < .05$, ** $p < .01$

Table 3 Table showing beta values and levels of significance of the three regression models

	AEI								
	Belief			Experience			Ability		
	β	t	p	β	t	p	β	t	p
HSP-12	-0.054	-0.65	0.52	-0.115	-1.56	0.12	-0.003	-0.03	0.97
BQ-18	0.212	2.53	<0.05	0.095	1.28	0.2	0.049	0.63	0.55
RTS	0.428	5.51	<0.001	0.673	9.74	<0.001	0.558	7.45	<0.001

(AEI-Experiences), Beliefs (AEI-Beliefs), and Abilities (AEI-Abilities).

Correlational analyses

Table 2 displays the correlation statistics between the HSP-12 overall score and subscales (EOE, AES, LST), transliminality, boundary-thinness, anomalous experiences, beliefs, and abilities variables. There were significant positive correlations between all variables apart from EOE and anomalous abilities.

Multiple regression analysis

Linear multiple regression analyses utilising a forced entry approach examined whether scores on the three personality measures (i.e., HSP-12 total score, BQ-18, and RTS) significantly predicted scores on the AEI sub-scales of belief, experiences, and ability.

The AEI-Belief model explained 28.3% of the variance and was significant, $F(3,195) = 27.05, p < .001$. The analysis showed that only RTS and BQ-18 were the significant predictors, with no contribution made from HSP-12 (see Table 3).

The AEI-Experiences model explained 43.8% of the variance and was significant, $F(3,195) = 54.23, p < .001$. Further analysis showed that RTS was the only significant predictor and that both BQ and HSP did not make any significant contribution to the model (see Table 3).

The AEI-Abilities model explained 33.2% of the variance and was significant, $F(3,188) = 32.7, p < .001$. However, analysis showed that RTS was the only significant

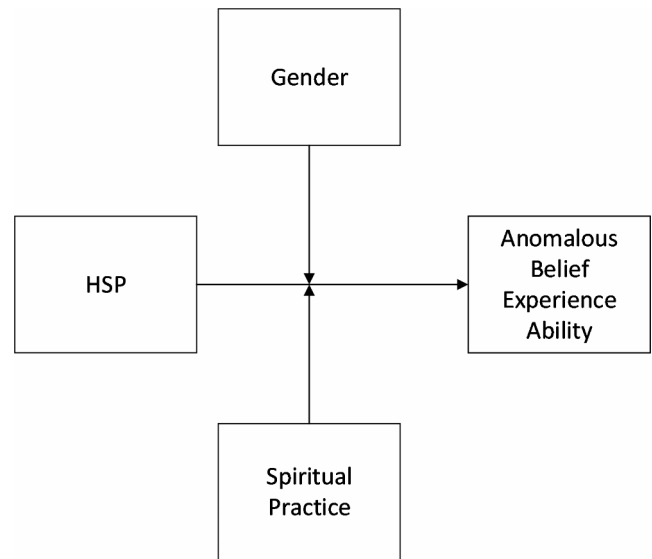


Fig. 1 Moderation model showing HSP predicting anomalous belief, and experience, and ability moderated by gender and spiritual practice

predictor and that both BQ and HSP did not make any significant contribution to the model (see Table 3).

Moderation analysis

Three exploratory moderation analyses were carried out using HSP as the predictor. Eight cases were excluded from the analysis as they did not identify a gender. The only significant moderation (Fig. 1) was between HSP and anomalous ability, with gender being the moderator ($\beta = 1.405$ 95% BCa CI [0.567, 2.243]). No moderating effect was found regarding spiritual practice ($\beta = 0.141$ 95% BCa CI [-0.550, 0.832]). The other two moderation analyses were

non-significant; HSP predicting belief (Fig. 1) with gender ($\beta = -0.132$ 95% BCa CI [-1.145, 0.881]) and spiritual practice ($\beta = 0.333$ 95% BCa CI [-0.502, 1.168]) as the moderators; HSP predicting experience (Fig. 1) with gender ($\beta = 0.587$ 95% BCa CI [-0.925, 2.098]) and spiritual practice ($\beta = -0.055$ 95% BCa CI [-1.301, 1.191]) as the moderators.

Non-hypothesised mediation analyses

Results of the mediation analyses (See Fig. 2) indicated a significant indirect effect of HSP on anomalous belief ($\beta = 0.635$ 95% BCa CI [0.334, 0.945]), experience ($\beta = 1.585$ 95% BCa CI [1.113, 2.122]), and ability ($\beta = 0.712$ 95% BCa CI [0.458, 1.111]) through transliminality. Furthermore, there was a significant indirect effect of HSP on anomalous belief ($\beta = 0.379$ 95% BCa CI [0.065, 0.712]), but not experience ($\beta = 0.275$ 95% BCa CI [-0.084, 0.680]) and ability ($\beta = -0.005$ 95% BCa CI [-0.225, 0.221]), through boundary thinness. However, caution should be taken when interpreting these results as coefficient values were greater than 1 for the relationships between SPS, transliminality and boundary-thinness, indicating possible multicollinearity, although correlation coefficients between these variables were not concerning.

Open-ended responses

In terms of why SPS might be associated with AEs, 43 participants (out of 80 who thought they were highly sensitive) said they thought being HSP made them more likely to have AEs and that this was because it made them more observant ($n = 18$; 49%), for example, “Because we pick up on things other people might miss” or because it made them more open-minded ($n = 14$; 38%), for example, “I think if you are open to things, you are more likely to experience them”. Other responses included being spiritual, feeling things more, greater sense of presence, and stronger instincts. In terms of types of AEs reported, 75 participants provided codable responses ($n = 38$ HSP; $n = 37$ not HSP). Apparitions were the most commonly reported AEs, such as seeing a ghost or apparition (‘visual’; $n = 24$ HSP; $n = 13$ non-HSP) or sensed presence (‘feeling’; $n = 7$ HSP and 4 non-HSP), followed by precognitive experiences, such as dreaming about things which later came true ($n = 14$ HSP; 9 non-HSP) or knowing about things in advance/sensing something was going to happen before it happened ($n = 9$ HSP; 4 non-HSP), followed by out of body experiences ($n = 7$ HSP; $n = 5$ non-HSP).

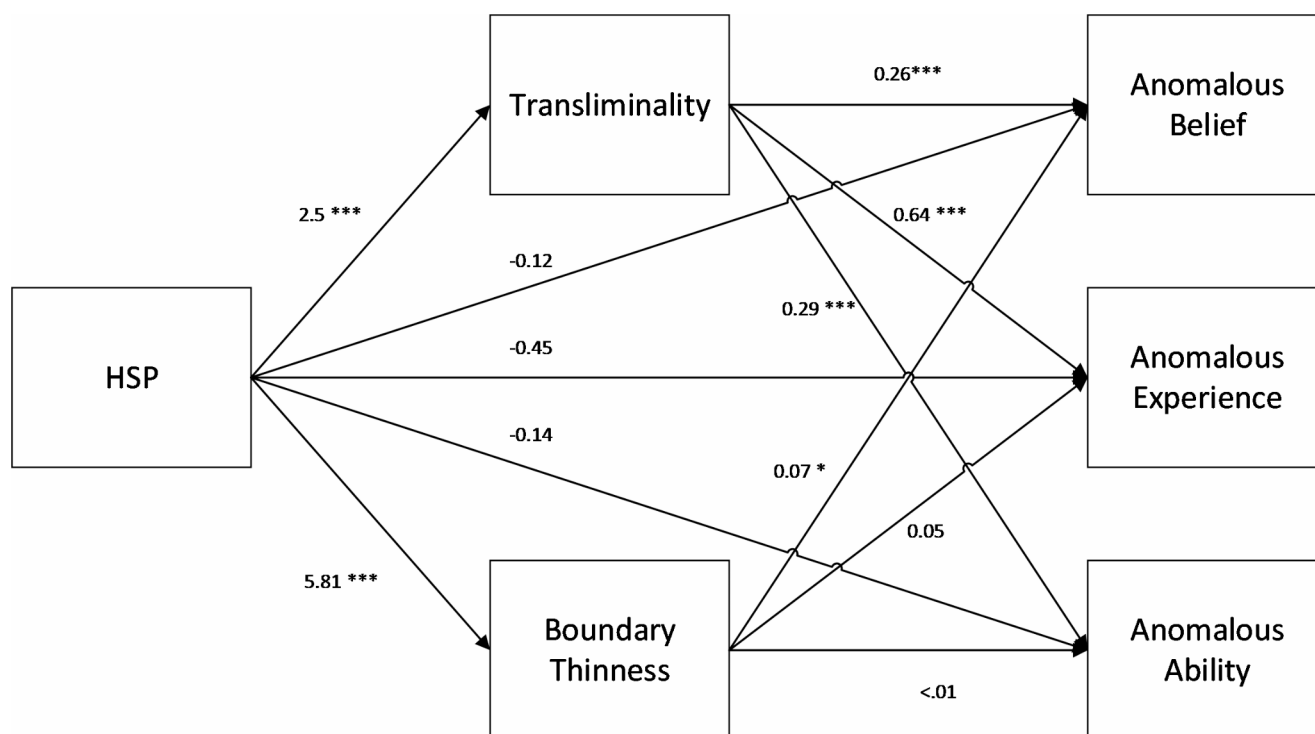


Fig. 2 Figure showing the model and path coefficients of HSP (highly sensitive people) on anomalous belief, anomalous experience, anomalous ability, transliminality, and boundary thinness as mediators. $p < .05$ ** $p < .01$ *** $p < .001$

Discussion

This study demonstrates that sensory processing sensitivity, transliminality, and boundary thinness are associated with anomalous experiences, beliefs, and abilities. Correlation analysis showed a clear linear relationship between each of the three personality predictor variables and the subscales of the AEI. There was a significant moderate, positive correlation between total HSP-12 score and all subscales of the AEI (experiences, belief, abilities). This is consistent with previous research that found a significant positive association between the HSPS and the Survey of Anomalous Experiences (Irwin et al., 2014; Williams et al., 2021). However, there were also significant positive correlations between the three subscales of the HSP-12 (EOE, LST, AES) and the subscales of the AEI, which was not found in the study by Williams et al. (2021). Specifically, moderate correlations were found between AES and anomalous experiences, beliefs, and abilities and between LST and abilities, small correlations were found between LST and belief and experiences, and between EOE and experiences and beliefs. Interestingly, no correlation was found between EOE and anomalous ability, which was noticeable given all other variables were correlated. Although speculative, it may suggest that this dimension of SPS needs to be particularly low (i.e., reducing internal and external stimuli) for people to report anomalous abilities, which would align with the ‘noise reduction’ approach that proposes anomalous phenomena are subtle and likely to remain nonconscious unless overwhelming sensory inputs are reduced (Honorton, 1977/1986).

There were also significant moderate, positive correlations between the measure of boundary-thinness (BQ-18) and anomalous experiences, beliefs, and abilities, and significant strong, positive correlations with the measure of transliminality (RTS) and anomalous experiences, beliefs, and ability, which is similar to previous research findings (e.g., Dagnall et al., 2010; Rabeyron & Watt, 2010; Rock et al., 2021; Simmonds-Moore, 2009). It is noted that there was a strong positive correlation between the BQ-18 and RTS ($r = .58$) which is similar to previous research correlating these measures (Simmonds-Moore, 2009 [$r = .53$]) but slightly smaller than studies using the global Boundary Questionnaire with 146 items (Houran et al., 2003 [$r = .66$]; Sherwood & Milner, 2005 [$r = .696$]; Thalbourne & Maltby, 2008 [$r = .75$]), suggesting both scales are measuring related but independent constructs. Interestingly, there was also a strong, positive correlation between the HSP-12 and the RTS ($r = .57$) and between the HSP-12 and the BQ-18 ($r = .65$), suggesting that SPS is a construct that is analogous to boundary-thinness and transliminality. This warrants further exploration in terms of whether a

factor analysis would reveal a single underlying factor and/or whether any specific facets of the boundary dimension or transliminality are associated with SPS. For instance, previous studies have used the global Boundary Questionnaire to see whether specific subscales are predictors of transliminality (Houran et al., 2003; Sherwood & Milner, 2005), which could be an area for further research in relation to SPS. A potential shared feature of the three personality measures could be Openness to experience, given that it has been associated with all three constructs previously (Hartmann, 1991; Lionetti et al., 2023; Thalbourne, 2000). In addition, participants in this study who identified with SPS stated that openness was one of the reasons that they felt highly sensitive people were more prone to AEs. Future research could also explore whether length of time identifying with SPS impacts on boundary-thinness, as qualitative research with those identifying with the trait found some participants discussed developing a ‘thicker skin’ to cope with absorbing others’ negative feelings (Roxburgh, 2022). Indeed, post hoc analysis does show a small negative correlation ($r = -.25$, $p = .026$), with length of time identifying as a HSP being associated with lower scores on the BQ-18 (indicating thicker boundaries). This could have important implications for the wellbeing of people who identify as HSP.

Further planned analysis using multiple regression found both transliminality and boundary thinness positively predicted anomalous beliefs, with transliminality being the strongest predictor, but only transliminality predicted anomalous experiences and anomalous abilities. SPS did not significantly contribute to the model. Results of unplanned post hoc mediation analyses showed that transliminality mediates between SPS and anomalous belief, experience, and ability, and that boundary thinness mediates the relationship between SPS and anomalous belief. Therefore, while there is a relationship between SPS and aspects of anomalous experience and belief, it could be that transliminality and boundary thinness explains it. This finding provides further evidence confirming the significance of transliminality in relation to anomalous belief (e.g., Dagnall et al., 2022; Rock et al., 2021; Thalbourne & Storm, 2012) and adds credence to the proposition that the RTS should be the preferred measure to investigate transliminality, boundary-thinness, and unusual experiences (Thalbourne & Maltby, 2008).

However, there are several limitations to consider. First, while there were different ethnicities reported by participants, most of the sample consisted of people who identified as English/ Welsh/ Scottish /Northern Irish, therefore this shortcoming should be addressed in future research in relation to the generalisability of findings for more culturally diverse populations. Second, it is possible that additional variables may relate to SPS (in a similar way that

transliminality and boundary thinness do here), such as synaesthesia, schizotypy, introspection, and creativity, or may contribute to predicting AEs, that have not been considered in the current study or elsewhere. Transliminality and boundary thinness could explain a large amount of the variance provided by SPS. The high coefficients in the mediation model seemed to suggest this, so caution must be taken when delineating between SPS and transliminality and boundary thinness. Further research needs to be undertaken to explore this relationship further. Finally, all measures were self-report, which, while a common data collection tool in social sciences research, has disadvantages in terms of potential bias. Additionally, the anomalous abilities subscale of the AEI is assessing belief in one's own anomalous abilities (e.g., 'I am able to move or influence objects with the force of my mind alone') rather than an objective test of alleged ability. Future research aims to address this in experimental research with two further studies to investigate if measures of sensitivity predict accurate dream pre-cognition and better performance on a presentiment task.

Conclusion

This study contributes to the growing body of research on the temperament trait of Sensory Processing Sensitivity (SPS), in relation to its association with anomalous experiences, beliefs, and abilities, which has also been found in previous research. While this study is exploratory in nature, its main aim was to establish the role of SPS in relation to anomalous belief and experience. It highlights the important role of transliminality in mediating the relationship between SPS and anomalous experiences, beliefs, and abilities. A novel finding was that SPS is conceptually similar to transliminality and boundary thinness, suggesting further research is warranted to explore whether there is a unifying factor between these psychological constructs, which may explain individual differences in sensitivity.

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Authors contribution Elizabeth C. Roxburgh: Conceptualization, Methodology, Formal analysis, Writing - Original draft preparation, Writing - Review and Editing, Funding acquisition; David Vernon: Conceptualization, Methodology, Formal analysis, Writing - Review and Editing, Funding acquisition, Investigation; Malcolm B. Schofield: Conceptualization, Methodology, Formal analysis, Writing - Review and Editing, Funding acquisition.

Data availability The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request

Declarations

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

Conflict of interest The authors declare no conflict of interest.

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