SENSORY PROCESSING SENSITIVITY: EXPLORING THE SENSORY, PERCEPTUAL, AND EMOTIONAL EXPERIENCES AND BEHAVIOURS OF THE HIGHLY SENSITIVE PERSON.

by

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Dedications

I dedicate this thesis to my son, Bobby, and loving partner, William.
You are both the light of my life and encourage me to better myself every day.

Furthermore, I dedicate this to my younger self for persevering
through the hardships and always remaining dedicated.
You would be so proud of how far we have come.

Summary

The current thesis aims to advance the theoretical and empirical understanding of the temperament trait Sensory Processing Sensitivity (SPS). Since its discovery and development in 1997, much research has investigated the sensory, perceptual, and emotional behaviours and experiences associated with SPS, as well as its negative and positive outcomes. This research focuses specifically on three behaviours/experiences that, to the author's knowledge, have been under-researched. Study One explores the perceptual ability of Highly Sensitive Persons. This investigation tested the associations of SPS with the perception of visually degraded words. The study found that the positive facet of SPS positively correlated and predicted the detection and identification of degraded words, tested at three levels of difficulty. In Studies Two and Three, the dreaming experiences of Highly Sensitive Persons are investigated. In particular, a cross-sectional study of SPS, dreams, and nightmare experience was conducted, as well as a longitudinal study of how daily life emotions can impact on the emotions experienced in dreams. Finally, Study Four considers the avoidance of violence. Item 18 of the Highly Sensitive Person Scale states that high SPS is associated with the avoidance of violence in television shows and movies, although this item has received no empirical validation since the development of the questionnaire. Due to the potential impact of witnessing violence on the emotional experiences of Highly Sensitives, a behavioural investigation was conducted to explore responses to viewing violence in fictional movies and real-life videos. This study confirmed the validity of Item 18. Importantly, most studies in the thesis controlled for the Big Five traits, as SPS has been recently claimed to be solely a combination of openness to experience, neuroticism, and introversion. The thesis provides evidence of the separability of SPS from these traits.

Declarations and Statements

I confirm the current work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

This thesis is the result of my own investigations and other sources are acknowledged by explicit references.

I give consent for the thesis, if accepted for a research degree, to be made available for electronic sharing and for inter-library load (subject to the law of copyright) and for the title and summary to be made available to outside organisations.

The University's ethical procedures have been followed and ethical approval was obtained from Swansea University's School of Psychology Research Ethics Committee.

Signed .....  ..... (candidate)

Date .....11/05/24.....

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Abbreviations

SPS – Sensory Processing Sensitivity

HSPS - Highly Sensitive Person Scale

EOE – Ease of Excitation

LST - Low Sensory Threshold

AES – Aesthetic Sensitivity

PSR – Positive Sensory Responsivity

NSR – Negative Sensory Responsivity

HSCS – Highly Sensitive Child Scale

DOES – Depth of Processing, Overstimulation, Emotional Responsivity and Reactivity, and Sensitive to Subtleties

IAPS – International Affective Picture System

ASMR – Autonomous Sensory Meridian Response

ASD – Autism spectrum disorders

ADHD – Attention deficit hyperactivity disorder

OCD – obsessive compulsive disorder

SPD – Sensory Processing Disorder

PTSD – Post-traumatic stress disorder

ATQ – Adult Temperament Questionnaire

SPSQ – Sensory Processing Sensitivity Questionnaire

EVP – Electronic Voice Phenomena

SAE – Survey of Anomalous Experiences

SDT – Signal Detection Theory

Emo Bio – Emotional Perceptions of Biological Motion Task

RMET – Reading the Mind in the Eyes Test

BFI – Big Five Inventory

SDS – Social Desirability Scale-17

ms – Millisecond

ANOVA – Analysis of Variance

SD – Standard Deviation

M – Mean

REM – Rapid Eye Movement

TDQ – Typica Dreams Questionnaire

BQ18 - Boundary Questionnaire-18

STAI – State Trait Anxiety Inventory

MADRE – Mannheim Dream Questionnaire

DRF – Dream Recall Frequency

NMF – Nightmare Frequency

df – Degrees of Freedom

PSS – Perceived Stress Scale

ICC – Intraclass Correlation Coefficient

SWS – Slow Wave Sleep

UK – United Kingdom

PSQI – Pittsburgh Sleep Quality Index

SQI – Sleep Quality Index

DSM-5 – Diagnostic and Statistical Manual of Mental Disorders

ICSD-3 – International Classification of Sleep Disorders

IRT – Imagery Rehearsal Therapy

DCT – Dream Completion Technique

NHS – National Health Service

IAPT – Improving Access to Psychological Therapies

GAD-7 – Generalised Anxiety Disorder Assessment

PHQ-9 – Patient Health Questionnaire

WSAS – Work and Social Adjustment Scale

PCL-5 – PTSD Checklist for DSM-5

SPIN – Social Phobia Inventory

PDSS – Panic Disorder Severity Scale

OCI – Obsessive Compulsive Inventory

NAS – Nightmare Assessment Scale

RA – Research Assistant

TAU – Treatment as Usual

TV – Television

BBFC – British Board of Film Classification

DSMM – Differential Susceptibility to Media Effects Model

IFG – Inferior Frontal Gyrus

C-ME – Content-based Media Exposure Scale

ANCOVA – Analysis of covariance

Chapter 1. Introduction

Sensory Processing Sensitivity and the development of the Highly Sensitive Person Scale

Sensory Processing Sensitivity (SPS), the focus of this current thesis, is a personality trait, leading to heightened environmental sensitivity. SPS is unique as it is characterised by increased sensory awareness, empathy, ease of overstimulation, and creativity (Aron, 2010; Aron & Aron, 1997; Greven et al., 2019). As a susceptibility factor, individuals with high SPS, termed Highly Sensitive Persons, tend to experience negative stimuli more negatively and positive stimuli more positively than low SPS persons, thus SPS is described as a *for better or for worse trait*, in terms of Differential Susceptibility (Belsky, Bakermans-Kranenburg, & van Ijzendoorn, 2007; Ellis, Boyce, Belsky, Bakermans-Kranenburg, & Ijzendoorn, 2011). The sections in the current chapter will consider the early research surrounding SPS, the development of a measure of SPS, the typical characteristics and experiences of a Highly Sensitive Person, inconsistencies with the theory, and the importance of researching environmental sensitivity.

SPS was termed by Elaine Aron in the 1990s. She had sought a way to describe herself and individuals presenting similar difficulties within a therapeutic context. In her first book describing Highly Sensitive Persons (Aron, 1996), she details that the trait was first thought to be introversion (shyness, inhibitedness) but the research that followed demonstrated that SPS is more than just low sociability (which characterises introversion). Instead, it is a cautious approach to the environment due to an enhanced processing of social and sensory stimuli (Xiao, Baetens, & Deroost, 2024), particularly referred to as "a difference not in the sense organs per se but to something that occurs as sensory information is transmitted to or processed in the brain." (Aron & Aron, 1997, p. 347). Aron (1999) suggested that approximately 15% of the population, based on temperament research (Kagan, 1994), present these sensitivity differences in that they are more reactive and attentive to subtleties and easily stimulated. As a result of lower thresholds for stimulation, individuals experiencing high SPS may present as lower in sociability and higher in negative emotionality (Aron, Aron, & Davies, 2005).

Investigating this temperament trait, a series of seven studies were conducted by Elaine and Arthur Aron (Aron & Aron, 1997) with the aim of defining SPS and differentiating it from

existing traits such as introversion and negative emotionality. The first study recruited those who were "*either highly introverted… or easily overwhelmed by stimulation*" (p. 350), and they were interviewed about their background and their understanding of sensitivity. Questions provided to them referred to their preferences and experiences with, for example, environments, television, school, love, and friendships. A total of 39 individuals were interviewed. Participants also completed measures of personality, including the Myers-Briggs Type Indicator (Myers 1962), which found that 30% of these individuals were extraverted as opposed to introverted. The information from these interviews was used to develop a series of identifying scale questions, and six questionnaire-based studies were conducted to create a new scale as well as to test the associations between SPS and established trait measures. Across all studies, the SPS questionnaire was positively correlated with introversion (moderately) and emotionality (strongly), and strongly correlated with the two combined. The latter traits were measured using 2 to 4-item questionnaires, with items referring to, for example, "*Are you a tense or worried person by nature?*" (emotionality) and "*Do you recharge your batteries by being alone rather than in the company of others?*" (introversion).

SPS, captured by the newly devised measure, displayed unique relationships with sensitivity-related variables and familial closeness measures compared with introversion and emotionality, and with intense dreaming, daylight sensitivity, and being affected by films, as well as questions relating to attachment styles and to adverse childhood environments. The associations of these variables with SPS remained significant when emotionality and introversion were partialled out. Other relationships were found between SPS and stimulus screening (Mehrabian, 1976), measures of extraversion (Eysenck & Eysenck, 1968), and the combined Big Five personality traits (including neuroticism and extraversion measures). Additionally, two clusters of highly sensitives were revealed, the first smaller group experiencing adverse conditions during childhood, presenting as more introverted and emotional, and the second (larger group) having no troubles with childhood, sociability, or emotionality. This cluster analysis suggested, according to Aron (1999), that highly sensitive individuals have an underlying sensitivity (perhaps inherited) but can be uniquely affected by environmental influences.

The initial paper (Aron & Aron, 1997) highlighted four important findings. The first is the development of the 27-item Highly Sensitive Person Scale (HSPS), which was shown to have strong internal consistency (alpha values .85 in study 7 and .87 in study 6). The other three are

as follows: “[SPS] is related to but not identical with introversion” (p. 362), “[SPS] is related to but not identical with emotionality” (p. 362), and “[SPS] is not merely the combination of social introversion and emotionality” (p. 363).

Highly Sensitive Person Scale: Recent research and developments

Since the development of the HSPS over 20 years ago, the scale has been used in vast amounts of research and has been translated into numerous languages including Italian, Turkish, German, Russian, Polish, and Spanish (Baryla-Matejczuk, Poleszak, & Porzak, 2021; Chacón, Perez-Chacón, Borda-Mas, Avargues-Navarro, Lopez-Jiminez, 2021; Ershova, Yarmotz, Koryagina, Shlyakhta, & Tarnow, 2018; Konrad & Herzberg, 2019; Santona et al., 2023). This section summarises the recent developments of the HSPS, including the facets of SPS and debates about possible subscales, distinct sensitivity groups, and the development of the Highly Sensitive Child Scale.

Subscales of the Highly Sensitive Person Scale

Although Aron and Aron (1997) intended for the HSPS to be a unidimensional measure of trait sensitivity, the scale has been suggested to have three factors or subscales. These are Ease of Excitation (EOE), which refers to becoming overwhelmed by internal and external processes, Low Sensory Threshold (LST), defined by items referring to arousal in response to the environment, and Aesthetic Sensitivity (AES), which relates to an awareness and processing of subtleties. These components were first defined by Smolewska, McCabe, and Woody (2006), whose goal was to examine the psychometric properties of the HSPS with a larger sample than in the original study (Aron & Aron, 1997) and to also explore the associations of SPS with other constructs such as the Big Five personality traits and the Behavioural Inhibition System / Behavioural Activation System. They recruited 851 students, and selected half of the sample on which to perform a principal component analysis. A screen test indicated a three-component optimal solution, which was further confirmed by a confirmatory factor analysis using the other half of the student sample. In particular, 12 items contributed to EOE (e.g., Do you try hard to avoid making mistakes or forgetting things?), 7 items to AES (e.g., “Do you notice and enjoy delicate or fine scents, tastes, sounds, works of art?”), and 7 items to LST (e.g., “Do you become unpleasantly aroused when a lot is going on around you?”). Significant correlations were found between the factors as well as with the overall HSPS score.

Further research has confirmed a bifactor organisation of the HSPS. The first factor consists of total HSPS score, that is, all items of the scale considered together. The second factor constitutes the individual subscales which, although intercorrelated, represent different aspects of environmental sensitivity. For instance, Liss, Mailloux, and Erchull (2008) suggest that AES is conceptually distinct from LST and EOE. Whereby AES is thought to represent attention to detail (Sobocko & Zelenski, 2015) and reactivity to positive experiences in the environment (Pluess et al., 2023), EOE and LST act as personal vulnerability factors (Elst et al., 2019), such as becoming easily overwhelmed by sensory experiences, and exhibiting withdrawing behaviours (Liss et al., 2008).

Since the suggestion of the three subscales, further investigations of the HSPS have been conducted. Firstly, an amendment to the HSPS that has been widely adopted throughout the literature is one by Konrad and Herzberg (2019). The study aimed to test the psychometric properties of the German HSPS, collecting 3588 participants (84% Female). The HSPS was translated by two researchers, and then proofed by retranslating it into English. Twelve additional items were added, with thirty-nine items in total, measured on a 5-point Likert scale (instead of 7 points as original). Confirmatory factor analysis was performed on half of the sample, and then another on the other half. They confirmed the three-factor model (as according to Smolewska et al., 2006; AES, EOE, and LST) was the best fit, but with the removal of 13 items due to high factor loadings and intercorrelations. The result was a 26-item (German) version of the HSPS.

More recently, Tabak et al (2022) found a two-component solution to the HSPS, labelled as Positive Sensory Responsivity (PSR) and Negative Sensory Responsivity (NSR). The 19-item NSR represents a combined factor of EOE and LST, but with the exclusion of items 3 (“Do other people's moods affect you?”) and 17 (“Do you try hard to avoid making mistakes or forgetting things?”) due to low factor loadings. PSR is a 6-item subscale, with all items belonging to AES, except for item 5 (“Do you find yourself needing to withdraw during busy days, into bed or into a darkened room or any place where you can have some privacy and relief from stimulation?”), which loaded onto NSR and is included instead there. Item 5 describes the experience of overstimulation, namely reducing such stimulation by withdrawing, thus not fitting with the “aesthetic awareness” account of AES and corresponding more to NSR.

Evans and Rothbart (2008) were the first to find a two-component solution of the HSPS and, based on their construct theory of environmental sensitivity, these factors referred to their measures of "Orienting Sensitivity" and "Negative Affect" on the Adult Temperament Questionnaire (Evans & Rothbart, 2007). Orienting Sensitivity refers to perceptive, associative, and affective sensitivity (e.g., awareness of low-intensity stimuli, cognition, and affective awareness), whereas Negative Affect corresponds to sensory discomfort, affective control, negative emotionality, and low sociability. This study especially found the one factor model (Aron & Aron, 1997) to be unsatisfactory, and the three-factor (Smolewska et al., 2006) and two-factor solutions were found to be better, although the conceptual decision to use the two-factor solution was expressed by the authors. Tabak et al. (2022) state that PSR and NSR are "almost identical to those identified as 'Negative Affect' and 'Orienting Sensitivity'" (p. 9).

Evidence of sensitivity groups

Although SPS was measured continuously by the HSPS in Aron and Aron (1997), there is the subgroup of highly sensitives within the general population, termed by Aron, Highly Sensitive Persons. This was supported by Lionetti, Aron, Aron, Burns, Jagiellowicz, and Pluess (2018), who tested the unitary construct of the HSPS and potential differences between sensitivity groups on personality traits and emotional reactivity. In two studies, a total of 1136 participants were collected (906 in Study One, 230 in Study Two). Importantly, and in agreement with but extending the Highly Sensitive Person terminology, three distinct groups were revealed, referred to as "Dandelions" (lowest 30% of sensitivity), "Orchids" (top 30% of sensitivity), and "Tulips" (remaining 40% of individuals in the middle of scores). Prior to this research, a binary distribution of SPS was accepted such that there were "highly sensitives" who make up 15-20% of the population and "non-sensitives" or "low sensitives", the remaining 80-85%. However, these findings imply the existence of individuals who fall in the middle and who make up the majority. The authors also confirmed that the bifactor solution (overall score of HSPS as well as the three subscales) was significantly better than the three-factor solution (just the subscales), supporting the idea of a unidimensional measure of sensitivity in addition to the unique factors that constitute SPS. Secondly, associations between total SPS score, EOE, LST and neuroticism were found as well as between SPS and emotional reactivity.

Highly Sensitive Child Scale

The HSPS has been modified so that it can measure Environmental Sensitivity in children and adolescents, with the Highly Sensitive Child Scale (HSCS). Pluess, Assary, Lionetti, Lester, Krapohl, Aron, and Aron (2018) tested the psychometric properties and robustness of this scale in a series of five studies, based in the United Kingdom. Using 25 original items from the HSPS (two were excluded as they did not load onto any of the three factors of the scale), items with a factor loading of more than 0.5 were selected, resulting in a 12-item HSCS (5 items EOE, 4 items AES, 3 items LST). Across all studies, the scale ranged from alpha values of 0.71 to 0.79, suggesting good internal consistency between the items, and it was also found to have acceptable test-retest reliability. In addition, the bifactor model was once again confirmed, suggesting there is an overall measure of sensitivity as well as the three separate subscales, which is consistent with the findings of the 27-item adult HSPS. Finally, three distinct groups of sensitives as measured by the HSCS were identified, confirming a highly sensitive group contributing 20-35% of the population, a medium sensitive group of 41-47%, and a low sensitive group of 25-35%, similar but not identical to Lionetti et al.'s (2018) splitting of adult sensitivity.

Iimura and Kibe (2020) found that the Japanese version of the HSC presents similar findings and properties as the English version (Pluess et al., 2018). Their study found that highly sensitive adolescents benefited from positive transitional experiences compared with non-sensitives (specifically transitions across high school). Another study using the HSCS revealed that highly sensitive boys were more influenced by the positive effects of an anti-bullying campaign in UK schools, an effect that was not observed for low-sensitive boys (Nocentini, Menesini, & Pluess, 2018). Similarly, Pluess and Boniwell (2015) found that highly sensitive children were more likely to respond positively to an anti-depression programme, with highly sensitive girls having lower depression scores 12-months after the intervention than did low SPS girls and the control group. These studies demonstrate the importance of measuring SPS in children, to inform the understanding of how highly sensitive children and adolescents respond to their environments in terms of positive and negative reactivity.

In order to test the cross-cultural comparisons of the HSCS, Weyn et al. (2019) collected a sample of Dutch adolescents and administered a translated version of the HSCS. The study supported the bifactor structure of the HSCS as found in Pluess et al. (2018), however, the scalar invariance of the Dutch scale was not established across gender, developmental stage,

or country, suggesting that the Dutch version and the English version of the scales are not equivalent or measuring the same construct of sensitivity. To address this, Weyn et al. (2021) established a new HSCS with 26 additional items to measure child sensitivity, developed to capture the critical aspects of SPS such as depth of processing, emotional reactivity, and awareness of subtleties across the three facets of SPS. For this scale, there were 6 items relating to EOE (only one item added from the original as the internal consistency was highest for this domain), 16 items for LST, and 15 items for AES. Results implied a two-factor solution for 21-items, whereby once again there was a general sensitivity factor, but this time, two sub-domains were revealed. LST and EOE were combined to form one facet of SPS in this study, as items belonging to EOE generally loaded onto LST. AES was found to be distinct from this facet. This is supportive of Evans and Rothbart's (2008) theory of environmental sensitivity, finding two constructs representing negative reactivity (Negative Affect) as well as automatic attentional processes and awareness of detail (Orienting Sensitivity), and matching also Tabak et al.'s (2022) two components of positive and negative sensitivity.

The Environmental Sensitivity Framework

SPS is considered within the Environmental Sensitivity Framework, which describes differences between individuals in terms of their sensitivity to internal and external environments, as well as the responsivity and reactivity to these (Pluess, 2015), emerging due to both genetic and environmental factors (Pluess, 2015; Pluess & Meany, 2016). Sensitivity is a fundamental trait found in various species, believed to be a result of evolutionary adaptations, leading to a cautious "pause to check" approach to the environment (Aron & Aron, 1997) as opposed to "acting before thinking". The former individuals display a deeper processing of sensory information, but at the same time higher reactivity and responsivity to stimulation (Booth, Standage, & Fox, 2015), which may reflect differences in functioning of the central nervous system (Pluess, 2015). According to Wolf, van Doorn, and Weissing (2008), differences in responsiveness have both evolutionary costs and benefits and higher responsiveness early in life increases the probability of occurrence again later in life due to the higher associated benefits, according to the individual. Furthermore, Ellis and Boyce (2008) state that evolution tends to favour "adaptive phenotypic plasticity", structured by gene and environment interactions. Assary, Zavos, Krapohl, Keers, and Pluess (2021) reveal, using a large twin study of 2868 individuals, that sensitivity is approximately 47% heritable, with non-

shared environmental influences accounting for the remaining variance, supporting a gene-environment interaction, resulting in heightened sensitivity and reactivity to the environment.

The Environmental Sensitivity Framework encompasses three models of sensitivity: Differential Susceptibility, Biological Sensitivity to Context, and SPS. Firstly, Differential Susceptibility, originally proposed by Belsky (Belsky, 1997; 2005), refers to the susceptibility for individuals to experience and respond to adversity and positivity more intensely than others. Secondly, the theory of Biological Sensitivity to Context (Boyce and Ellis, 2005) states that early life experiences shape sensitivity, and both extremely supportive *and* adverse environments during childhood lead to increased reactivity later in life. The third, SPS, is a personality trait defined by an enhanced awareness of subtleties and increased depth of processing (Aron & Aron 1997), which impacts upon the way in which external and internal information is processed.

Differential Susceptibility, in line with the diathesis stress hypothesis (e.g., Ingram & Luxton, 2005) states that an individual who is increasingly vulnerable (perhaps due to their individuality, such as temperament, or genetics) is adversely affected by their environment, which, in turn, poses risks of developing negative symptomology (e.g., depression). Contrary to diathesis stress, however, Differential Susceptibility proposes that these same individuals increasingly experience positivity when in supportive contexts (Belsky & Pluess, 2009), a so-called "bright side of general environmental sensitivity" (Pluess, 2015, p. 41). As described in Belsky and Pluess (2009), "…some individuals appear more susceptible to the adverse effects of unsupportive contextual conditions and the beneficial effects of supportive ones" (p. 902), and there are many factors that impact differential responsivity (e.g., parenting, life events, and lifestyle factors), leading to certain outcomes (e.g., externalising problems, mental health symptomology), and the relationships between these environmental factors and outcomes can be moderated by susceptibility factors (e.g., temperament, genetics). For instance, Pluess, Belsky, Way, and Taylor (2010) found that responses to both positive and negative contexts are linked to the short serotonin-transporter-linked polymorphic region (5-HTTLPR) allele. Particularly, this allele has been associated with the experience of negative events in high neuroticism individuals, and positive events in low neuroticism. Furthermore, an interaction between genetic susceptibility and poor childhood environments and parenting has been demonstrated, resulting in vulnerability to negativity in adulthood (Keers & Pluess, 2017), as well as problems in childhood (e.g., externalising problems), but while also playing a protective

role when faced with positive environments (Bakermans-Kranenburg & van Ijzendoorn, 2011; Lionetti, Aron, Aron, Klein, & Pluess, 2019).

It has been recently theorised that Differential Susceptibility may result from the altered activity of and interactions between the salience, default, and central executive networks (Homberg & Jagiellowicz, 2022). Reactivity of the salience network provides strong expectations based on previous experiences, stored in the default network, which the brain can use to predict future experiences. If an experience does not meet these expectations, the salience network will attempt to receive further information regarding the necessary behavioural outcomes, and if needed, recruit the executive control network to drive attention elsewhere (Homberg & Jagiellowicz, 2022). This reactivity is thought to be exaggerated in sensitive individuals, and although this system is thus negatively biased with high sensitivity, interventions can aid in promoting a focus on positivity and positive responses.

Alternatively, Biological Sensitivity to Context proposes a hypothesis of stress reactivity, in that early adversity is curvilinearly associated with reactivity, producing highly reactive individuals ("orchids"; Ellis & Boyce, 2008) in both stressful *and* protective environments (Boyce & Ellis, 2005). As with Differential Susceptibility, this hypothesis is thought to be an evolutionary advantage as "…BSC increases adaptive competence in highly *stressful* environments by augmenting vigilance to threats and dangers and in highly *protective* environments by increasing susceptibility to social resources and ambient support." (Boyce & Ellis, 2005; p. 272). A study of 338 children measured autonomic and adrenocortical stress responses and captured information on family structure, family stress, parenting style (restrictive parenting), and economic condition. Overall, the findings revealed support for a curvilinear association between family adversity and heightened stress responses (Shakiba, Ellis, Bush, & Boyce, 2020).

Behaviours, characteristics, and experiences of Highly Sensitive Persons

Depth of Processing, Overstimulation, Emotional Responsivity and Reactivity, and Sensitive to Subtleties (DOES)

Elaine Aron (Aron, 2010) explained SPS as having four core features, described by the "DOES" acronym: Depth of Processing, Overstimulation, Emotional Responsivity and Reactivity, and Sensitive to Subtleties.

Depth of Processing: Depth of processing refers to the ability of highly sensitives to perceive and process internal and external information more deeply. An enhanced attentional awareness of environmental cues may have perceptual benefits, such as the ability to perceive meaning within random noise (Williams, Carr, & Blagrove, 2021). Evidencing this depth of processing, Jagiellowicz et al. (2011) tested the association between brain activations and SPS while completing a change detection task. Participants viewed a series of scenes, some with minor changes and some with major changes, controlling for neuroticism and introversion: high SPS individuals spent longer responding to minor compared with major changes to the presented images. These responses to minor changes were associated with heightened activations of functional brain areas related to visual attention, including the right temporoparietal cortical junction, intraparietal sulcus, and middle frontal gyrus. Supporting this, Acevedo et al. (2014) demonstrated activations of the visual and attention areas during an emotional recognition task involving photographs of romantic partners and strangers, and Acevedo et al. (2017) also supported such depth of processing through brain activations of these regions, specifically in response to emotional stimuli. Furthermore, a recent study demonstrated heightened connectivity between brain structures implicated in memory, cognitive processing, and emotion processing, as a function of high SPS (Acevedo, Santander, Marhenke, Aron, & Aron, 2021).

Overstimulation: Highly Sensitive Persons are susceptible to overstimulation, as assessed by HSPS items referring to the need to be alone after stimulating episodes. Van Reyn, Koval, and Bastian (2023) measured daily diaries across a period of twenty-one days to capture highly sensitives' reactions to negative and positive daily events. The analyses found that HSPS score, in response to subjective negative events, was associated with decreased perceived well-being, self-esteem, self-efficacy, and coping ability, and that these associations were driven by the negative subscales of EOE and LST. However, no significant effects of positive daily events were found for positive reactions, although this could be due to subjective bias of recalling positive and negative events, in that negativity is exaggerated amongst highly sensitives (Weyn et al., 2022). Reactivity to negative emotional cues could thus be a function of emotion dysregulation, such as a lack of regulation strategies and disrupted acceptance over negative emotionality, which can result in psychological distress (Brindle, Moulding, Bakker, and Nedeljkovic, 2015; Eskisu, Agirkan, Celik, Yalcin, & Haspolat, 2021).

Emotional Responsivity and Reactivity: There is considerable literature describing the emotional reactivity and responsivity of Highly Sensitive Persons, and this feature can be considered in terms of how highly sensitives react to emotional stimuli, as well as how these experiences can benefit the individual (e.g., increased empathy to others). Specifically, highly sensitives have been shown to respond quicker to emotional images from the International Affective Picture System (IAPS), as well as to rate these as more positive or negative, depending on valence (Jagiellowicz, Aron, & Aron, 2016). Also, the higher-order processing of emotional stimuli in the environment has been evidenced as a feature of high SPS by Hoffman, Marhenke, and Sachse (2022), in a study in which forty-four participants took part in an emotional and classic anti-saccade paradigm. This method involved participants focusing their eyes on the opposite side of a screen to a cue (either a neutral stimulus or an emotional face). Performance, reaction times and error rates were calculated. Results showed that SPS predicted reaction times during the emotional task, beyond mood and depression, and especially for sad faces. Considering positive emotional responsivity, research conducted by Acevedo and colleagues (Acevedo et al., 2014; Acevedo et al., 2017) has evidenced, with the use of brain imaging, a greater processing of emotional faces (especially of related individuals, e.g., romantic partners) amongst high SPS individuals (Acevedo et al., 2014), as well as increased activation of areas associated with reward-processing and calmness in response to positivity.

In terms of Differential Susceptibility (Pluess, 2015), SPS can thus be considered a trait that leads to the experience of heightened positive and negative emotions, in response to contextual environments (Paola, Nocentini, & Lionetti, 2022; Pluess, Lionetti, Aron, & Aron, 2023). Over the course of a month, Iimura (2021) asked adolescents to provide two significant events that had occurred each week, and each event was rated in terms of how positively or negatively it had affected the individual. Measures of socioemotional well-being were also captured. Supporting Differential Susceptibility, when events were negative, SPS was considered a vulnerability factor for lower well-being, while highly sensitive individuals also benefited from positive events, suggested to be "vantage resistance". Iimura (2021) suggests that SPS should be viewed as a "susceptibility" trait, rather than a "vulnerability trait". In addition, Pluess et al. (2023), using a brief version of the HSPS, found that newly qualified teachers exhibited detriments to well-being due to their stressful, first year of teaching. In an additional study, however, highly sensitive undergraduate students displayed an increase in positive mood following a happy video, and this effect was greater than for low sensitives. Li and Davies

(2021) revealed that better conditions support the cognitive and behavioural functioning of children with high SPS, and Lionetti et al. (2022) also show that high parental closeness (i.e., supportive home environment) for highly sensitive children is linked to a decrease in internalising behaviours.

Sensitive to Subtleties: Similar to depth of processing, Highly Sensitive Persons seem to be more aware of environmental subtleties. This does not necessarily involve heightened primary senses, but instead an increased processing and response to such stimuli. For instance, Jagiellowicz et al. (2024) found a positive relationship between SPS and sensitivity to medication. This sensitivity may also refer to the possibility of perceptual advantage of high SPS, that is the ability to filter and accurately process important sensory information, such as touch and perceptual information (Schaefer, Kühnel, & Gärtner, 2022); Williams et al., 2021; discussed in Chapters 2 and 3). Interestingly, individuals who experience increased Autonomous Sensory Meridian Response (ASMR) are also shown to be higher in Environmental Sensitivity; ASMR is typically described as a strong, positive, and emotional response to sensory stimulation (Poerio, Hostler, & Man, 2021). Another example of such subtle sensitivity is the ability to sense others' emotions and intentions, in terms of empathy (Acevedo et al., 2018; Chacón et al., 2024; discussed in Chapter 7), enabling highly sensitives to interpret and respond appropriately to social cues.

Differences between SPS and mental health, neurological, and neurodevelopmental disorders

The SPS literature, including Aron (2010) has been concerned with distinguishing high SPS from pre-existing mental health, neurological, and neurodevelopmental disorders, such as autism spectrum disorders (ASD), attention deficit hyperactivity disorder (ADHD), obsessive-compulsive disorder (OCD), and Sensory Processing Disorder (SPD).

SPD as opposed to SPS, is a neurological disorder in which sensory input is not appropriately processed to provide responses to environmental stimuli and can be a symptom of other disorders such as ASD. In other words, SPD can result in a lack of responsivity. In addition, symptoms of ASD include poor social skills, heightened attention to detail, and poor communication ability (Liss, Mailloux, & Erchull, 2008), as well as an increased sensitivity to visual, auditory, and tactile stimulation. Although SPS is associated with heightened autistic traits (Assary et al., 2024), distinctions between the two have been revealed. Acevedo, Aron,

Pospos, and Jessen (2018) conducted a review of fMRI studies to investigate the differences in brain function between SPS, ASD, post-traumatic stress disorder (PTSD), and schizophrenia. SPS, ASD, and PSTD shared increased activations of brain areas involving reward processing, attention, reflective thinking, and cognitive control, suggesting commonalities in structures involved in hyper-sensitivity, possibly explaining overlaps in specific features of related disorders. Unique to SPS, however, were activations shown for reward processing in response to positivity, hormonal balance, calmness, empathy, reflective thinking, and self-control, with the authors implicating these regions as distinguishing SPS from ASD, PTSD, and schizophrenia.

Sensory Processing Sensitivity and relationships with mental health

There are many detriments to high SPS noted in the literature, including the vulnerability to developing mental health symptomology. The susceptibility to mental health disorders is discussed in Chapter 6. In summary, SPS is shown to be related to psychological distress (Brindle et al., 2015), poor mental well-being (Carr et al., 2020; Black & Kern, 2020), depressive tendencies (Eskisu et al., 2021; Liss, Timmel, Baxley, & Killingsworth, 2005; Yano, Kase, & Oishi, 2019), trait anxiety (Eskisu et al., 2021; Khodarahimi, Minderikvand, & Amreal, 2021; Takahashi, Kawashima, Nitta, Kumano, 2020), stress (Benham, 2006; Redfearn, van Ittersum, & Stenmark, 2020), PTSD (Karam et al., 2019), and negative symptomology such as nightmares (Carr et al., 2020).

Highly Sensitive Persons are also shown to be susceptible to negative experiences in everyday life. SPS is linked to stress and burnout in a sample of nurses (Redfearn et al., 2020), and burnout and compassion fatigue amongst healthcare and education workers (Perez-Chacón, Chacón, Borda-Mas, & Avargues-Navarro, 2021). Benham (2006) evidenced the links between negative physical health and symptoms of stress amongst Highly Sensitive Persons, supporting subsequent research finding that highly sensitives experience increased gastrointestinal issues, such as indigestion, diarrhoea, reflux, and constipation (Iimura and Takasugi, 2022). SPS is also considered a risk factor for dysfunction amongst highly sensitive children in everyday life, impacting sleeping and eating, as well as unexplained physical symptoms (Boterberg & Warreyn, 2016). Moreover, above stressors, emotionality, and demographics, mothers high in SPS report heightened difficulty with parenting (Aron, Aron, & Zhou, 2019).

Benefits of being Highly Sensitive

Contrary to the negative outcomes of high SPS, there are also benefits of being a Highly Sensitive Person. SPS can serve as a protective factor in adulthood, regardless of exposure to adverse environments during childhood (Paola, Nocentini, & LIonetti, 2022), with highly sensitives disproportionately benefiting from positive environments when compared with low sensitives (Iimura & Kibe, 2020). Importantly, recent work shows that high SPS has differential impacts on memory and learning (Marhenke, Acevedo, Sachse, & Martini, 2023). During this investigation, participants were given two-word lists during two separate encoding tasks. One task was followed by a period of rest, and the other with a distraction task. Seven days later, participants recalled the lists. After seven days, SPS predicted better performance in recalling the lists of words if they had actively rested after the task, thus implying improved recall of memory for Highly Sensitive Persons when allowed to process such information. Consequently, however, the distraction task caused a decrease in memory ability for high SPS participants, at the seven-day recall period, therefore suggesting a supportive effect of SPS on memory when individuals can process the task without distraction.

Referring to everyday life, Highly Sensitive Persons are thought to have high entrepreneurial intention (a state of mind that diverts action and attention towards entrepreneurial behaviours; Moriano et al., 2012) and are able to see and approach opportunities (Harms, Hatak, & Chang, 2019). Corroborating these findings, SPS may amplify the relationship between job resources and helping behaviour, overall promoting helping behaviour and responding accordingly to positive workplace environments (Elst et al., 2019).

Also, discussed in Chapter 7, highly sensitives may be more empathetic towards other people, due to their enhanced emotional processing. They are also thought to be more creative (Bridges & Schendan, 2018), with an eye for detail, heightened appreciation of subtleties (such as fine scents, tastes, sounds, and works of art; Aron & Aron, 1997; Aron, 2010; Dunne, Lionetti, Pluess, & Setti, 2023), and a complex connection to their inner self (Aron & Aron, 1997). Furthermore, Highly Sensitive Persons may benefit more from psychological interventions, including preventative interventions for mental health (Pluess & Boniwell, 2015), well-being (Amemiya et al., 2020), anti-bullying (Nocentini, Menesini, & Pluess, 2018), and positive school transitions (Iimura & Kibe, 2020). These are considered in Chapter 6.

Perceptions of being Highly Sensitive

The majority, if not all the literature discussed in this Introduction has quantitatively considered the experiences of Highly Sensitive Persons, except for the initial investigation to develop the HSPS, which was based on interviews with those who considered themselves highly introverted or high in emotionality. To the author's knowledge, only two subsequent studies have considered the qualitative experiences of those with high SPS.

The first study is Bas et al. (2021), who interviewed twenty-six adults who considered themselves highly sensitive. To measure high sensitivity, they used the HSPS as well as a new questionnaire by De Gucht and colleagues (De Gucht, Woestenburg, & Wilderjans, 2022; see section "Addressing Possible Inconsistencies with the Highly Sensitive Person Scale" below); the Big Five personality traits were also captured. Semi-structured interview guides were created, asking open-ended questions about the key characteristics of SPS, and participants' perceptions of these characteristics and experiences. Questions regarding well-being and psychological problems were also discussed. Five themes (and corresponding subthemes) were discovered during the analysis, these being emotional responding, relatedness to others, thinking, overstimulation, and perceiving details. Global SPS aspects were also discussed. Firstly, emotional responding refers to the experience of and responses to negative emotions and positive emotions and needing more time to process such emotions. Secondly, relatedness to others was revealed to have five subthemes, which corresponded to noticing and understanding others' emotions and intentions, paying close attention to others, empathetic actions, and a feeling of connectedness to others. Thirdly, worrying and ruminating, self-reflection and thinking, and individuals requiring meaning were found for "thinking". Fourthly, these individuals reported overstimulation in response to sensory and social stimuli, as well as negative effects of overstimulation on cognitive processing and mood regulation. The fifth theme, perceiving details, referred to taking in a greater quantity of information and perceiving information in greater detail. Finally, as a global aspect, participants felt different because of their high sensitivity, resulting in low self-esteem, and they felt more stressed and tired as a result of being highly sensitive.

The second study is Roth et al. (2023), who conducted interviews with 38 self-identified highly sensitives, using an interview guide split into ten sections of open-ended questions. Questions included "How would you define high sensitivity?" and "How do highly sensitive people differ from less sensitive people?" Analysis revealed, once again, core features of being a Highly

Sensitive Person. Participants defined high sensitivity as having "…an altered response to emotional stimuli" (p. 7), including empathic responses, and inability to block out emotional stimuli. Furthermore, consequences of SPS were described in terms of exhaustion, overstimulation, and becoming overwhelmed, and coping strategies were highlighted to reduce negative outcomes. Participants explained how learning about high sensitivity led to self-acceptance, and a greater ability to understand their feelings and experiences.

The findings of Bas et al. (2021) have important implications on researching SPS, as the experiences and key characteristics of high SPS are confirmed through qualitative investigation involving self-identified highly sensitives. The themes also confirm theories of SPS, such as enhanced emotional processing and depth of processing, perceiving subtleties, and overstimulation in response to the environment. However, Roth et al. (2023) argue that, although they found core characteristics of being highly sensitive, this could be due to frequent mentions of SPS in social media and popular scientific literature. The findings imply that although SPS overlaps with the negatively perceived traits of neuroticism and introversion, individuals can adopt a label of "Highly Sensitive Person" to describe that they feel different from others in a positive sense, rather than using terms that have negative connotations ("neurotic" or "introverted"). This is further discussed in the next section.

Sensory Processing Sensitivity and the Big Five personality traits

Theories of personality consider a range of traits that determine individual differences, and one theory that has dominated the field in recent decades (Feher & Vernon, 2021) is that of the Big Five Personality Traits (Costa & McCrae, 1982; McCrae & John, 1992; John & Srivastava, 1999). The traits that constitute this model are neuroticism (stable versus neurotic), agreeableness (agreeable versus hostile), conscientiousness (spontaneous versus conscientious), extraversion (introverted versus extraverted), and openness to experience (open versus closed) These are suggested to be approximately 41-61% genetically determined (Jang, Livesley, & Vernon, 1996), although a more recent study concluded that only openness and neuroticism are heritable (Power & Pluess, 2015). The definitions of each trait are as follows:

- Neuroticism is "the tendency to experience frequent, intense negative emotions with a sense of uncontrollability (the perception of inadequate coping) in response to stress" (Barlow et al., 2014, p. 481).

- Conscientiousness is the tendency to follow social norms and be goal-directed (Roberts et al., 2012). Behaviours of conscientious individuals typically include being clean and tidy, working hard, planning, following the rules, thinking before acting, and being well-organised (Jackson et al., 2010).
- Agreeableness reflects an individual's ability to act pro-socially, maintain relationships and work in harmony with others, and have personal characteristics of being empathetic, kind, and cooperative (Graziano & Eisenberg, 1997).
- Extraversion, in contrast to introversion, refers to the need and requirement for external satisfaction, such as from sociability. Extraverts tend to be warm and positive, dominant, and are adventure seeking (Saklofske, Eysenck, Eysenck, Stelmack, & Revelle, 2012). On the other hand, introverted individuals are pleased by their mental, inner self and are more reserved.
- Openness to experience tends to relate to multiple facets of behaviour, including the dimensions of having an active imagination, sensitivity to aesthetic experiences, attentiveness to feelings, and intellectual curiosity (Costa & McCrae, 1992).

The Big Five traits can be measured at the domain level, that is, an overview of each trait. For instance, the 44-item Big Five Inventory (John, Donahue & Kentle, 1991; John & Srivastava, 1999) provides between eight and ten items referring to each individual trait, which are summed to give a total score for each trait. They can also be measured using more extensive questionnaires that capture the facet level of each independent trait, that is, the different elements that constitute each personality trait, e.g., hostility and self-consciousness facets of neuroticism, and fantasy and aesthetics facets of openness to experience (Costa & McCrae, 1992).

Since the development of the HSPS, studies have investigated the associations between SPS and the Big Five traits. HSPS score (overall) and the subscales of the HSPS have been claimed to be differentially related to neuroticism, introversion, and openness to experience, such that AES is associated with openness to experience, and total HSPS score, EOE, LST and AES are associated with neuroticism (e.g., Bröhl et al., 2021; Chacón et al., 2024; Grimen & Diseth. 2016; Lionetti et al., 2024; Smolewska et al., 2006; Yano et al., 2019). Although (negative) correlations between extraversion and EOE and LST have been demonstrated, such as in Grimen and Diseth (2016) and with a Japanese sample of participants (Yano, et al., 2019), a meta-analysis revealed no relationship between SPS and

extraversion, conscientiousness, or agreeableness (Lionetti, Pastore, et al., 2019), thus, the evidence for the association between SPS and extraversion is weak. Corroborating this, Bröhl et al. (2021) concluded that agreeableness and conscientiousness are less likely attributes of the Highly Sensitive Person's personality but did find evidence that AES is associated with facets of openness (e.g., creativity, curiosity, and expressiveness), whereas LST and EOE present relationships with the shyness, irritability, and anxiety facets of neuroticism.

Recently, there have been claims that SPS, as measured by the HSPS, is inseparable from the Big Five, particularly neuroticism, introversion, and openness to experience, due to the overlap in definitions, behavioural outcomes, and the strong relationships found by previous research (Hellwig & Roth, 2021; Roth et al., 2023). For instance, openness to experience and AES are closely linked, perhaps because open individuals, as well as high AES individuals, tend to be more creative and have an appreciation of aesthetic experiences (Aron & Aron, 1997; Aron, 2010; Bridges et al., 2019). Furthermore, high SPS tends to be characterised by an aversion of negativity and enhanced processing of emotional events, and experience of stress (Aron & Aron, 1997; Benham, 2006; Grimen & Diseth, 2016; Redfearn, van Ittersum, & Stenmark, 2020), thus overlapping with neuroticism. The evidence to suggest a clear relationship between SPS and introversion, however, is limited (Schaefer et al., 2022). Although there are similarities between the behaviours of introverts and Highly Sensitive Person, Highly Sensitive Persons may simply be more likely to possess introverted behaviours due to their enhanced processing and awareness of social stimuli. Interestingly, not all highly sensitives are introverted, an estimated 30% are extraverted (Aron, 2010).

When developing the HSPS, Aron and Aron (1997) recruited individuals who were "either highly introverted… or easily overwhelmed by stimulation" (Aron & Aron, 1997, p. 350) to be interviewed about high sensitivity. Behaviours, feelings, and reactions of these introverted and reactive individuals were the initial grounding for the items of the HSPS. To control for these traits, the authors included a set of questions relating to social introversion (e.g., "Do you avoid crowds (at malls, carnivals, fairs, etc.)?"), and negative emotionality (e.g., "Are you prone to fears?"), and when testing for the relationships between the constructs, the HSPS was found to be unique of social introversion and emotionality, with correlations "clearly well below unity" (p. 362). However, items still share commonalities with the Big Five personality traits, for instance, "Are you conscientious?" (conscientiousness), "Do you notice and enjoy delicate or fine scents, tastes, sounds, works of art?" (openness), "Do you find yourself needing

to withdraw during busy days, into bed or into a darkened room or any place where you can have some privacy and relief from stimulation?" (introversion), "Do changes in your life shake you up?" (neuroticism) (Roth et al., 2023).

Supporting this inseparability, Hellwig and Roth (2021) assert that SPS has increased in popularity due to the re-definition of certain negative traits and socially undesirable behaviours (i.e., neuroticism and introversion) as positive attributes. Additionally, the authors caution that the theory is inconsistent in terms of definitional elements and behavioural outcomes of the trait, such as depth of processing, shyness, and inhibited behaviour. In other words, they pose the questions, what are defining elements of the trait, and what are the behavioural outcomes? Exploring the distinguishability of SPS from existing personality traits mentioned, Hellwig and Roth (2021) conducted an experiment with 289 participants (study one) and 226 participants (study two), using the NEO PI-R (Costa & McCrae, 1992) and German HSPS (Konrad & Herzberg, 2019). Confirmatory factor analysis, with three models to estimate latent variable correlations between the subscales of HSPS and the Big Five (facet level of neuroticism and extraversion), found a high correlation between EOE and neuroticism (r = .91), as well as a negative correlation between EOE and extraversion, and a correlation of near one between AES and openness to experience. From these results, they summarise that LST is the only element of SPS that is distinct from pre-existing personality traits, although it could be a mix of neuroticism and extraversion. Study two replicated these findings. Their overall conclusion was that the "empirical basis for SPS is currently weak" (p. 10) and that SPS is not an entirely new personality construct. It is therefore necessary to expand the research on SPS and the Big Five personality traits, to test for the separability of SPS from other facets of personality, as the literature is clearly not yet sufficient in determining such distinction.

On the other hand, limitations of Hellwig and Roth (2021) should be considered. The authors employed item parcelling as a strategy to reduce model complexity, and measures were taken to minimize biases by using random item-to-parcel allocations and summarising across 1000 random allocations. However, the lack of convergent validity between EOE and AES introduce concerns regarding the effectiveness of parcelling. The high correlations between AES and openness to experience could reflect parcel-level aggregation, rather than a genuine reflection of how these constructs are related (MacCallum & Austin, 2000). Parcelling simplifies the data and can distort true relationships between latent constructs. Also, there is no indication that the authors assessed the unidimensionality of the factors, prior to parcelling (Little et al., 2002).

Without evaluating if the factors items reflect an underlying construct, item-parcelling methods may misrepresent the relationships between latent variables and thus limits the conclusions regarding the associations between SPS and the Big Five.

Addressing possible inconsistencies with the Highly Sensitive Person Scale

In attempts to address these issues, amendments to measures of SPS and Environmental Sensitivity have been made in subsequent papers, including removal or additions of items to the HSPS, and entirely new questionnaires.

Firstly, a recent paper by Attary and Ghazizadeh (2021) explored measures of the Big Five personality traits, depression, shyness, autism, alexithymia, and SPS and found two distinct clusters consisting of positive (cluster one) and negative (cluster two) traits. Although SPS belonged to the negative cluster, scores showed positive correlations with both positive and negative clusters, proposed to be due to the subdomains of SPS (EOE, LST, and AES). Investigatory analyses revealed AES held associations in the positive cluster and EOE and LST had strongest correlations and remained within the negative cluster. Scores on AES had closest relationships with openness to experience and conscientiousness and LST/EOE were closest to neuroticism, shyness, and alexithymia. This was also confirmed by analysing the individual items of the HSPS (not just the total score of the subscales). The authors suggest, overall, that SPS should be considered a spectrum trait at which an individual can score across, rather than falling into either positive or negative categories. The paper also found that specific items of the scale were not statistically separable from pre-existing personality traits, for example, items 12 and 17 were not separable from conscientiousness. Removing 11 items from the scale, creating a 16-item HSPS, resulted in a Cronbach's alpha value of 0.92 compared with 0.82 for the original 27-item scale. However, the authors had thus removed all items referring to positive sensitivity (AES), as these were inseparable from the construct of openness to experience, meaning the questionnaire loses measures of core aspects of SPS, such as depth of processing, empathy, and aesthetic awareness. As well as this, the questionnaire was translated into Persian and back translated into English for reporting. The result of this is that some wordings were altered from the original English questionnaire to the final 16-item HSPS reported in this paper, such as item 10 reading "I am deeply inspired by art and music" instead of "Are you deeply moved by the arts or music?" and item 12 "I am a conspicuous person" instead of "Are you conscientious?". This questions whether the two scales (full HSPS and 16-item HSPS) are truly measuring the same construct of SPS. Another important example of this

is the translation of item 2 which states “In my opinion, I notice the existing elegance and beauty of my circumference.” This is very different to the original, “Are you aware of subtleties in your environment?”, an item referring to one of the core aspects of being a highly sensitive person, increased depth of processing. For a table of items in Attary and Ghazizadeh (2021), see Appendix A.

Secondly, Pluess et al. (2023) tested a new 12-item version of the HSPS (HSP-12) in a series of five studies. This scale includes 12 of the original 27-items. Correlation between the two was found to be $r = .94$, and the Cronbach’s alpha value was lower (0.78) for the shorter version than the normal HSPS. Supportive of the previous findings of associations between SPS and the Big Five personality traits (Bröhl et al., 2021; Grimen & Diseth. 2016; Smolewska et al., 2006; Yano et al., 2019), the highest associations of the total HSP-12 were found for neuroticism, particularly the facets of vulnerability and anxiety, and this was also strongest for the subscale of EOE. Openness was also closely related to AES, especially the facet of artistic interests. The authors conclude from these findings that the associations with SPS (as measured by the new HSP-12) support the notion that environmental sensitivity is manifested by reactivity to both negative and positive experiences. Lionetti et al. (2024), while testing the HSP-12 cross-culturally, found it has good psychometric properties, and confirmed its associations with the Big Five. Importantly, these authors found that SPS, measured by this short scale, was distinct from these traits, opposing the ideas of Hellwig and Roth (2023).

Finally, De Gucht, Woestenberg, and Wilderjans (2022) recently created a new measure of environmental sensitivity “that maps not only negative but also a broad range of positive aspects of sensory processing sensitivity” (p. 2), referred to as the Sensory Processing Sensitivity Questionnaire (SPSQ). The aims of the authors were to develop and validate the questionnaire and investigate its relationship with the pre-existing sensitivity measures of the HSPS and the Adult Temperament Questionnaire (ATQ; Evans & Rothbart, 2007). In order to create the scale, a series of pre-existing questionnaires were highlighted, and relevant items referring to dimensions of the scale were selected, including those belonging to, for example, the HSPS, ATQ, Sensory Hypersensitivity Scale (Dixon et al., 2016), and Body Consciousness Scale (Miller, Murphy, & Buss, 1981). The SPSQ presents six different dimensions arranged within a positive and negative domain, with each dimension measuring different aspects of high sensitivity. The dimensions are “emotional and physiological reactivity”, “sensory discomfort”, “sensitivity to (subtle) internal and external sensory stimuli”, “social affective

sensitivity", "aesthetic sensitivity", "and sensory comfort/pleasure". Their findings revealed that HSPS score, EOE and LST had strong correlations with the negative dimensions of emotional and physiological reactivity, sensory discomfort, and the overall negative domain, and moderate to strong associations were revealed between the HSPS and HSPS subscales and the positive domain, as well as "affective sensitivity", "social-affective sensitivity", and "sensitivity to subtle internal and external sensory stimuli". Also, moderate to strong correlations were found for AES and all dimensions of the SPSQ, especially highly with the "aesthetic sensitivity" dimension. "Sensory comfort" held the weakest relationships with the subscales of the HSPS, with coefficients of $r = .06$ with EOE, $r = .07$ with LST, $r = .13$ with total HSPS score, and $r = .34$ with AES. Correlations were also revealed between the SPSQ dimensions and the Big Five personality traits. Overall, these findings suggest multiple factors that constitute the trait of SPS, with a clear distinction between a positive and negative aspect, and the authors emphasise the importance of considering not only these two domains, but the six individual dimensions when measuring SPS. Recently, the SPSQ has been shortened to a 26-item version (SPSQ-26; De Gucht & Woestenburg, 2024), which resembles the original HSPS in terms of length and includes all six dimensions, which are arranged within the two higher-order domains of positive and negative sensitivity. The full SPSQ has also been translated into Spanish (Salinas-Quintana et al., 2024).

The SPSQ seems to address issues with the HSPS that have been identified previously. For instance, Greven et al. (2019) suggests that "cardinal characteristics" of being a Highly Sensitive Person are not fully accounted for by the HSPS, and even includes here enhanced depth of processing, which describes the Highly Sensitive Person's ability to detect and process sensory information more deeply. The SPSQ's dimension of sensitivity to subtle internal and external sensory stimuli could resolve this issue, due to the addition of items such as "I am often aware of hardly noticeable things in my environment", "I often notice weak odours", and "It usually strikes me when the tone of a person's voice does not match his or her words." Furthermore, the positive aspects of being a Highly Sensitive Person were captured only by 7 items on the AES subscale of the HSPS. The SPSQ, on the other hand, includes a more thorough overview of the positive aspects of being a Highly Sensitive Person, such as noticing subtleties in music, elicitation of positive feelings, enjoyment of activities, and social and empathic awareness. Thus, the inclusion of this questionnaire as an additional measure of SPS would benefit the research on what it means to be a Highly Sensitive Person, including any behavioural validation of SPS moving forward. However, further in-depth analysis of the

validity and reliability of the scale cross-culturally is firstly necessary, as only Dutch subjects were included in their sample.

The importance of researching Sensory Processing Sensitivity

Although SPS is being more widely researched in current years, there still remain misunderstandings regarding the trait, regarding what characterises a Highly Sensitive Person, and how to measure such sensitivity. SPS can thus be confused for mental health and neurodevelopmental conditions (e.g., depressive tendencies, anxiety, ADHD and ASD), and might be inseparable from the pre-existing, negatively perceived personality traits of neuroticism and introversion, as well as openness to experience. Additional research will therefore help in clarifying overlaps with the Big Five personality traits. Also, raising awareness of the existence of SPS through research of the consequences, and benefits of being highly sensitive is important. This awareness can be an advantage for individuals in everyday life, for example, by enabling highly sensitives to become aware of why they experience certain reactions to environmental stimuli, and, in this way, behaviour change can be promoted, such as implementing coping strategies. In addition, awareness is important in therapy settings, as SPS can be confused with and lead to the development of negative mental health symptomology. Thus, alerting a therapist to such high sensitivity, and certain experiences and behaviours that may result, can aid in developing unique treatment plans.

Summary: Thesis aims

The current thesis aims to explore the behaviours and experiences of the Highly Sensitive Person, to inform the literature of how these individuals differ in terms of real-world experiences. Three topics of interest were investigated. Firstly, the perceptual experiences of Highly Sensitive Persons were explored, to determine their unique sensory and perceptual interpretations of the environment. Secondly, the thesis considers dreaming and nightmares, with a lack of research on dreaming and SPS, and nightmares being a real-world consequence of being high sensitivity especially when presenting as symptoms of mental health conditions. Finally, the viewing and avoidance of violence was studied, which is an additional consequence of SPS. Each of these topics enhances the understanding of certain mechanisms for negative experiences (e.g., overstimulation), while also shifting the focus to the positive aspects of being highly sensitive (e.g., increased empathy, adherence to treatment

programmes); overall, these insights will prove useful in improving the daily lives of Highly Sensitive Persons.

Perception and Sensory Processing Sensitivity

Chapters 2 and 3 aim to investigate the hypothesised perceptual advantage of Highly Sensitive Persons. Gerstenberg (2012) found that SPS is related to a greater awareness of subtleties in the environment, highly sensitive participants being less prone to errors during a detection task. In support of this, Williams et al. (2021) investigated such perceptual advantage and found that Highly Sensitive Persons are more likely to filter unnecessary information; they were more likely to detect spoken words within random noise. However, further research is required to investigate how SPS is related to different aspects of perceptual experiences, such as the detection (bottom-up) and identification (top-down) of ambiguous stimuli. As well as this, it is uncertain as to what aspects of SPS relate to such advantage, although the positive subscale (e.g., AES) has been implicated as this is characterised by an increased attentional ability (Evans & Rothbart, 2008). On the one hand, the greater perceptual ability of highly sensitives can be seen as an advantage of high SPS, in that they are more aware of the subtleties in their environment. On the other hand, a heightened awareness can also lead to increased stimulation, and consequently, overstimulation and negative reactivity.

Chapter 2 firstly considers the two-subscale approach to the HSPS, compared to the three-subscale approach, by conducting additional analyses on perceptual data reported in Williams and Blagrove (2022). The original aim of this article was to test the associations between paranormal experiences, SPS, and perceptual ability by replicating the methods of Nees and Phillips (2015). An overview of this study is provided in Chapter 2. The methods in Williams and Blagrove (2022) allow for the assessment of both accurate auditory perception and susceptibility to perceptual illusions. Secondly, Chapter 3 aims to distinguish SPS as an ability construct from overlapping personality traits (neuroticism, openness, introversion), and provide evidence that the positive element of high sensitivity is associated with perceptual ability. Whilst the literature has evidenced the separability (e.g., Aron & Aron, 1997; Tabak et al., 2022; Gerstenberg, 2012), Hellwig and Roth (2021) argue that SPS simply redefines negative traits (neuroticism, introversion) in a positive manner. However, one limitation of this study was the use of item parcelling in latent-variable correlations. This method, commonly used to reduce model complexity could spuriously inflate the relationships between SPS and the Big Five. Furthermore, the authors did not assess the unidimensionality of the items within

each factor prior to parcelling (Little et al., 2002). Given the mixed convergent validity, as well as the other limitations noted, caution is needed when interpreting these findings (Little et al., 2002). Therefore, further investigation is required to determine the separability of SPS, as an ability construct, from the Big Five traits.

Dreaming and nightmares

During the development of the Highly Sensitive Person Scale (Aron and Aron, 1997), two items relating to dream experiences were removed, as these were not considered defining characteristics of being highly sensitive. These related to recalling dreams and experiencing intense dreams. Since then, there has been a lack of investigation of how SPS relates to dreaming. To the author's knowledge, there have been three studies investigating dreaming amongst Highly Sensitive Persons. Firstly, Schredl et al. (2022) found that SPS, particularly AES, is associated with frequency of dream recall. Secondly, Carr, Matthews, Williams, and Blagrove (2020) cross-sectionally investigated the relationship between lower mental wellbeing and nightmare experience, considering high, medium, and low sensitives separately, and showed an association between SPS and dream and nightmare frequencies. Thirdly, Carr et al. (2022) found associations between the three subscales of the HSPS and nightmare frequency and distress, as well as dream recall frequency. Although relationships with dream and nightmare frequencies have thus been addressed, the range of emotions within dreams and nightmares has not been studied, as well as the longitudinal associations between dreams and waking-life emotions (Carr et al., 2020).

Also, according to Carr and Nielsen (2017), SPS may be a common personality trait amongst nightmare sufferers, providing a mechanism for the formation and experience of nightmares, and they thus put forward their Differential Susceptibility Framework of nightmares. They propose that when facing adverse contexts, Highly Sensitive Persons may differentially respond, resulting in more negative outcomes, such as increased emotional reactivity, and the experience of nightmares. On the other hand, positive contexts and environments may promote a positive dream response, as predicted also by the continuity hypothesis (e.g., Domhoff, 2017; Schredl, 2017; Schredl & Hofmann, 2003), which proposes that cognition and emotions during dreams is continuous with cognition and emotions during waking life. The Differential Susceptibility Framework of nightmares was firstly tested by Carr et al. (2020), finding that nightmare frequency and distress correlated with lower mental wellbeing for highly sensitives, although this cross-sectional study did not test for changes in nightmare experience as a

function of daily wellbeing and stress, and the results were limited by its small, majority-female sample. Furthermore, the idea that positive emotions predispose highly sensitives to positive dreaming was not addressed. Thus, Chapter 5 focuses on such associations, predicting dream emotions from emotionality of daily events but also assessing the interaction of these relationships with SPS. Such investigation of dreaming experiences as a result of daily events and mental wellbeing amongst highly sensitives is very important, as dream emotions can have lasting impacts on an individual's general outlook on life and on their specific day ahead (Gilchrist et al., 2007; Solomonova et al., 2021).

The notion that SPS may predispose an individual to heightened nightmare experience also poses implications for the treatment of nightmares, which is considered in Chapter 6. As Highly Sensitive Persons can be more adaptive to positive environments and coping strategies (Chacón et al., 2024), they may also show enhanced responses to clinical interventions (Pluess et al., 2022; Pluess & Boniwell, 2015). Therefore, high SPS may result in better adherence to treatment programmes and behaviour change. The first step to investigating this is to assess the relationship of SPS to nightmare variables with a clinical sample of participants, that is, individuals who have reached out for help with their nightmare symptoms, in some instances because of a pre-existing mental disorder. This is because frequency of and responses to nightmares, and the relationship of these variables with SPS, may differ within a very specific, clinical population when compared to participants from the general or student populations. These relationships for a clinical sample of people who have consented to a treatment programme for nightmares are investigated in Chapter 6.

The avoidance of violence

Chapter 7 considers an important real-world behaviour of Highly Sensitive Persons. Item 18 of the Highly Sensitive Person Scale (Aron & Aron, 1997) refers to the avoidance of violent movies and television shows and is predicated on the idea that Highly Sensitive Persons will seek to avoid seeing such violence. However, since its development, this item has not received any investigation or validation. Violent media is widely available to consume in current days, through television, social media, and video-sharing platforms, and so this item has real-world resonances. Chapter 7 investigates whether Highly Sensitive Persons give violent movie clips higher violence ratings than do non-Highly Sensitive Persons, and whether they report greater discomfort at viewing the movie clips. It also investigates whether scores on Item 18 are predictive of violence and discomfort ratings. A possible mechanism for this avoidance is then

investigated, namely that the tendency of Highly Sensitive Persons to be empathic results in higher empathy towards victims of violence in the film clips, which introduces negative emotions to the individual, and thus leads to overstimulation and avoidance of the violent stimuli. These research questions are addressed while also differentiating between fictional violence in movie clips and in brief films of real-life violence.

Chapter 2. Secondary Data Analysis: Testing the Perceptual Advantage of Sensory Processing Sensitivity.

The following Chapter is an extension of the article by Williams and Blagrove (2022).

A potentially relevant characteristic of SPS is a perceptual advantage, due to a greater depth of processing and awareness of external subtleties (Greven et al., 2019). (This is further explored in Chapter 3). For example, Jagiellowicz et al. (2011) tested participants' responses and brain activation to subtle changes of scenes in a change detection task. Participants high in SPS took longer to respond to minor (versus major) scene changes, thought to be a result of closer attention to the subtle details of the scene. There also seemed to be higher levels of activation within the visual and attentional areas of the brain during such changes, once again highlighting deeper processing of the images. In addition, Gerstenberg (2012) found that high SPS was associated with faster reaction times and fewer error rates on a visual detection task, suggesting an increased processing of visual information.

The original aim of Williams & Blagrove (2022) was to replicate the methods of Nees and Phillips (2015), to test the associations between paranormal experiences, SPS, priming, and perception (including accurate perception and misperception). Importantly, this study tested the perceptual advantage of high SPS. Williams et al. (2021) highlight that high SPS is associated with the detection of subtle, degraded stimuli, and not pareidolia, supporting a lower filtering of incoming information, assisting in processing true signals in the environment, which is a potential evolutionary advantage. Thus, it was hypothesised that SPS (and possibly the facets of SPS) will correlate with accurate detection of true, degraded stimuli but not with pareidolia. That is, a correlation with the proportion of voices detected within the degraded human speech recordings, which contain real voices that have been audibly degraded to create difficulty with accurate speech perception.

The secondary analysis of this study aimed to explore the above hypothesis, but using the two-subscale approach instead of the three-subscale approach to the Highly Sensitive Person Scale (HSPS). For a full overview of the subscales of the HSPS, see Chapter 1. Subsequent research (Smolewska et al., 2006) has highlighted that the HSPS may have three subscales

referring to different aspects of trait sensitivity. The first, Ease of Excitation (EOE), refers to becoming overwhelmed by internal and external processes, whereas the second, Low Sensory Threshold (LST), is defined by items referring to arousal in response to environmental surroundings. The third factor, Aesthetic Sensitivity (AES) relates to an awareness and processing of subtleties and aesthetics in the environment. Although relationships are shown between the factors, each represents different elements of SPS. On the other hand, Tabak et al. (2022) recently found a two-component solution to the HSPS, supporting Evans and Rothbart's (2008) account of environmental sensitivity. Namely, these are Positive Sensory Responsivity (PSR) and Negative Sensory Responsivity (NSR); PSR is an alternative to AES (except for one item which loaded onto NSR) and NSR is a combination of EOE and LST. Therefore, analyses were conducted with PSR and NSR instead of the three subscales of the HSPS (three subscale analyses shown in Appendix B), in order to test the suitability of the two-component approach. In addition to this, Signal Detection Theory (SDT) was applied to support relationships with perceptual experiences, providing the ability to differentiate between true perception and response bias (Lynn & Barret, 2014).

Method

Participants

There was a total of N = 61 participants; there were 20 men and 41 women, with a mean age of 26.95 years (SD = 9.86). The study was granted ethical approval from Swansea University's College of Human and Health Sciences Research Ethics Committee. For full details of the participants, see Appendix B.

Sensitivity analysis: A sensitivity analysis found that a sample of N = 61 (95% power, alpha = .05) was sensitive enough to detect an effect size of Cohen's F = .19 (ηp^2 = .003) for the within-subjects main effect and within-between interaction, and an effect size of Cohen's F = .37 (ηp^2 = .12) for the between-subjects main effect.

Materials

Questionnaires

The Highly Sensitive Person Scale (HSPS) (Aron & Aron, 1997) was used to capture SPS. The mean scores for each of the subscales were also calculated according to Smolewska et al.'s three subscales of AES (7 items; Cronbach's alpha = .68), EOE (12 items; Cronbach's alpha =

.75), and LST (6 items; Cronbach's alpha = .68). PSR (6 items; Cronbach's alpha = .67) and NSR (19 items; Cronbach's alpha = .86) were calculated according to Tabak et al. (2022).

Auditory Stimuli

For full details on the stimuli, see Appendix B. To summarise, the stimuli were taken from Nees and Phillips (2015). There were four conditions, with 34 stimuli per condition: EVP, human speech, degraded human speech, and artificially produced white noise. EVP stimuli were used to test for the susceptibility to pareidolia, while degraded human speech contained real voices, thus used to capture accurate speech perception. A total percentage of detected and correctly identified degraded words, as well as the percentage of words detected in EVP, were calculated.

Procedure

The study replicated the procedure of Nees and Phillips (2015), with the addition of questionnaires (Appendix B), including the HSPS. There were two groups, a primed and unprimed group. The primed group were informed of the paranormal nature of the noises while the unprimed group remained unaware. Other than the title of the study (paranormal vs non-paranormal), all participants received the same experiment. They were presented with all 136 stimuli in a random order, and after each presentation, they were asked to state if they heard a voice (detection) and to make a guess as to what the voice said (identification). Once the task was complete, participants completed the questionnaires. Once again, for a full overview, see Appendix B.

Statistical analyses

All analyses were conducted using IBM SPSS Statistics for Macintosh, Version 26.0 and Version 28.0 (IBM Corp, Armonk, N.Y, USA), graphs were created using Python Programming Language (version 3.8.8) and Microsoft Excel (version 16.57). The variables of interest measured perception (percentage of yes responses across the degraded and EVP conditions), and SPS (HSPS Score and scores on PSR and NSR). Bivariate correlations were conducted between these to test for associations. A multiple regression was also used to test the distinct relationships of the SPS subscales and paranormal experiences with perception, in that SPS and pareidolia were expected to be independent predictors of the reporting of paranormal experiences. To investigate and support associations between perception and SPS, Signal Detection Theory (SDT) measures were used to distinguish true perceptual sensitivity

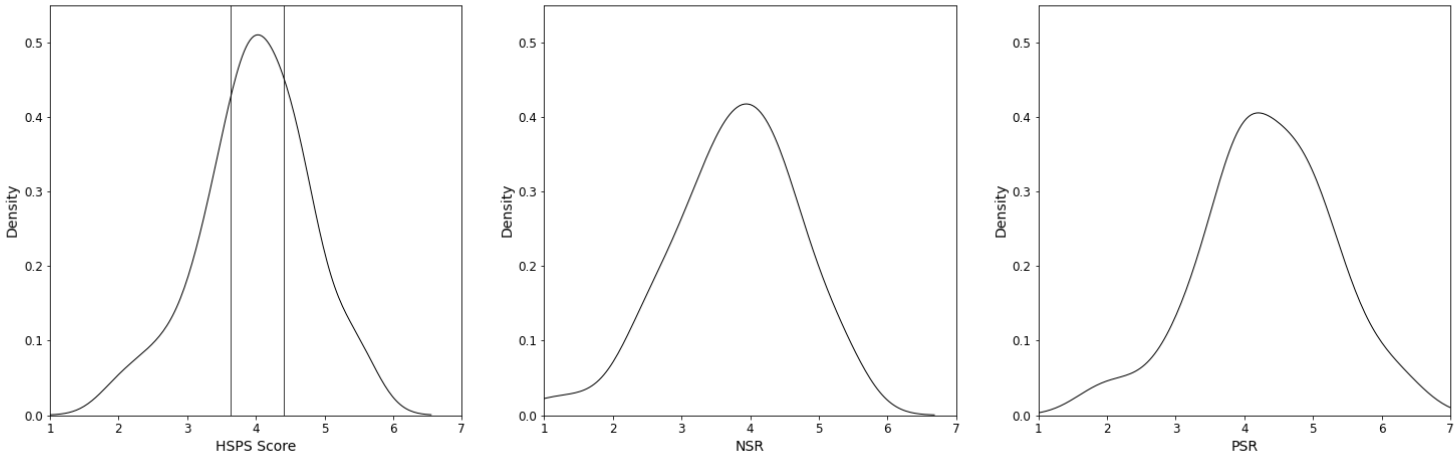
from a tendency to respond with bias. Responding “Yes” in the degraded speech condition were considered “Hits” and responding “Yes” in the noise condition were considered “False Alarms”. Scores of zero were replaced with $\frac{0.5}{34}$ = 0.014 and d’ (sensitivity) and β (response bias) were calculated per participant, according to the method detailed by Stanislaw and Todorov (1999).

It is important to note the potential confound that is introduced in that the recordings of human speech were the basis also of the stimuli in the degraded human speech condition. Thus, it is possible that an advantage due to priming is present for degraded human speech stimuli that are presented after the speech equivalent. The task order effect was analysed for n = 40 participants (specific order of presentation data were unavailable at time of analysis for the remaining participants), for whom there was a mean of 17.55 (SD = 2.54) degraded stimuli presented before the speech equivalent and 16.45 (SD = 2.54) presented after, there was no significant difference between these, $t(40) = 1.37$, $p = .18$. This did result in a priming effect, the mean percentage of voices detected was 50.24 (SD = 21.70) for degraded words presented after the non-degraded words, and 44.23 (SD = 22.72) when presented before, $t(40) = -2.151$, $p = .038$. As the order of presentation of spoken word and degraded word stimuli was balanced by randomisation, order of presentation was not included as a factor in the analyses.

Secondary analysis results

Density distributions of HSPS score and the subscales are displayed in Figure 2.1. Independent t-tests revealed no significant differences between males and females for any of the variables (all *p*s > .05) and age was significantly correlated with HSPS Score ($r(59) = -.390$, $p = .002$), NSR ($r(59) = -.385$, $p = .002$) and PSR ($r(59) = -.254$, $p = .048$).

Figure 2.1. Density distribution of mean HSPS score, NSR, and PSR. For HSPS score, lines represent cut-off points for SPS groups as according to Lionetti et al. (2018). The first line is the cut-off between the low SPS group (29.5% of the sample) and medium group (HSPS score = 3.63) and the second line for medium and high SPS group (31.1% of the sample) (HSPS score = 4.41).

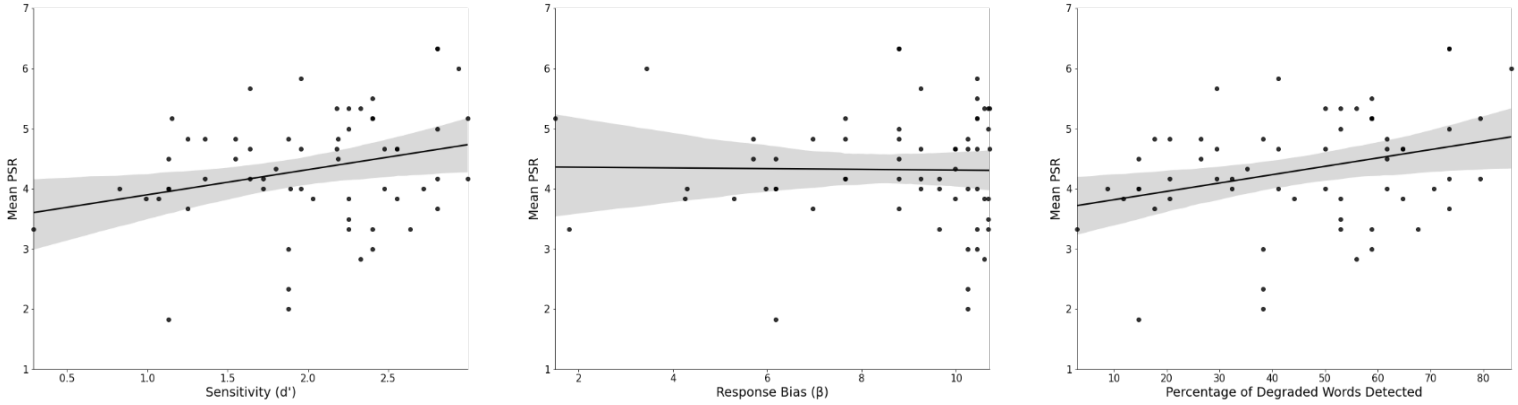


The correlation statistics with the HSPS and the three subscales, as well as descriptions of these are displayed in Appendix C. The mean NSR score was 3.77 (SD = 0.92) and the mean PSR score was 4.32 (SD = 0.95). All correlations with NSR were non-significant ($p > .05$). On the other hand, PSR positively correlated with Paranormal Responses, and negatively correlated with SAE No Responses. Considering the associations with perceptual variables, PSR was positively related to the percentage of yes responses in the degraded speech condition, the number of correctly identified words in the degraded speech condition, and perceptual sensitivity (Figure 2.2). Correlation statistics are displayed in Table 2.1.

Table 2.1. Correlations (coefficient, p-value) between NSR and PSR with the variables Spearman's rho were used for correlations with Human Speech, Noise, and Paranormal Responses due to non-normality. All DFs = 59. Significance is highlighted in bold.

	NSR	PSR
Percentage of Words Detected:		
Degraded Human Speech	.049, $p = .710$	**.307, $p = .016$**
EVP	.075, $p = .564$	.165, $p = .230$
Correctly Identified Degraded Words	.012, $p = .928$	**.258, $p = .044$**
SDT Measures:		
Perceptual Sensitivity (d')	.039, $p = .764$	**.271, $p = .035$**
Responses Bias (β)	-.020, $p = .876$	.238, $p = .064$

Figure 2.2. The relationships of PSR and the SDT measures of perceptual sensitivity and response bias, as well as with the detection of degraded words. Scatterplots with confidence intervals demonstrating the relationship between PSR and sensitivity (d') and the lack of association between PSR and response bias (β). Larger d' values indicate greater tendency to differentiate signals from noise whereas larger β values correspond to a bias towards responding "No" (no voices present) (Stanislaw & Todorov, 1999). As well as this, a scatterplot with confidence intervals is provided to show the association between PSR and the percentage of words detected in the degraded speech condition.



Comparing the above correlations with those including AES, EOE, and LST (see Appendix C), there are not many changes. For instance, previously, neither EOE or LST correlated with any

perceptual measures or paranormal experience measures, which is seen here for NSR (NSR is considered to be a combination of EOE and LST).

Considering PSR, the significant correlations with AES remained significant with PSR, and the magnitude of the relationship between variables did not vary. However, there are two exceptions to this. Firstly, AES did not correlate with Response Bias ($r(59) = -.026$, $p > .05$), however, the coefficient between PSR and Response Bias increased, $r(59) = .238$, $p = .06$, although it remained non-significant. Thus, it is difficult to draw any reliable conclusions from this change. Secondly, a correlation between PSR and the number of correctly identified degraded words emerged ($r(59) = .258$, $p = .04$).

Overall, these findings suggest that PSR, but not AES, is related to increased ability to identify truly spoken words within ambiguity and supports the idea that the removal of item 5 better represents the positive and attentional aspect of high SPS (e.g., Williams et al., 2021). Also, the lack of change with the inclusion of NSR instead of EOE and LST also supports the use of the two-subscale solution, as the lack of findings further maintain the notion that it is the positive aspect, not the negative aspect, of high SPS that is related to enhanced perceptual ability.

Discussion

Although there was a lack of support for HSPS score being related to the detection of true degraded stimuli, it was found that a higher score on the subscale PSR was related to a higher proportion of voices detected within the degraded human speech condition. This was also demonstrated using SDT measures, which distinguish perceptual sensitivity from response bias, in that PSR scores were associated with heightened ability to distinguish signals from noise and not with the tendency to respond with bias. These findings partially support the perceptual advantage of SPS and the multi-dimensionality of the HSPS, such that PSR might represent an aspect of sensitivity that differs from the negative subscale of NSR (Grimen & Diseth, 2016). These findings were consistent regardless of whether PSR or AES was used as a measure of positive sensitivity.

The positive subscale, whether this is labelled as PSR (Tabak et al., 2022), AES (Smolewska et al., 2006), or Orienting Sensitivity (Evans & Rothbart, 2007; 2008) is defined as an

awareness of aesthetic subtleties, leading to more positive emotional, sensory, and perceptual experiences (Evans & Rothbart, 2008; Smolewska et al., 2006). AES has also been shown to have associations with positive elements of personality and behaviours, such as openness to experience and helping behaviours in the workplace (Elst et al., 2019; Grimen & Diseth, 2016). Therefore, these findings suggest that it is the positive aspect of SPS that captures the depth of processing described by previous research (Aron & Aron, 1997; Aron, 2010; Jagiellowicz et al., 2011; Gerstenberg, 2012; Williams et al., 2021). This finding can prove useful in highlighting that high SPS is not a deficit and can result in beneficial behaviours, depending on the environment. Demonstrating such advantages can aid in the understanding of SPS, such as in therapeutic environments, which support and promote the flourishing of Highly Sensitive Persons in their everyday lives (Aron, 2010).

Furthermore, one difference that did emerge between PSR and AES was the association with stimulus identification, such that higher PSR (but not AES) scores positively correlated with the ability to identify the spoken content of words in the degraded speech condition. This supports the removal of one item from AES that may not correspond to the depth of processing account of SPS, thus creating a better and more accurate measure of positive sensitivity. Nevertheless, the number of correctly identified words was very low across the entire sample (ranging from zero to six), suggesting that the signal to noise ratio simply created too much ambiguity and degradation to allow for accurate speech identification. Such a high level of degradation was the aim of the original researchers (Nees & Phillips, 2015) upon creation of the stimuli. Thus, it would be interesting to explore degradation levels at which accurate stimulus detection and identification can occur, and the associations of this with SPS, so as to test thresholds for accurate stimulus detection and identification.

Limitations

An important limitation to note is the sample size, which was sensitive enough only to detect an effect size of $\eta p^2 = .12$ for the between-subjects effect of priming group. Thus, if the true effect size was smaller than this, the difference between groups would not be detectable. In addition, as mentioned previously, there was a confound introduced by the nature of the stimuli used in the current paradigm. Unaccounted for in Nees and Phillips (2015), the degraded human speech recordings were the same as those used in the human speech condition. This means that participants may have had a detection and identification advantage on trials where the human speech equivalent was heard prior to the degraded speech recording, leading to inflated scores

in the degraded speech condition only. This has implications for the comparisons conducted with the other conditions, including the EVP condition (another type of ambiguous stimuli).

Also, this unintentional prime may not have been consistent across participants in the sample, and specific individual differences (e.g., being a Highly Sensitive Person) could cause variations in the effect of the confound across the sample. Therefore, generalisability issues arise, as the perceptual bias of presenting the human speech prior to the degraded speech may affect some individuals more than others. Furthermore, this confound could only be analysed for n = 40 participants due to a file error, which meant the original (trial) presentation order of n = 21 participants was lost and could not be restored. Future research adopting this paradigm should take this confound into consideration when determining the presentation order of stimulus conditions, perhaps fully testing the impact it has on perceptual ability and individual differences. Alternatively, the confound could be avoided by using different words for the speech and degraded speech conditions.

Conclusion

Concluding the secondary analysis, the positive subscale of the HSPS is related to increased perceptual sensitivity to detecting truly degraded stimuli, supported by SDT. Furthermore, support for the use of the two-subscale approach, as posited by Tabak et al. (2022), was found. No associations emerged for NSR, which is in accordance with the results found for EOE and LST (Smolewska et al., 2006). Similar findings were revealed for PSR when compared with AES. However, one significant association emerged for PSR, that with the identification of degraded words. This suggests that the removal of a single item (item 5) may be better reflective of the positive, reflective, and deeper processing facet of high SPS.

Chapter 3. The Perceptual Advantage of Sensory Processing Sensitivity and its Association with the Big Five Personality Traits.

Sensory Processing Sensitivity (SPS) is characterised by an enhanced depth of processing and is thought to be associated with increased attentional and perceptual awareness of subtleties in the environment. Research has suggested that this trait is associated with the ability to perceive and process sensory information more deeply (Aron & Aron, 1997; Acevedo, Santander, Marhenke, Aron, & Aron, 2021; Lionetti et al., 2018), although this is thought to not concern the sense organs directly, but the way in which the information is transmitted, interpreted, and responded to by the brain (Aron & Aron, 1997).

Hellwig and Roth (2021) claim that SPS is a positive redefinition of three of the Big Five traits, namely neuroticism, introversion, and openness to experience. For an extensive overview, see Chapter 1. Thus, on the one hand, Hellwig and Roth (2021) propose there is insufficient evidence for the ability and depth of processing account of SPS, above and beyond the Big Five Personality Traits. In their study, an emotional recognition task was completed by 226 participants (66.8% women), in addition to measurements of SPS and the Big Five. A correlation between emotion recognition and Aesthetic Sensitivity (AES) was revealed, which diminished after controlling for openness to experience, as well as between Ease of Excitation (EOE) and recognition, which also became close to zero after controlling for neuroticism. They therefore concluded that emotional recognition ability of Highly Sensitive Persons can be fully accounted for by the Big Five, and that their study found "…no evidence that SPS can be viewed as an ability to process stimuli" (Hellwig & Roth, 2021, p. 9).

Further critiquing Hellwig and Roth (2021), Tabak et al. (2022) conducted a two-part study to explore the associations between environmental sensitivity, the Big Five, and measures relating to interpersonal sensitivity, including the Emotional Perceptions of Biological Motion Task (Emo Bio; Heberlein et al., 2004) and the Reading the Mind in the Eyes Test (RMET; Baron-Cohen et al., 2001). The Emo Bio task assesses emotion recognition through observing videos of body movement, whereas the RMET asks participants to best describe the feelings of thirty-six male and female actors. In Study 1, the positive facet of SPS (Positive Sensory

Responsivity; PSR), but not the negative facet (Negative Sensory Responsivity; NSR), was significantly associated with scores on the RMET, demonstrating those with higher PSR were more likely to accurately identify the feelings of the actors in the images. It was also revealed, through regression analyses, that both PSR and NSR predicted RMET scores above and beyond neuroticism, agreeableness, and extraversion. Only these three traits were included due to prior exploration of these in terms of interpersonal processes, however, once openness was added to the model, only NSR predicted RMET. Neither NSR nor PSR predicted Bio Emo performance. Study 2 confirmed the positive correlation between PSR and RMET, while also finding PSR to be related to Bio Emo score, and both PSR and NSR predicted RMET (above and beyond all Big Five traits). These findings differ from Study 1 in that neither PSR nor NSR predicted Bio Emo, and only NSR was a predictor of RMET score. Regardless of the non-significant predictions, overall, this paper demonstrates that SPS predicts emotional cognitive ability independent of the Big Five personality traits, and thus, SPS is shown to be a unique construct.

Other literature also contradicts the conclusions of Hellwig and Roth (2021). A study conducted by Gerstenberg (2012) found that EOE, AES, and Low Sensory Threshold (LST) all negatively correlated with reaction times during a visual detection task (while controlling for the Big Five throughout). That is, the higher the scores on the subscales, the faster the reaction times. EOE and LST were also related to fewer errors. Neuroticism and extraversion were negatively and positively (respectively) associated with reaction times, although there were no significant associations with error rates. Also, individuals with high LST experienced increases in stress from before to after participating, no such difference was found for any of the other personality traits or subscales of the HSPS. In summary, this study suggests that Highly Sensitive Persons are less prone to errors during a visual search task, and are quicker at responding, posing implications on the way in which they view the world around them. That is, Highly Sensitive Persons are more aware of the subtleties in their environments, and process information quicker and more deeply than non-Highly Sensitive Persons. Also, the lack of relationship between error rates and the Big Five, specifically neuroticism, extraversion, and openness, imply that SPS (as measured by the HSPS) is a separable construct, challenging the view of Hellwig and Roth (2021).

To further support the findings of Gerstenberg (2012), Williams, Carr, and Blagrove (2021) found an association between high SPS and the filtering of sensory information. This study recruited 50 participants to participate in an auditory task. They were presented with Diana

Deutsch's (Deutsch, 2003; 2019) Phantom Word Illusion. During this task, one or two words (e.g., "Boris", "Go Back") are presented from a left and right speaker, placed approximately 60 centimetres away from the participant's head, with the words playing from two alternating stereo channels. The space between the speakers is filled with the sounds, and the alternating voice, as well as the speed of the spoken words, creates the illusion that other phantom words are being spoken. Two measures of performance were captured: first, the number of words reported that were illusory was calculated, and second, the number of words reported that were the actual words spoken by the voice (e.g., "Boris") was calculated. No associations were found for SPS and reporting of illusory words, revealing a lack of evidence of Highly Sensitive Persons' susceptibility to perceptual illusions. However, there was a correlation between the number of real words heard and SPS, implying that those who scored higher on the HSPS detected more true, degraded words within the random sounds, supporting an increased filtering of sensory information account of SPS as well as providing evidence that Highly Sensitive Persons are more aware of subtleties within their environment.

Additionally, Williams and Blagrove (2022) (as in Chapter 2) conducted a replication study of Nees and Phillips (2015), to test the effect of priming on the perception of words within electronic voice phenomena (EVP; conceptualised as ghost voices attempting to communicate through audio recording equipment). The researchers presented participants with four conditions of spoken recordings (human speech, EVP, degraded human speech, and white noise), and their task was to state whether they heard a voice in the sound (yes/no) and if they did, to state what the voice had said. This method allows for testing of detection (did you hear a voice?) and identification (what did the voice say?) of degraded human speech, as well as misperception of voices within EVP. Williams and Blagrove (2022) added the HSPS to the procedure, to capture participants' scores on SPS and to test their ability to hear voices within degradation. Surprisingly, there was no evidence that total SPS score was related to the ability to detect or accurately identify real, humanly spoken words within the sounds. However, the AES element of the HSPS was related to the ability to detect words, but not to identify the spoken content of the words, suggesting that those who score higher on AES are more likely to hear words within degradation, partially supporting the idea that Highly Sensitive Persons are more aware of subtleties in the environment. The relationship between AES and enhanced perception was reinforced when associations with perceptual sensitivity (as captured by Signal Detection Theory) were revealed, further implying that high AES participants are sensitive to differentiating truly degraded words from noise.

When considering perception and the processing of sensory information, an important distinction to make is that between the *detection* of stimuli and the *identification* (or recognition) of stimuli. Jimenez, Grassini, Montoro, Luna, and Koivisto (2018) suggest that visual awareness depends on levels of processing, such as lower-level (features of a stimulus) and higher-level processing (perceiving the stimulus as meaningful). Detection occurs at lower-level processing, the *presence of something*, whereas higher-level processing enables the *identification of something as meaningful*. Jimenez et al. (2018) demonstrate that conscious awareness is possible without conscious identification (Koivisto, Grassini, Salminen-Vaparanta, & Revonsuo 2017), and detection can occur as early as the stimulus appears, although the properties of the stimulus and identifying what it is occurs later.

It is unclear whether the perceptual advantage of SPS refers to the detection or the identification of stimuli. Williams and Blagrove (2022) were the first to test the perceptual advantage of Highly Sensitive Persons while making the distinction between detection and identification. For instance, it is not possible to do this in Williams et al. (2021) using the Phantom Word Illusion, as participants were only asked to state what they heard in the noise, thus identifying the words is not possible without first detecting the words are there, and detecting the words cannot be separated from identification (as the words were spoken aloud). Additionally, Gerstenberg (2012) was unable to explore both detection and identification, as the task was a detection task in nature, with participants instructed to respond to the presence of a target surrounded by distractors.

Therefore, it seems evident that SPS is an ability construct, in that it is associated with a perceptual advantage of being more aware of the environment, including of sensory and emotional stimuli (Gerstenberg, 2012; Jagiellowicz et al., 2011; Tabak et al., 2022; Williams et al., 2021; Williams & Blagrove, 2022). This partially contradicts the claim of Hellwig and Roth (2021) that SPS cannot be viewed as an ability to process stimuli above and beyond the Big Five personality traits, although only two studies actively controlled for the Big Five traits (Gerstenberg, 2012; Tabak et al., 2022). Thus, further research is required to extend these findings, and to investigate any perceptual ability of Highly Sensitive Persons beyond these traits. Also, the link between SPS, detection, and identification is not yet clear, as well as which aspects of sensitivity result in or are linked to such advantage, although the positive subscale

of AES has been implicated, characterised as an increased automatic attentional ability (Evans & Rothbart, 2008; Liss et al., 2008; Sobocko & Zelenski, 2015).

Aims

The aim of this study was to test the associations between SPS, the Big Five personality traits, and perceptual ability, including the detection and identification of words in degraded images. A task was created that presents participants with a series of images containing words that are degraded at one of three levels, with each level increasing in degradation. Participants were asked after each presentation whether they saw a word within the image (to measure detection) and if they did, to make a guess as to what the word was (to measure identification). Perceptual confidence was also measured. It was particularly expected that SPS and the HSPS subscales would be related to perceptual ability, although no predictions were made regarding differences between associations of SPS with detection and identification. Additionally, those high in SPS may have lower thresholds at which accurate perception can occur, explaining the decision to include differing levels of degradation (Williams & Blagrove, 2022; as in Chapter 2).

For the current investigation, the PSR and NSR factor model was used, instead of the three-factor model, as these two facets may map better onto the positive and negative aspects of SPS (Tabak et al., 2022) (Chapter 2). PSR is the same as AES but with the removal of one item (item 5), which seems to be more suited to describing the negative experiences of Highly Sensitive Persons (withdrawing during busy days to reduce overstimulation); its removal is also supported by the factor analyses of Tabak et al. (2022). Evans and Rothbart (2008) were the first to find a two-component solution of the HSPS based on their construct theory of environmental sensitivity, these factors referring to their measures of "Orienting Sensitivity" and "Negative Affect" on the Adult Temperament Questionnaire (Evans & Rothbart, 2007). Orienting Sensitivity refers to perceptive, associative, and affective sensitivity (e.g., awareness of low-intensity stimuli, cognition, and affective awareness), whereas Negative Affect corresponds to sensory discomfort, affective control, negative emotionality, and sociability. Evans and Rothbart (2007) especially found the one factor model (Aron & Aron, 1997) to be unsatisfactory, and the three-factor (Smolewska et al., 2006) and two-factor solution were found to be better, although the conceptual decision to use the two-factor solution was expressed by the authors. Tabak et al. (2022) state that PSR and NSR are "almost identical to those identified as "Negative Affect" and "Orienting Sensitivity"" (p. 9).

Also, due to the claim that Highly Sensitive Persons dislike being observed when performing tasks (Aron & Aron, 1997; Gerstenberg, 2012), these individuals may be more likely to respond to such tasks in socially desirable ways. Therefore, social desirability was measured in the current study to test for any confounding effect on SPS and perceptual performance. For instance, those who are high in SPS may act more desirably, and thus respond as to seeing words more often during the word task. However, this may also be related to a lack of confidence, in that if they did not see a word, they may be likely to guess when identifying it, and to thus have low confidence scores.

Furthermore, associations were expected to emerge between SPS and the Big Five personality traits, particularly with neuroticism, introversion, and openness to experience. The literature is extensive in demonstrating these relationships, the negative facets of SPS (EOE/LST/NSR) are associated with neuroticism and introversion while the positive facet (AES/PSR) is associated with the more positive openness to experience (e.g., Bröhl et al., 2020; Grimen & Diseth, 2016; Smolewska et al., 2006; Yano et al., 2019). However, following the argument that SPS (as measured by the HSPS) is simply a positive redefinition of negatively viewed Big Five personality traits (Hellwig & Roth, 2021) (Chapter 1), this study attempted to test this distinction of SPS from these other traits, to establish an independent construct. The relationships of the Big Five with perception were thus also tested, and unique associations were tested for so as to understand if SPS is independent of the Big Five. The 44-item Big Five Inventory (BFI) was included to measure these traits, with John and Srivastava (1999) stating that this scale is short, easy to understand, and efficient in measuring the "core attributes" of each personality trait.

Method

Participants

Pilot

A pilot investigation was conducted to test the appropriateness of the stimuli in testing detection and identification. A total of N = 17 participants were recruited by advertisement on social media. Participants reached out to the experimenter if they were interested, and they were provided a link. There were 4 males and 13 females, aged between 18 and 54 years (mean age = 27.88 years). All were White and had normal to corrected vision. The results from these

participants were not included in the main study and they only completed the computer task. The findings are presented in the Results section.

Main study

Participants were recruited from three sources. Individuals (n = 37) could click a link on social media to take part and choose to be entered into a £20 voucher prize draw. The university participant pool was used (n = 40), for which two course credits were awarded. Prolific was also used (n = 145), and participants were given monetary payments for participation. Prolific participants were limited, using Prolific's screening settings, to being from the United Kingdom, native English-speaking, and with a Prolific approval rate of 90-100%. This sample was also balanced for gender. All participants (regardless of recruitment method) were screened for age (18-50 years) and device usage (desktops only). Prolific participants were screened for these using the built-in Prolific settings.

A total of N = 232 participants were recruited. However, time taken to complete the study was analysed and six participants were flagged as outliers on this and excluded. A further four participants were excluded due to age, slow internet connection, repetitive responses, and having multiple outlier scores. Thus, the final sample size was N = 222. There were 88 men and 134 women, with a mean age of 29.99 years. 90.9% were White, 3.7% were Black, 2.7% were Asian, and 1.8% were of Mixed Ethnicity. 97.3% of the sample stated that English was their first language, and 94.6% had normal-to-corrected eyesight. Education level is displayed in the Table 3.1. This study received ethical approval from Swansea University's School of Psychology Research Ethics Committee and full informed consent was provided by participants.

Table 3.1. The frequency and percentage of participants that had achieved educational qualifications.
Two participants did not give a response.

Education Level	Frequency of Responses	Percentage of Sample
Doctoral Degree or Equivalent	5	2.3
Master's Degree or Equivalent	29	13.2
Bachelor's Degree or Equivalent	69	31.4
A-Levels or Equivalent	91	41.4
GCSE's A*-C or Equivalent	20	9.1
Other Qualifications	5	2.3
No Qualifications	1	0.5
No Response	2	0.5

Sample size and power calculation: A power calculation conducted using G*Power software (Faul, Erdfelder, Buchner, & Lang, 2007) revealed a sample size of N = 159 would be necessary to achieve an effect size of $f^2 = 0.10$ ($r^2 = 0.09$; from Williams & Blagrove, 2022) with 80% power for a hierarchical regression model with a maximum of 8 predictors. However, this study was not restricted on time or resources, and thus once this target was reached, data collection continued. A sample size of N = 222 was achieved after exclusions, which is comparable to previous research on SPS, personality, and ability measures (e.g., Hellwig & Roth, 2021). A sensitivity analysis (G*Power) revealed that a sample of N = 222 was sensitive enough to detect an effect size of $f^2 = 0.070$ ($r = 0.255$, $r^2 = 0.065$) at 80% power, and an effect size of $f^2 = 0.106$ ($r^2 = 0.096$, $r = 0.310$) at 95% power.

Materials

Stimuli

Word Selection

Words were selected from the English Word Database of EMOtional TErms (EMOTE; Grühn, 2016), a database of 1287 nouns and 985 adjectives. Nouns with 4-5 letters, and 1-2 syllables were included in the process. Words were chosen where imagery, concreteness, meaningfulness, and familiarity had a mean score of 4.00 or more (Mean (M) Imagery = 5.61; M Concreteness = 5.00; M Meaningfulness = 6.31; M Familiarity = 4.24). 186 nouns met these criteria, although one was excluded due to its inappropriateness. Words were then identified according to their valence, and based on tertiary cut-off points, 45 words were selected. Those with mean valence scores between 1.47 and 3.01 were considered negative (top 15 words),

between 3.02 and 4.56 were neutral (middle 15 words), and between 4.56 and 6.08 were positive (top 15 words).

Image creation

The noisy stimuli were created on PyCharm CE (JetBrains, 2020; Version 3.3), using Python 3.9. The program created a blank, white image with each written word in one of nine different positions on the screen, and then each image was randomly degraded at one of three noise levels. Firstly, the program randomly selected which position on a plain white image (500 x 500 pixels) to place each word, with the options being top-right, top-middle, top-left, bottom-right, bottom-middle, bottom-left, centre-right, centre-middle, and centre-left. The lower-case words appeared in black, and the font "Hershey Simplex" was used. The basic size of the words (standard size that is generated) were multiplied by 2.5. An example of these words is demonstrated in Figure 3.1.

Figure 3.1. An example of images created prior to degradation. This image displays the word "bomb" placed in the top-left of a white background (black border added to highlight image dimensions).

Table 3.2 demonstrates the coordinates of where each word was placed, depending on position. The positions were determined by the axis of the image (i.e., the x and y axis). The words appeared 40 pixels (margin of 8% of the image size) from the edge of the image in each direction (top/bottom; left/right), if they were placed to the top-left, top-right, bottom-left, and bottom-right of the image. If in the centre-middle of the screen, the word was placed halfway from the top and bottom (height; y axis), and halfway from the left and right (width; x axis). If to the centre-right or centre-left, the word was placed 40 pixels from the (left or right) edge of the image (x axis), and in the middle of the image along the y axis (half the height). If the word was top-middle or bottom-middle, the word appeared 40 pixels from the top or bottom of the

screen (depending on position) and half-way between the left and right of the image (half of the width).

Corrections for word length and width were made to ensure words appeared the same regardless of which position they were in, i.e., words began and ended in the correct position. The words placed at the "Top" of the image were corrected for the height of the word, to ensure the top of the word appeared 40 pixels from the top of the image. Words that were placed to the "Left" of the image *began* on the *x* coordinate. If the word was in the "Centre" of the image, it was corrected for the width of the word, that is, it was shifted to the left according to half of the word width. The result was that the centre of the word was placed on the *x* and *y* coordinate (the middle of the image). For those placed on the "Right", the word was shifted to the left by the entire width of the word, so that the word *ended* on the x coordinate.

Table 3.2. The formulas of the coordinates for the screen positions where each word could have been placed.

Position on Image	Image x Coordinate	Image y Coordinate
Bottom-Left	Mx	My
Bottom-Middle	$\frac{W}{2}$	My
Bottom-Right	$W - Mx$	My
Centre-Left	Mx	$\frac{H}{2}$
Centre-Middle	$\frac{W}{2}$	$\frac{H}{2}$
Centre-Right	$W - Mx$	$\frac{H}{2}$
Top-Left	Mx	$H - My$
Top-Middle	$\frac{W}{2}$	$H - My$

Top-Right	$W - Mx$	$H - My$

My = Margin of Image in Vertical Axis (40 pixels, 8% of the height).

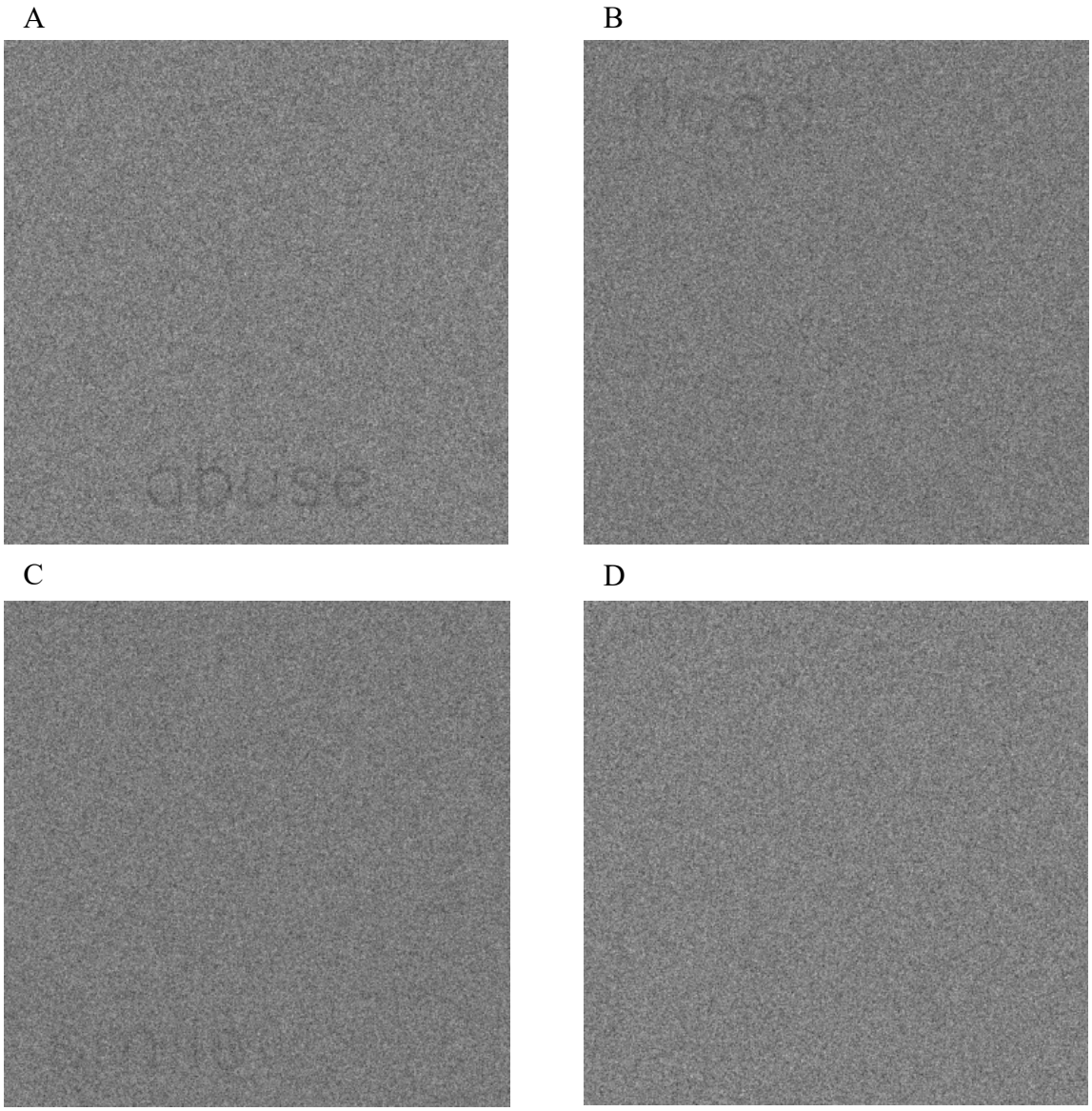
Mx = Margin of Image in Horizontal Axis (40 pixels, 8% of the width).

H = Height of Image (500 pixels)

W = Width of Image (500 pixels)

The program randomly assigned each image to one of three levels of noise (degradation levels) and degraded the image using additive Gaussian noise based on a normal distribution where the mean (M) was equal to 0, and the standard deviation (σ) increased in increments of 250 from Level 1 (σ = 750), to Level 2 (σ = 1000), to Level 3 (σ = 1250). The Gaussian noise was generated, resized to the image dimensions (500 x 500), and then added to image. Additive Gaussian noise (M = 0, σ = 750) was also applied to 15 blank white images (with no word), to create random white noise as a control condition. The noise levels are displayed in Figure 3.2. There were 13 words degraded at Level 1, 16 at Level 2, 16 at Level 3, and 15 random noise images, resulting in a total of 60 stimuli.

Figure 3.2. Examples of each degradation level. Figure 3.2A shows the word “Abuse” degraded at the lowest level (Level 1), located at the bottom-middle of the screen. Figure 3.2B shows the word “Flood”, degraded at Level 2, located at the top-left. Figure 3.2C contains the word “Smile”, degraded at the highest level (Level 3), bottom-left of the screen. Figure 3.2D is random white noise.



Questionnaires

The Highly Sensitive Person Scale (Aron & Aron, 1997) (HSPS; current study Cronbach’s alpha = .92) was used to measure SPS. Participants were asked to respond to 27 questions with reference to a 7-point Likert scale (1 = Not at all; 7 = Extremely). Examples of questions include, “Are you easily overwhelmed by strong sensory input?” and “Do you startle easily?”. The responses to each question were added together to give a total score, and a mean score was calculated, with a higher score representing higher SPS. Mean PSR (6 items) and NSR (19

items) scores were calculated (Tabak et al., 2022). The Cronbach's alpha values found for these in this study were .75 and .92 respectively.

To measure the Big Five personality traits, the 44-item Big Five Inventory (BFI; John, Donahue & Kentle, 1991; John & Srivastava, 1999) was used (current study Cronbach's alpha = .77). This questionnaire gives participants a series of characteristics to which they respond with how much they agree that the characteristic applies to them, on a 5-point Likert scale of 1 (Disagree Strongly) to 5 (Agree Strongly). Participants were measured across five personality traits, and a mean score was calculated for the following: extraversion (8 items, alpha = .88), agreeableness (9 items, alpha = .78), conscientiousness (9 items, alpha = .82), neuroticism (8 items, alpha = .75), and openness to experience (10 items, alpha = .79).

Finally, participants completed the Social Desirability Scale-17 (SDS-17; Stöber, 2001) (Cronbach's alpha = 70), which provides 17 statements regarding socially desirable or undesirable behaviour, for example, "I occasionally speak of others behind their back" and "I always admit my mistakes openly and face the potential negative consequences". Participants choose to respond "True" if the statement applies to them, or "False" if not. Statements that refer to socially undesirable behaviours were reverse scored (True = False; False = True) and the number of times participants respond in a socially desirable way (True responses) was calculated, and a total social desirability score was given.

Procedure

Participants were recruited to take part in an online study titled "*Word Detection Task*", powered by Gorilla Experiment Builder (www.gorilla.sc; Anwyl-Irvine et al., 2019). Upon clicking the link, an information sheet and consent form was provided. Participants were told the study was about factors influencing perception, so that the personality aspects of the study remained undisclosed so as to not impact questionnaire responses. If participants consented to taking part, they ticked the box on the screen. Participants recruited through Prolific were further screened to ensure they met the study criteria at this point. They were asked the following questions: "Are you aged 18-50?", "Do you live in the United Kingdom?", and "Is English your first language?", all questions had the response options "Yes" or "No". This was to ensure the built-in Prolific screening was successful. If they answered "Yes" to all questions, they moved to the task. If they answered "No" to any of the questions, they were automatically disqualified. All participants were presented with a set of instructions regarding their computer

screen and comfort as the task was conducted remotely due to the COVID-19 pandemic, and the researcher had no control over participants' environments. The instructions were as follows:

> *"Please sit comfortably, preferably at a table or desk, with your computer/laptop placed in front of you. Turn off all music and/or other devices that may cause a distraction. Please pay full attention to the task as you complete it. Do not have your computer screen too close to your face, approximately 50cm away is appropriate. Please adjust your brightness and screen angle (if using a laptop) to ensure your display is optimised for your own viewing. As this is a visual task, it is important that you can see your screen. This means if you are in a bright room or the sun is shining on your computer, you may need to move to a different room with better conditions. Once you have made yourself comfortable, please press the button below to read the instructions for the task."*

They were then given the task instructions:

> *"This is a word recognition task. Please read the following instructions carefully. During this experiment, you will be presented with a number of "noisy" images for a few seconds each. Your task is to indicate whether or not you can see a written word within the noise. If you see a word, please click the "YES" button, and if you do not, press the "NO" button. These buttons will appear on the screen after a few seconds. If you see a word and respond "Yes", you will be asked to write what word you saw in a box on the screen. Please be as accurate and honest as possible in your responses and try not to respond with words such as "I don't know" or "not sure". Once you have written the word in the box, you will be asked to state how confident you were that you saw that particular word. A slider will appear on the screen, and you will be asked to rate your confidence on a scale of 1 (not at all confident) to 10 (extremely confident). For instance, if you saw a word but were unsure of what it said and just made a guess, you will give a rating of 1. After the experiment, you will be asked to complete a series of questions before the end of the study. When you are ready, please press the button to begin."*

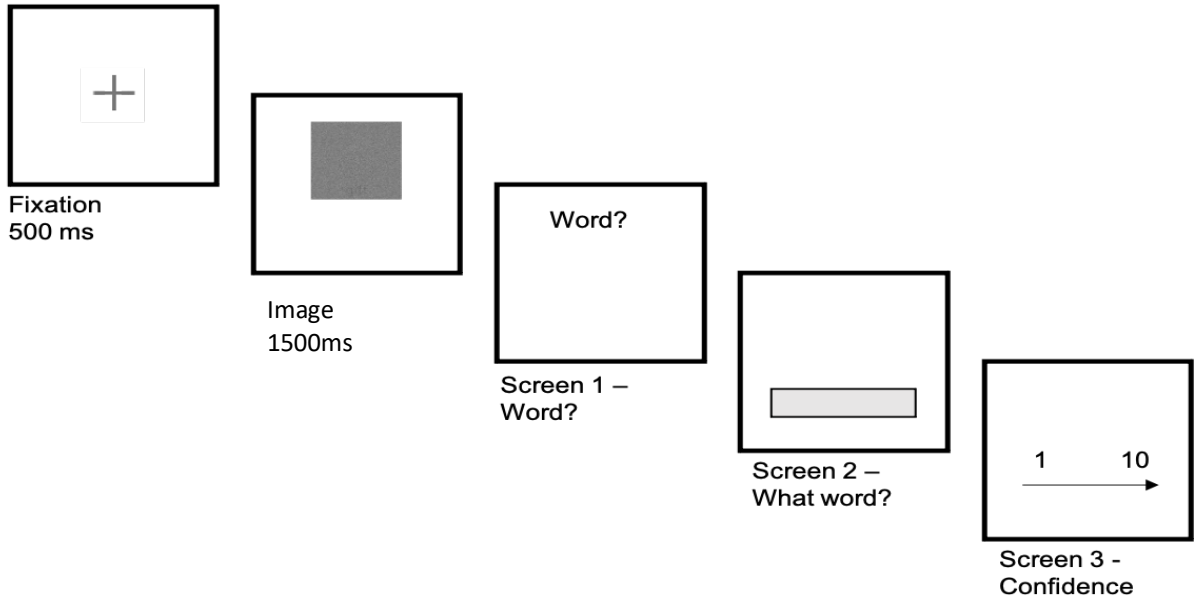
Once ready, they clicked a button and began the first trial. After a 100 millisecond (ms) onset, a fixation cross was displayed in the centre of the screen for 500ms, then after another 100ms onset, the stimulus was presented on-screen for 1500ms. The experiment automatically moved after the display had finished to a response screen (detection) which asked participants "*Did you see a word in the image?*", with the options "Yes", or "No" to choose from on the screen. Participants provided a response by clicking the button on-screen with their mouse. If they responded "*Yes*", another response screen (identification) was displayed which asked, "*What do you think the word was? Please type in the box below the word you saw in the image, try to make your best guess*." Once they had made their guess, a further response screen (confidence) asked "*How confident are you in your response? Please rate your confidence by using the slider below. 1 = Not at all confident that I saw the word I stated. 10 = Extremely confident that I saw the word I stated.*". Upon rating their confidence, they moved to the next trial. If

participants did not see a word, they were immediately moved onto the next trial. Thus, each trial (60 trials in total) consisted of the fixation cross, image presentation, detection screen, identification screen, and the confidence screen (Figure 3.3). Each image was displayed in a different random order for each participant, and they were given unlimited time to respond at each screen.

The total number of words detected (is there a word?), and total number of accurate identifications of words (what the word says) were summed per participant, and the percentage of words detected, and percentage of words accurately identified were calculated per noise level as well as overall, as a measure of participants' tendency to detect and identify words within white noise. Mean confidence per level and overall was also calculated, in addition to mean confidence where participants correctly identified the word and when they did not.

Participants completed a demographic questionnaire after the task, where they provided their age, gender, ethnicity, education level, and whether they had normal-to-corrected vision. They also completed the BFI, HSPS, and SDS-17. Two attention checks were added to the questionnaires, one in the BFI and one in the HSPS to test participants' attention during the study. All participants passed these attention checks.

Figure 3.3. The experimental procedure, with screen one measuring detection, screen two identification, and screen three confidence. If participants state they did not see a word at Screen 1, they skip the remaining screens and begin the next trial.



Statistical analysis

Statistical analyses were conducted using IBM SPSS Statistics for Macintosh, Version 28.0 (IBM Corp, Armonk, N.Y, USA). To test the differences between the levels of degradation, repeated-measures analysis of variance (ANOVA) with pairwise comparisons were conducted, with the levels of degradation as the independent variable, and the dependent variables of the percentage of words detected, the percentage of words identified, and mean confidence score.

Bivariate correlations tested for associations between the personality traits (HSPS score, NSR, PSR, openness, extraversion, agreeableness, conscientiousness, and neuroticism), as well as between these traits and the perceptual variables (the percentage of words detected, percentage of words identified, and mean confidence scores). Multiple linear regressions were conducted to further examine the variance in HSPS score that can be accounted for by the Big Five personality traits. Due to the claim that SPS is simply a combination of neuroticism, openness, and introversion, a series of hierarchical regressions were conducted to test these traits as unique predictors of perception, where the three Big Five traits were entered first and the HSPS subscales second.

Signal Detection Theory was used to test the associations between the personality measures, true perceptual sensitivity, and the tendency to respond with bias. The proportion of words detected at the highest level of degradation (Level 3) were considered “Hits”, whereas the

proportion of words detected within the white noise stimuli were considered "False Alarms". Scores of zero and one were replaced with 0.03 and 0.98 respectively for the proportion of words detected at Level 3, and scores of zero were replaced with 0.03 for the white noise condition. Zeros were replaced according to the formula 0.5 / n and ones were replaced using the formula (n - 0.5) / n, where n = the number of trials (16 Level 3, 15 white noise). d' (perceptual sensitivity) and β (response bias) were calculated to measure the ability of participants to distinguish true signals from noise (d') as well as their tendency to respond with a bias towards yes or no (β). Larger d' values correspond to a greater sensitivity to differentiate signals from noise. Larger β (greater than 1) demonstrate a bias towards responding that no words are present ("No"), smaller β values (less than 1) show a bias towards responding words are present ("Yes") (Stanislaw & Todorov, 1999).

Finally, partial correlations were conducted to test the potential confounding effect of social desirability on the relationship between SPS and perception.

Results

Pilot:

To test the levels of degradation prior to the main investigation, three repeated-measures ANOVAs were conducted, with degradation levels as the independent variable and the three dependent variables of percentage of words detected, percentage of words correctly identified, and mean confidence scores. Greenhouse-Geisser correction was used for detection and identification due to the violation of Sphericity. Descriptive statistics are displayed in Table 3.3.

There was a significant difference between the levels of degradation for detection, $F(1.12, 17.92) = 48.19$, $p < .001$, $\eta p^2 = .75$ and paired-samples t-tests revealed that Level 1 and Level 2 did not significantly differ ($t(16) = 1.534$, $p = .144$), but Level 1 and 3 ($t(16) = 7.11$, $p < .001$) and Level 2 and 3 ($t(16) = 7.03$, $p < .001$) significantly differed from one another.

The levels of degradation were revealed to be significantly different for identification, $F(1.35, 21.60) = 323.22$, $p < .001$, $\eta p^2 = .95$, and paired-samples t-tests revealed that all levels were significantly different ($p < .001$).

Finally, for mean confidence scores, there was a significant difference between levels of degradation, $F(2, 32) = 175.67$, $p < .001$, $\eta p^2 = .92$, and paired samples t-tests revealed that all levels were significantly different from one another ($p < .001$).

Table 3.3. The descriptive statistics (mean (SD), minimum, and maximum) for the percentage of words detected, percentage of words identified, and mean confidence ratings for the whole sample. White noise is not reported for identification as there were no words within the images, and no possibility for accurate identification to occur.

Percentage of Words Detected	Mean (SD)	Minimum	Maximum
Level 1	99.55 (1.87)	92.00	100.00
Level 2	98.16 (2.94)	94.00	100.00
Level 3	76.47 (12.60)	50.00	94.00
White Noise	1.56 (4.43)	0	13.33
Percentage of Words Correctly Identified			
Level 1	97.29 (3.79)	92.00	100.00
Level 2	65.44 (12.82)	50.00	100.00
Level 3	20.22 (7.82)	6.00	31.00
Confidence Ratings			
Level 1	9.31 (0.75)	7.38	10.00
Level 2	7.24 (1.00)	5.81	9.19
Level 3	4.20 (1.26)	2.00	6.43
White Noise	0.02 (0.06)	0.00	1.88

Exploring individual words

Level 1 Words: All participants correctly detected every word in Level 1, except for one person not detecting a word for "steal". In terms of identification, two participants wrongly identified the word "riot", and one wrongly identified "steal".

Level 2 Words: One person did not detect the word in "board", three people did not detect in "thief", and one person did not detect in "tire". Only two words were correctly identified by all participants, these were "kiss", and "ocean". The most difficult word to identify seemed to be "strip", whereby only three participants correctly identified this degraded word.

Level 3 Words: The image that seemed hardest to detect was "fall", only 2 participants correctly detected a word in this image. All participants detected a word in "joke" and "women". No participants correctly identified the words "bomb", "laugh", or "month". 13 participants correctly identified the word "joke", which seemed to be the easiest in terms of detection and identification at this level.

Main Study:

All perceptual variables, except for mean confidence score at Level 2 violated the assumption of normality, as well as LST Score. Males and females significantly differed on EOE ($p = .02$), LST ($p = .005$), HSPS Score ($p = .02$), agreeableness ($p < .001$), conscientiousness ($p = .002$) and neuroticism ($p < .001$) whereby females had higher scores than males. There were no differences for the remaining variables ($p > .05$).

Testing differences between levels of degradation

The means of the percentage of words detected, the percentage of words identified, and confidence at all three levels as well as overall, are displayed in Figures 3.4 and 3.5. Three repeated measures ANOVAs were conducted to test the differences between the percentage of words detected, identified, and confidence scores at each level of degradation; these are displayed in Table 3.4. The results remained unchanged with the inclusion of white noise, however, as scores were very low (M percentage detected = 0.60, SD = 2.38; M confidence = 0.17, SD = 0.10), the ANOVAs with white noise are not reported. Pairwise comparisons revealed there were significant differences between each level for all perceptual variables ($p < .001$) (Figure 3.4), indicating that Level 3 was the most difficult for detection and identification, and that participants were least confident at this level.

Table 3.4. The findings of the repeated measures ANOVAs conducted to test the differences between the levels of degradation on each perceptual variable.
Greenhouse-Geisser correction was used due to the violation of Sphericity.

	F(dfs)	*p*	ηp^2
Percentage of words detected	592.01 (1.34, 296.07)	< .001	.73
Percentage of words identified	3103.44 (1.74, 383.47)	< .001	.93
Mean Confidence	3200.86 (1.96, 432.46)	< .001	.94

Figure 3.4. The percentage of words detected and correctly identified at all three levels of degradation, as well as overall. Standard deviations (SD) are displayed in Table 3.3.

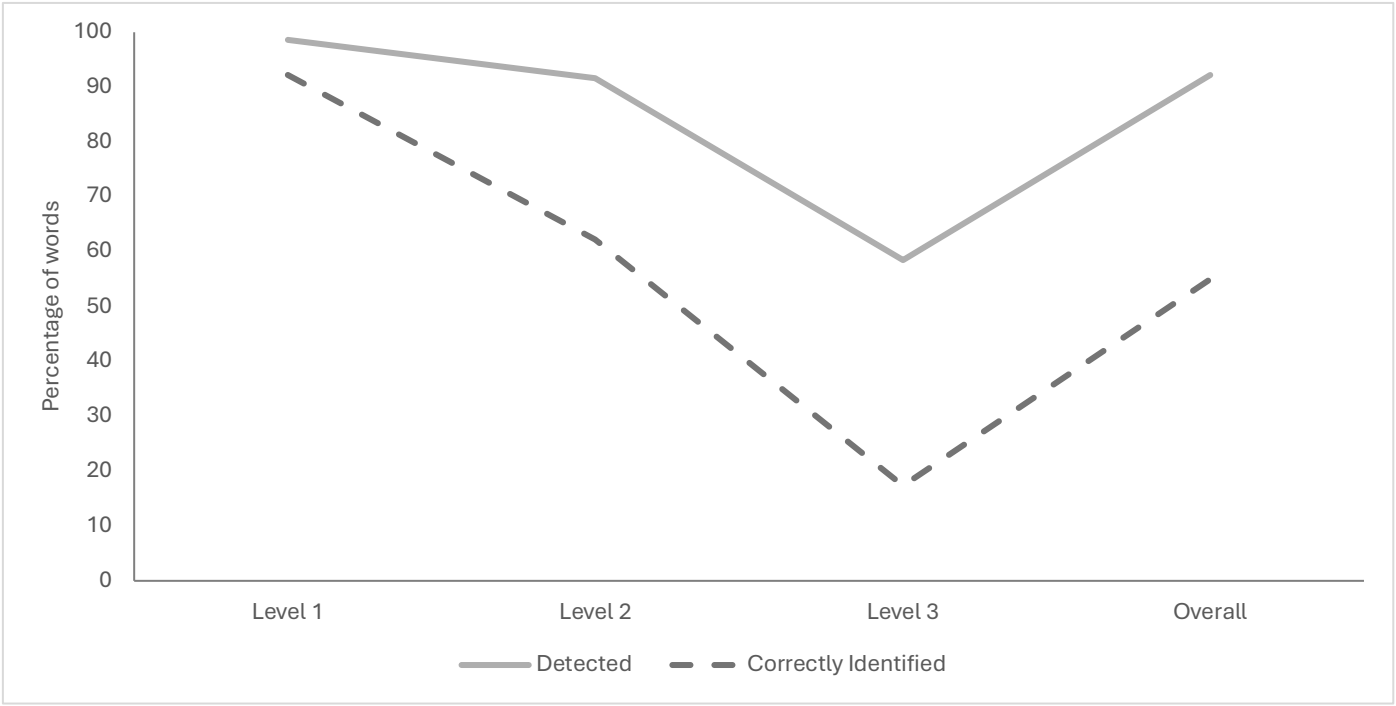
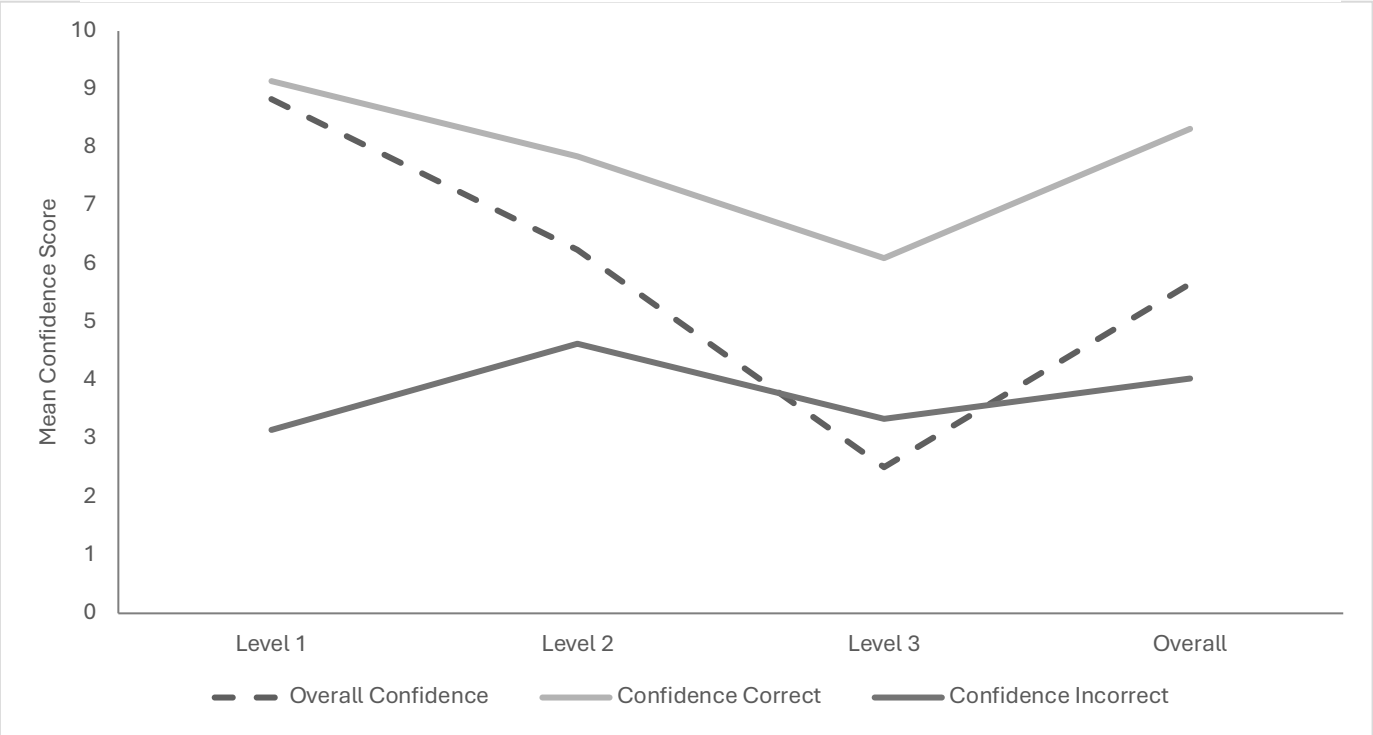


Figure 3.5. The mean confidence scores across the three levels of degradation and overall, for the words that participants correctly identified and incorrectly identified, as well as total (overall) confidence. Standard deviations (SD) are displayed in Table 3.3.



Personality

The descriptive statistics for each personality trait are displayed in Table 3.5. The mean HSPS score (M = 4.28) is comparable to that found in Study 6 of Aron and Aron (1997) (M = 4.38).

Table 3.5. The descriptive statistics for the personality measures, including mean (SD), minimum and maximum.

	Mean (SD)	Minimum	Maximum
HSPS Score	4.28 (0.99)	1.59	6.93
NSR	4.06 (1.17)	1.32	7.00
PSR	4.62 (1.06)	1.67	7.00
SDS	9.86 (3.28)	1.00	17.00
Extraversion	3.04 (0.87)	1.25	5.00
Conscientiousness	3.57 (0.68)	1.89	5.00
Agreeableness	3.80 (0.61)	1.89	5.00
Neuroticism	3.18 (0.87)	1.13	5.00
Openness to experience	3.41 (0.67)	1.60	5.00

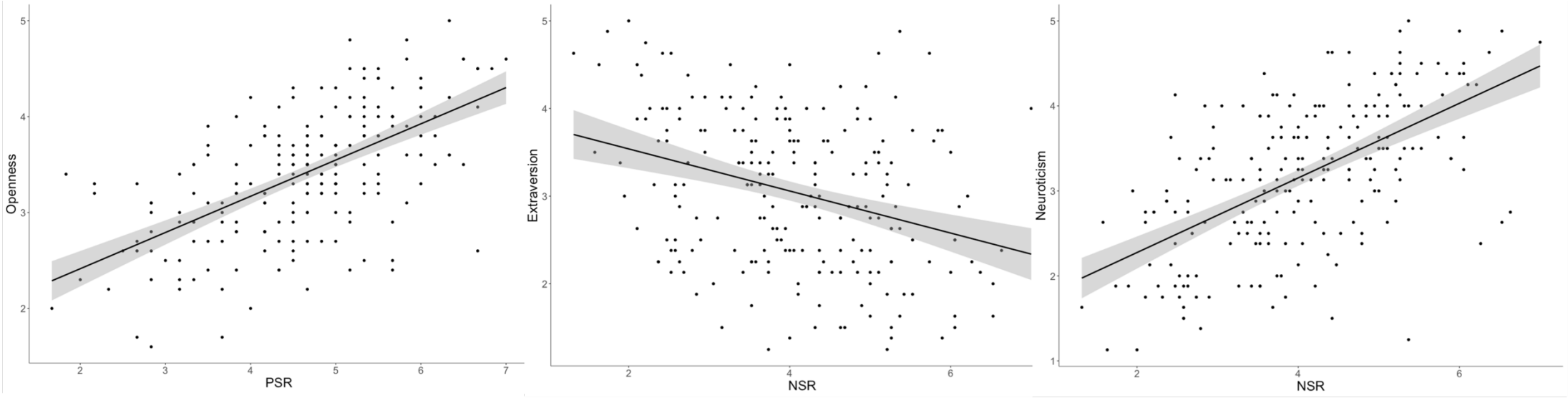
Pearson's correlations between the personality measures are displayed in Table 3.6. Correcting for multiple correlations, the significance level is set to $p < .001$. Interesting associations to note include the negative correlation between NSR and extraversion, as well as the strong positive correlation with neuroticism. PSR had a positively correlated with openness to experience. Social desirability was not associated with SPS but was related to all Big Five personality traits except openness to experience.

Determining the amount of variance in SPS accounted for by the Big Five, a multiple linear regression was conducted. A significant regression equation was found, $F(5, 216) = 26.93$, $p < .001$, with an R^2 of 0.384, and the Big Five personality traits accounting for 38.4% of the variance in SPS score. Extraversion ($p = .04$), neuroticism and openness ($ps < .001$) were significant predictors of SPS score. Testing the individual subscales, it was revealed that the Big Five personality traits account for 39.5% of the variance in NSR score ($F(5, 216) = 28.17$, $p < .001$), with extraversion ($p = .006$), openness and neuroticism ($ps < .001$) as significant predictors. 43.3% of the variance in PSR score was accounted for by these traits, ($F(5, 216) = 33.03$, $p < .001$ with neuroticism, openness, and conscientiousness ($ps < .001$) as significant predictors.

Table 3.6. Pearson's bivariate correlations (coefficient, p-value) between the personality measures of SPS (and three subscales), SDS, and the Big Five personality traits. Correcting for multiple correlations, significance is set at $p < .001$, highlighted in bold. All dfs = 220.

	HSPS Score	NSR	PSR	SDS-17	Extraversion	Conscientiousness	Agreeableness	Neuroticism
NSR	**.971, *p* < .001**							
PSR	**.589, *p* < .001**	**.387, *p* < .001**						
SDS	-.027, *p* = .688	-.073, *p* = .279	.163, *p* = .015					
Extraversion	**-.238, *p* < .001**	**-.324, *p* < .001**	.183, *p* = .006	.195, *p* = .003				
Conscientiousness	-.109, *p* = .105	-.196, *p* = .003	.202, *p* = 002	**.445, *p* < .001**	.202, *p* = .003			
Agreeableness	-.086, *p* = .201	-.150, *p* = .026	.155, *p* = .021	**.450, *p* < .001**	**.251, *p* < .001**	**.313, *p* < .001**		
Neuroticism	**.540, *p* < .001**	**.590, *p* < .001**	.050, *p* = .459	**-.287, *p* < .001**	**-.362, *p* < .001**	**-.291, *p* < .001**	**-.223, *p* < .001**	
Openness	**.228, *p* < .001**	.094, *p* = .164	**.610, *p* < .001**	.121, *p* = .073	**.221, *p* < .001**	.065, *p* = .335	.116, *p* = .086	-.096, *p* = .152

Figure 3.6. Scatterplots with confidence intervals demonstrating the significant associations between the SPS subscales and the Big Five personality traits of openness, neuroticism, and extraversion.



Perception and personality

Correlations between personality and the perceptual and confidence variables are displayed in the Appendix D. All correlation coefficients were small ($r_s < .22$).

A hierarchical regression was conducted with the three Big Five personality traits of neuroticism, openness to experience, and extraversion entered in Model 1, and the HSPS subscales of NSR and PSR in Model 2, as predictors of overall detection. Model 1 accounted for 3.7% of the variance in detection scores, and this model was significant, $F(3, 218) = 2.77$, $p = .04$. Model 2 was also significant, $F(5, 216) = 3.35$, $p = .006$, and explained 7.2% of the variance, a significant R^2 change of .035. Standardised coefficients are displayed in Table 3.7. Extraversion and PSR were significant predictors, with extraversion negatively predicting detection. The regression remained unchanged with the addition of gender.

The same analysis was conducted for overall identification. Firstly, the three Big Five personality traits were entered into Model 1, and then NSR and PSR were added in Model 2. Model 1 accounted for 5.5% of the variance in identification scores, and this model was significant, $F(3, 218) = 4.26$, $p = .006$. Model 2 was also significant, $F(5, 216) = 4.16$, $p = .001$, and explained 8.8% of the variance, a significant R^2 change of .032. Standardised coefficients are displayed in Table 3.7. Extraversion negatively predicted and PSR positively predicted identification scores, the regression remained unchanged with the addition of gender.

Next, Signal Detection Theory d' (perceptual sensitivity) and β (response bias) were calculated. The correlations between these measures and personality are displayed in the Table 3.8. The only significant (small) associations were found between PSR and d' ($r(220) = .232$, $p < .001$) (Figure 3.7), openness to experience and d' ($r(220) = .186$, $p < .001$), and openness and β ($r_s(220) = -.163$, $p < .05$). A hierarchical regression was conducted, with the three Big Five traits entered as predictors of perceptual sensitivity (d') in Model 1 and the addition of PSR and NSR subscales in Model 2. The findings are displayed in Table 3.7. From Model 1 to Model 2, there was a significant R^2 change of .036, suggesting that the subscales of the HSPS predicted perceptual sensitivity beyond the Big Five, PSR significantly predicted perceptual sensitivity. The regression remained unchanged with the addition of gender as a predictor. The hierarchical regression with response bias was non-significant ($p > .05$) and thus not reported.

Table 3.7. Hierarchical regression analysis of predictors of the overall (total) percentage of total words detection and overall (total) percentage of words correctly identified, and perceptual sensitivity (d').

Predictor Variables	Overall Detection		Overall Identification		Perceptual Sensitivity (d')	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Extraversion	-.095	-.151*	-.181*	-.219**	-.109	-.161*
Neuroticism	.003	.059	-.114	-.111	-.010	.031
Openness	.188**	.060	.189**	.048	.210**	.072
NSR		-.173		-.072		-.148
PSR		.265**		.255**		.273**
R^2	.037	.072	.055	.088	.045	.081
R^2 Change		.035*		.032*		.036*
F	2.77*	3.35**	4.26**	4.16**	3.46*	3.83**

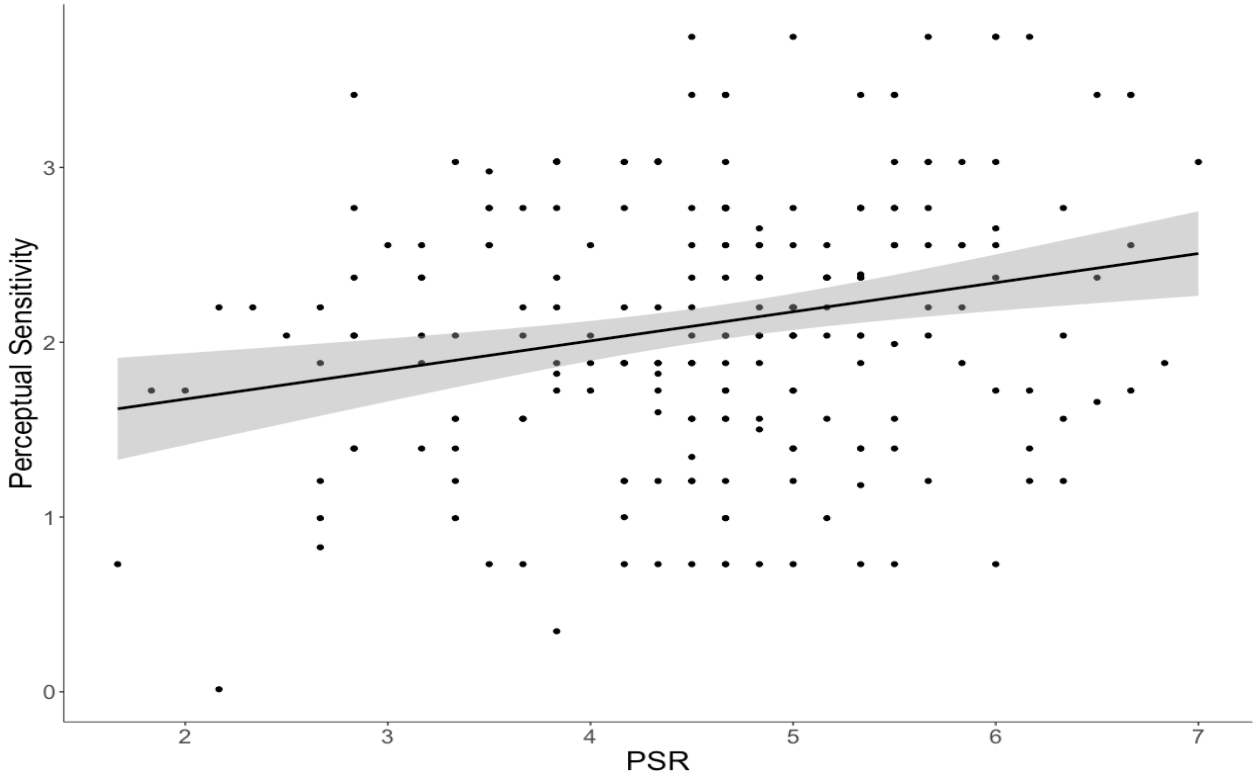
Standardised coefficients are reported.
*$p < .05$
**$p < .01$

Table 3.8. Correlations between the personality variables and signal detection measures, including perceptual sensitivity and response bias.
Pearson's correlations were conducted for perceptual sensitivity, and Spearman's rho (r_s) for response bias, due to non-normality. All dfs = 220.

	Perceptual Sensitivity (d')	Response Bias (β) (r_s)
HSPS Score	.092	.035
NSR	.035	.074
PSR	***.232	-.116
Extraversion	-.059	-.074
Conscientiousness	.035	.024
Agreeableness	*.158	-.001
Neuroticism	.009	.036
Openness	***.186	*-.163

* $p < .05$
*** $p < .001$

Figure 3.7. Scatterplot with confidence intervals demonstrating the relationship between PSR and perceptual sensitivity (d').



Six regressions were conducted with PSR as a predictor of the percentage of words detected and words correctly identified at each level of degradation. Full statistics are displayed in Table 3.9. The models with Level 2 and Level 3 detection and identification were significant.

Table 3.9. Model statistics for linear regressions with PSR as a predictor of the percentage of words detected and percentage of words accurately identified at each level of degradation. Significance is highlighted in bold.

	Detection			Identification		
	Level 1	Level 2	Level 3	Level 1	Level 2	Level 3
Model						
F	0.028	**7.209**	**10.579**	2.184	**9.244**	**5.913**
p	.868	**.008**	**.001**	.141	**.003**	**.016**
R^2	.000	**.032**	**.046**	.010	**.040**	**.026**

Social Desirability, SPS, and perception

No significant associations were found between SPS and social desirability (Appendix E). Spearman's partial correlations were conducted, but no effect of SDS on the relationship between SPS and perception were found. This is reported in Appendix E.

Discussion

This study firstly tested the associations between the Big Five personality traits and HSPS. The findings were in line with the previous literature, specifically revealing moderate-to-strong associations between HSPS and neuroticism, openness to experience, and extraversion (Bröhl et al., 2020; Grimen & Diseth, 2016; Hellwig & Roth, 2021; Smolewska et al., 2006; Tabak et al., 2022; Yano et al., 2019), traits that have been claimed to capture the entirety of SPS as measured by the HSPS (Hellwig & Roth, 2021). In particular, PSR was related to openness, and NSR with extraversion and neuroticism. The correlations found between HSPS and the Big Five personality traits, using bivariate correlations, were smaller than those found using latent variable correlations in Hellwig and Roth (2021), but are comparable to previous studies (e.g., Lionetti et al., 2019; Smolewska et al., 2006).

The study also sought to assess whether behavioural measures are differentially associated with the HSPS and Big Five traits, by testing the correlation between Big Five and HSPS with the detection and identification of degraded stimuli at differing levels of difficulty using a newly devised perceptual method. This new method was validated, as the findings demonstrated that all three degradation levels differed from one another, in that detection and identification were easiest at Level 1 and became increasingly more difficult at Level 2 and Level 3. Participants' confidence in their identification attempts decreased from Level 1 to Level 3, once again suggesting this increased perceptual difficulty. Furthermore, the percentage of words detected and words correctly identified also significantly differed at every level (as well as overall), supporting the distinction between identification and detection of external stimuli (Grill-Spector & Kanwisher, 2005; Hillis & Brainard, 2007; Jiminez et al., 2018; Koivisto & Revonsuo, 2003; Koivisto et al., 2017; Straube & Fahle, 2011).

Additionally, previous research has found that SPS is associated with an increased ability to detect subtleties in the environment (e.g., Gerstenberg, 2012; Williams et al. 2021) and an increased attentional awareness (Jagiellowicz et al., 2011; Liss et al., 2008; Sobocko & Zelenski, 2015). This is demonstrated using emotional viewing tasks as in Acevedo et al. (2014) and Tabak et al. (2022) In addition, SPS also shows associations with non-emotional perceptual ability, such as the ability

to detect and/or identify the presence of subtleties within degradation (Gerstenberg, 2012; Jagiellowicz, et al., 2011; Williams et al., 2021; Williams & Blagrove, 2022, as in Chapter 2).
In the current investigation, the PSR dimension of the HSPS was related to perceptual ability. PSR and NSR explained variability in both detection and identification scores beyond neuroticism, introversion, and openness to experience, showing that SPS cannot be reduced to Big Five variables, contrary to Hellwig and Roth (2021). The question thus arises of how the HSPS is associated with such perceptual advantages. Williams and Blagrove (2022) found that individuals high in AES were able to detect the presence of voices that had been degraded within white noise, although there was no evidence to suggest a heightened ability to identify the spoken content of these voices. This further raises the question of whether high SPS indicates low perceptual thresholds, such that accurate perception, in this case identification, can occur. In the current study, SPS (specifically PSR) predicted the percentage of words detected and identified at Level 2 and Level 3. However, the predictive power of PSR seemed stronger for Level 2 identification than Level 2 detection but was stronger for Level 3 detection than Level 3 identification. This implies that Highly Sensitive Persons have an advantage at detecting stimuli at higher levels of difficulty, but the threshold for identification may be higher and require lower levels of degradation for accurate identification to occur. Thus, the predictive power of PSR for identification peaked at Level 2. Nevertheless, it seems that high HSPS individuals possess a perceptual advantage for both detecting and identifying stimuli, and their thresholds at which this can occur may be lower than non-sensitives, particularly for detection, which supports the bottom-up account of high SPS (Williams et al., 2021).

Importantly, the finding that there is a perceptual advantage of being a Highly Sensitive Persons may balance the disadvantage of being easily overwhelmed and stimulated. This also indicates an evolutionary advantage and strategy for high SPS individuals (as well as in other mammals), in that the factors driving environmental sensitivity may be exaggerated more in highly sensitives (Lionetti et al., 2018). For instance, Lionetti et al. (2018) suggest that highly sensitives (“orchids”) have higher levels of emotional reactivity (positive and negative), but present as more introverted, whereas low sensitives (“dandelions”) are more extraverted and score lower on emotional reactivity.

Notwithstanding these findings that the perceptual advantage of SPS is not a function of Big Five personality traits, there remains the perspective that SPS is predominantly a combination of high neuroticism, openness to experience, and low extraversion. This indicates that SPS comprises a unique mix of traits present in approximately 15-30% of the population (Aron & Aron, 1997; Lionetti et al., 2018), resulting in an interesting personality profile of an individual who is highly reactive to internal and external stimuli, processes sensory information more deeply, and is inherently flexible and appreciative of aesthetics. Although SPS is not the same as the combination of the Big Five traits, given its unique perceptual component, we consider what causality may be present for this association between SPS and Big Five. One possibility is that the Big Five personality profile develops in some individuals *as a result* of high SPS. For instance, if an individual is susceptible to experiencing negative stimuli and environments more negatively, and positive stimuli and environments more positively (Differential Susceptibility; Belsky, 1997; Belsky & Pluess, 2009), they may be more likely to develop personality traits that correspond to these experiences. Thus, overstimulation from social experiences may result in introverted tendencies and/or behaviours, as well as increased emotionality. On the other hand, increased introversion and neuroticism, as well as an inherent openness to experiences early in life could result in the development of a highly sensitive personality profile. Nevertheless, the development of traits is difficult to test, and would need to involve measures of environmental sensitivity and personality development across the lifespan (at least into adulthood).

Although there is evidence here to suggest an independence of SPS and its subscales from neuroticism, openness, and extraversion, there still seems to be overlaps in definitions and behavioural outcomes which lead to confusion in their distinction. Recent attempts have been made to combat this through establishing alternative measures of environmental sensitivity. For example, Attary and Ghazizadeh (2021) investigated the location of SPS and its elements, as well as other measures of personality, within the trait space. They found two domains, a positive and negative cluster of traits, with neuroticism strongly dominating the negative. They highlighted the bordering of LST and EOE with neuroticism, but the separability of these elements. However, they were unable to separate AES from openness to experience within the positive cluster. To combat this, the authors removed AES from the scale entirely as an alternative measure of SPS, while highlighting the issue that the scale loses its measure of aesthetic appreciation, empathy, enhanced

depth of processing and awareness, which are all said to be core aspects of SPS (Aron & Aron, 1997; Aron, 2010).

Limitations

One limitation of the current study is online data collection. As a result of the COVID-19 pandemic and restrictions imposed by government bodies, traditional methods of collecting behavioural data were postponed, meaning online methods had to be adopted as an alternative. The consequence of this was the lack of control over the participants' environments. For instance, the computer screen was especially important in this study due to the visual nature of the task, and any difference in computer brand, model, size, and screen angle may have impacted upon viewing, thus influencing the perception of the noisy images. Also, although participants were instructed to sit approximately 50cm away from their screen, they could have ignored this and sat very close to optimise viewing or simply zoomed in to "cheat". Furthermore, distractions could have been present during the task, posing implications on participants' attention and consequently, their responses. Attempts were made to minimise these by including detailed instructions of computer screen set-up, comfort, and the minimisation of distractions. Also, time taken to complete the task was analysed and all outliers were excluded, and attention checks were added to test if all participants paid attention (not just clicking buttons) as well as to eliminate the possibility of "bots" (Eerola, Armitage, Lavan, & Knight, 2021). Nevertheless, variability in performance could have resulted from the above factors.

A second limitation is that the majority (n = 145) of participants were recruited using the online data collection platform Prolific. Crowdsourcing platforms have increased in popularity in recent years due to their convenience and fast data collection abilities while maintaining high quality data, specifically for personality research (Buhrmester, Talaifar, & Gosling, 2018; Eerola et al., 2021). However, the quality and how this compares to other platforms and traditional lab settings is still disputed (Anwyl-Irvine, Dalmaijer, Hodges, & Evershed, 2020; Elliot, Bell, Gorin, Robinson, & Marsh, 2020; Litman, Moss, Rosenzweig, & Robinson, 2021; Peer, Rothschild, Gordon, Evernden, & Ekaterina, 2021; Spinde, Krieger, Plank, & Gipp, 2021) although Prolific has been indicated as a reputable data source (e.g., Elliot et al., 2020; Stanton, Carpenter, Nance, Sturgeon, Villalongo, 2022).

Finally, the majority of participants were from the United Kingdom and of White ethnic backgrounds. SPS varies depending on country, with, for example, individuals from countries such as Belgium scoring higher on the positive subscale of the HSPS than British participants (Greven et al., 2019). Also, although attempts were made to balance the sample for gender, there was a higher proportion of women to men. With differences between men and women in the Big Five traits, as well as cross-culturally (Costa, Terracciano, & McCrae, 2001; Schmitt, Realo, Voracek, & Allik, 2009), caution is to be taken when generalising these results to different cultures, and, although gender was checked as a covariate in analyses here, a more equal sample size for males and females should be aimed for when testing for associations with personality.

Conclusion

The current investigation reinforces the moderate-to-strong associations between aspects of SPS and other personality traits, including of NSR with introversion and neuroticism, and of PSR with openness to experience. Despite this shared variance, the enhanced perceptual ability of high PSR scorers was shown for increased detection and identification of visually degraded words, and importantly this dimension of SPS was shown to predict perception beyond the variance accounted for by Big Five traits. This contradicts the view that SPS is simply a positive redefinition of neuroticism, low extraversion, and openness to experience, and supports the independent construct account of SPS and of the HSPS measure of SPS.

Chapter 4. Cross-Sectional Exploration of Dream Experiences and Associations with Sensory Processing Sensitivity.

Dreaming is defined as "…the recollection of mental activity which has occurred during sleep" (Schredl, 1999, p. 12), and usually consists of mental imagery, typically follows a narrative and may or may not relate to a person's physical and/or emotional state. Dreaming is suggested to occur intermittently all through the night, but subsequent arousal levels determines whether a dream is remembered. This arousal increases with Rapid Eye Movement (REM) sleep; this is one reason why dreams are more likely to be recalled during this phase. On the other hand, while dreams can occur during other phases (Siclari, Bernardi, Cataldi, & Tononi, 2018), non-REM sleep is associated with global and regional decreases in cerebral activation and blood flow, which might result in less elaboration of mental imagery (Palagini & Rosenlicht, 2011; Scarpelli et al., 2020).

Dreaming and Sensory Processing Sensitivity

When creating the Highly Sensitive Person Scale (HSPS), Aron and Aron (1997) included a set of sensitivity-related questions to correlate with SPS, including feelings of intense love and crying easily. Two items also related to remembering dreams and experiencing intense dreams. Sensory Processing Sensitivity (SPS) weakly correlated with the propensity to remember dreams in Study One (r = .19) and with the intensity of dreams in Study One and Study Four (r = .19), and this correlation in Study Four remained significant once social introversion and emotionality were partialled out. Since this early study on SPS, further research has demonstrated associations between the HSPS and dream experience. Firstly, using the German version of the HSPS (Konrad & Herzberg, 2019), Schredl et al. (2022) found that Aesthetic Sensitivity (AES) significantly predicted dream recall frequency above and beyond the Big Five personality traits, specifically, openness, neuroticism, and extraversion. Only AES was a significant predictor within their regression model, the other (negative) aspects of SPS (namely Ease of Excitation; EOE and Low Sensory Threshold; LST) did not contribute to the variance in dream recall (Schredl et al., 2022).

Secondly, and focusing mainly on nightmare experience, Carr, Matthews, Williams, and Blagrove (2020) found that highly sensitives who experience lower mental wellbeing

experience increased nightmares and nightmare distress, as well as associations between SPS and dream recall frequency. Finally, supporting this research, Carr et al. (2022) explored the relationships between nightmare frequency and distress and the three subscales of the HSPS, and revealed significant associations of the negative subscales of the HSPS (EOE and LST, as according to Smolewska et al., 2006) with nightmare frequency (while controlling for dream recall and the Big Five traits), as well as the significant prediction of EOE on nightmare distress (controlling for the Big Five traits). Therefore, SPS seems to hold relationships with dream experiences. However, since the development of the HSPS, there have been few studies that have confirmed the associations between SPS and different aspects of dreaming (Carr et al., 2020; Carr et al., 2022; Schredl et al., 2022), and two of these studies were focused on nightmares.

In order to extend the small amount of research on SPS and dreaming, it is important to consider other traits related to sensitivity. As mentioned, SPS has previously been associated with openness to experience, neuroticism, and extraversion and research has implicated these traits as a common personality profile of Highly Sensitive Persons (see Chapter 1). Therefore, these traits may aid in the understanding of the relationship between SPS and dreaming. Klepel, Schredl, & Goritz (2019) suggest that higher creativity is associated with remembering and being influenced by dreams involving creativity and problem-solving. The authors implicate openness to experience in creative dreaming. Openness to experience (Schredl, Henley-Einion, & Blagrove, 2016; Schredl & Rauthmann, 2022), as well as extraversion and neuroticism have been previously associated with the frequency of recalling dreams (Aumann, Lahl, & Pietrowsky, 2012), and open to experience individuals are also more likely to report lucid dreaming (Hess, Schredl, & Goritz, 2017). Schredl and Rauthmann (2022) hypothesise that openness relates to increased inner awareness, extraversion with dream sharing, and neuroticism with emotionally negative dreaming due to higher anxiety and depression during waking life, providing explanations as to why these personality traits are implicated in dream recall frequency. Mathes and Schredl (2016) particularly demonstrate that higher neuroticism is linked with increased threatening dreams, whereas openness to experience correlates with a decreased reporting of such dreams. Also, extraversion relates to positive emotions in dreams (Konig, Mathes, & Schredl, 2016) and neuroticism with negative emotions, such as frustration and confusion (Bernstein & Roberts, 1995).

Overview of Thin Boundaries and associations with dreaming

"*At the other extreme are people who are especially sensitive, open, and vulnerable. In their minds, things are relatively fluid; they experience thoughts and feelings – often many different feelings – at the same time. Such people have particularly thin boundaries*."

- Hartmann (1991; p.4).

Thin boundariness is another type of personality trait associated with sensitivity, vulnerability, and creativity (Hartmann, 1989), and was developed after Ernest Hartmann explored the question of "who has nightmares?" (Hartmann, 1991). Hartmann considered that an individual with thin boundaries is aware of others' thoughts and feelings, can become immersed in daydreaming and tends to think in "shades of grey", as opposed to black and white. Types of boundaries include those between perceptions, between sleep, dreaming and wakefulness, and between thoughts, feelings, and memories (Hartmann & Kunzendorf, 2006).

Research has found that thin sleep-dream-wake boundaries introduce an increased state of fluidity between waking and dream life, the result of this being increased dream frequency, as well as heightened recall of dreams and nightmares (Hartmann, 1991; Hartmann, Rosen, & Rand, 1998; Pietrowsky & Kothe, 2003; Schredl, Kleinferchner, & Gell, 1996; Schredl, Shafer, Hofmann, & Jacob, 1999; Zborowski et al., 1998). Hartmann et al. (1987) studied nightmare sufferers in structured interviews and a series of psychological tests. He discovered that these open and fluid individuals differed from controls/non-nightmare sufferers. This led to the eventual development of thin boundaries as a personality trait, measured with a questionnaire of 145 items, and a short 18-item form by Kunzendorf (Hartmann, 1991; Kunzendorf et al., 1997). Subsequent research has confirmed associations between thin boundaries and nightmare experience (e.g., Kráčmarová & Plháková, 2015; Pietrowsky & Kothe, 2003; Schredl, Bocklage, Engelhardt, & Mingebach, 2008). In addition, thin boundary individuals may be more likely to experience lucid dreaming due to a flexible dream-wake barrier (Schredl & Erlacher, 2004), posing implications on the treatment of nightmares by inducing lucid dreams (Gieselmann et al., 2019). Furthermore, thin boundary individuals may have specific types of dream content, for instance, reporting emotional and vivid dreams, with more interaction between characters (Hartmann, Elkin, & Garg, 1991) and appearing as something else (e.g., a child) (Schredl, 2020). A relationship with overall emotional intensity of dreams is also highlighted, for positive and negative emotions (Schredl, et al., 1996; Schredl et al., 1999).

As mentioned, dream content is related to thin boundariness. For instance, according to Hartmann (1991), thin boundary individuals often dream of being someone or something else in a dream, like a member of the opposite sex or an animal. Schredl (2020) suggests that the ability to imagine themselves as someone else in waking life can cross that boundary into dreamlife, in-line with the continuity hypothesis of dreaming (Domhoff, 2017; Hall & Nordby, 1972; Schredl, 2017; Schredl & Hofmann, 2003). Schredl (2020) investigated this and conducted a secondary analysis of previous data (Schredl, Ciric, Gotz, & Wittmann, 2004), with 444 participants (85% women). Dream recall frequency, boundaries, and typical dream content were measured. Dream content was measured using the Typical Dreams Questionnaire (TDQ; Nielsen et al., 2003), which provides 55 different dream topics (e.g., "eating delicious foods" and "insects or spiders"), to which participants state (by ticking a box) whether they have ever dreamed of that topic. There are four items on this scale concerning being something or someone else in a dream: being an object, being a member of the opposite sex, being an animal, and being a child again. Controlling for dream recall frequency, age, and sex, logistic regressions revealed that thin boundariness was significantly predictive of all dream topics concerning being something else. The author posits the imaginativeness and fluidity of thinking in waking life as a reason for this being reflected in dreams, as well as thin boundary individuals being more in touch with their autobiographical memories, demonstrated by dreaming of being a child again.

Sensory Processing Sensitivity and Thin Boundaries

Although there was heavy focus on thin boundaries from 1990 to 2010, more recently there has been a decrease in the number of investigations into boundaries of the mind. Perhaps this is because the theory of thin boundaries is so heavily associated with sleep and dreaming that it did not cross into other fields of psychology. Research questions that are based on the concept of sensitivity are now better operationalised by the more widely used HSPS measure, but while recognising the overlap between SPS and thin boundariness. For example, Hartmann (1991) proposed that thin and thick boundaries are a result of a mix of genetic and environmental influence. Boundariness does seem, however, to be closer to the positive facet of SPS (e.g., Positive Sensory Responsivity (PSR) or AES), in that both are associated with increased aesthetic awareness, empathy, creativity, and awareness of subtleties and delicacy (Aron, 2010; Aron & Aron, 1997; Harrison, Hartmann, & Bevis, 2005; Hartmann, 1991; Schredl & Erlacher, 2007; Smolewska et al., 2006; Tabak et al., 2022).

One difference between these measures, however, is their conception. Aron and Aron (1997), to create the HSPS, recruited individuals who were highly overwhelmed by stimuli or who were introverted, leading to the discovery of behavioural characteristics of Highly Sensitive Persons relating to ease of overstimulation, depth of processing, aesthetic awareness, and emotional reactivity. On the other hand, Hartmann (1989; 1991) conducted interviews with nightmare sufferers to develop the concept of thin boundariness; individuals described themselves as being able to cross mental boundaries, being more emotionally aware, creative, and appreciative of aesthetics. Additionally, SPS is suggested to be a combination of openness to experience, neuroticism, and introversion (Hellwig & Roth, 2021), whereas thin boundaries is related to openness to experience (e.g., Schredl et al., 2003), but, to a lesser extent, neuroticism and low conscientiousness (e.g., Schredl et al., 2008).

Therefore, due to both sensitivity traits being related to dreaming, as well as having overlaps with other traits (e.g., temperament, openness to experience), further research is required to investigate the associations between SPS and thin boundaries. Also, as thin boundaries is related to dream complexity, this might also apply to high SPS. Schredl (2020) found that individuals with thin boundaries tend have more dreams related to being something else, perhaps due to the complexity of their imaginativeness in their waking thoughts. Extending this to Highly Sensitive Persons, increased empathy (Aron, 2010) could result in greater complexity of thoughts in waking life, as well as being more able to put themselves in others' positions. It would therefore be interesting to explore these aspects of dream experience amongst highly sensitives, thus conceptually replicating Schredl (2020), as well as investigating their frequency of dream and nightmare recall.

Aims and hypotheses

Although there is limited research, SPS seems to hold associations with the different facets of dreaming experience, such as nightmares (Carr et al., 2020; Carr et al., 2022) and dream recall frequency (Aron & Aron, 1997; Schredl et al., 2022), and might extend, like thin boundariness, to measures that capture the complexity of dreaming (Aron & Aron, 1997). The first aim is to test the associations between SPS and dream variables. Also, as to the author's knowledge, there is no research to date that has tested the association between SPS and thin boundariness, this will be tested for. These cross-sectional relationships were investigated.

Method

Participants

Participants (N = 245) were recruited from two sources. An advert was posted on social media with a link to take part. Participants (n = 198) were entered into a prize draw to win a £25 gift voucher. The university participant pool was also used, participants (n = 47) were rewarded two course credits for participation. A total of 9 participants were excluded (all were recruited using social media) because of significant missing data, leaving a sample size of N = 236. Due to a system error, age was only recorded for 223 participants. The mean age was 35.13 years (SD = 13.95), ranging from 18 to 82 years. There were no exclusion criteria based on age, as the study aimed to explore the dream experiences of the general population. There were 193 women (81.8%) and 37 men (15.7%). 4 participants were non-binary, 1 stated "Other", and 1 preferred not to state their gender. The majority (94.9%) were White, 3% were Asian, 0.9% were of Mixed Ethnicity, and 1.3% stated they were of "Other" ethnic backgrounds.

Sample size and power calculation: A power calculation using G*Power software (Faul, Erdfelder, Buchner, & Lang, 2007) revealed a necessary sample size of N = 432 to detect an effect size of $f^2 = 0.037$ (from Aron & Aron, 1997) at 80% power for a regression model with a maximum of 9 predictors. However, due to time restraints and participant exclusions, only a sample size of N = 236 was achieved. A sensitivity analysis (G*Power) revealed that a sample of N = 236 was sensitive enough to detect an effect size of $f^2 = 0.069$ at 80% power.

Materials

To measure thin boundariness, the Boundary Questionnaire-18 (BQ18; Kunzendorf, Hartmann, Cohen, & Cutler, 1997) was used (Cronbach's alpha = .64). This scale is a short (18 item) version of the original 145 item Boundaries Questionnaire (Harrison et al., 2006), that measures core attributes of having thin boundaries. Items include "My feelings blend into one another" and "I believe I am influenced by forces that no one can understand", and participants rate each of the statements on a scale of 0 ("Not at all true of me") to 4 ("Very true of me"). All items were summed to create a total Thin Boundaries score.

The 27-item Highly Sensitive Person Scale (HSPS; Aron & Aron, 1997) (Cronbach's alpha = .90) was used to measure SPS. Participants responded to each question according to a 7-point Likert scale (1 = Not at all, 7 = Extremely). The mean HSPS score was calculated for each

participant. Mean PSR (6 items; a = 0.66) and mean Negative Sensory Responsivity (NSR) (19 items; a = 0.90) were also calculated (Tabak et al., 2022).

The Big Five Inventory-10 (BFI-10; Rammstedt & John, 2007) was administered to measure extraversion (Cronbach's alpha (a) = .45), agreeableness (a = .24), conscientiousness (a = .40), neuroticism (a = .61), and openness to experience (a = .77. The scale has two items that correspond to each trait, where participants rate how the statements describe their personality on a scale of 1 = "Disagree strongly" to 5 = "Agree strongly". For instance, to measure neuroticism, participants rate themselves according to the statements "gets nervous easily" and "is relaxed, handles stress well" (reversed). The items were summed, and a mean score was calculated for each personality trait. A brief measure of the Big Five was included to only control for the traits in the analysis with HSPS score.

To measure anxiety, the State Trait Anxiety Inventory (STAI; Form Y2; Spielberger, Gorsuch, Lushene, Bagg, & Jacobs 1983) (Cronbach's alpha = .93) was provided to participants. Form STAI-Y2 provides a series of statements which could describe how participants feel (e.g., "I feel pleasant"; "I feel inadequate"), participants rate themselves according to these on a scale of 1 = "Almost Never" to 4 "Almost Always", with positive statements being reverse scored (1 = "Almost Always"; 4 = "Almost Never"). All items are totalled to create a total STAI score, with higher scores indicating higher trait anxiety.

Two questionnaires were administered to explore dream experience. Firstly, the Mannheim Dream Questionnaire (MADRE; Schredl, Berres, Klingauf, Schellhaas, & Goritz, 2014) asks participants about general dream experience. Across the questionnaire, there was a varied number of responses per question due to lack of forced choice, the number of responses per question ranged from 131 (age of first lucid dream experience) to 236.

- The first item refers to how often dreams are recalled, on a 7-point Likert scale ranging from 0 = "Never" and 6 = "Almost every morning". This item measured dream recall frequency (DRF)
- Secondly, the intensity of dream emotions is rated on a scale of 0 = "Not at all intense" to 4 = "Very intense". This item measured dream emotional intensity.
- Dream emotional valence is measured from -2 ("Very negative") to +2 ("Very positive").

- Nightmare frequency is measured using an 8-point scale of 0 = “Never” to 7 = “Several times a week”.
- Nightmare distress is measured using a 5-point scale of 0 = “Not at all distressing” to 4 = “Very distressing”.
- One question asks if the participant experiences nightmares related to a waking-life experience (“Yes” or “No”), as well as the percentage of nightmares that are recurrent.
- Childhood nightmares was measured using the same 8-point scale as previously (0 = “Never” and 7 = “Several times a week”). Participants were also asked to list the topics of their childhood nightmares.
- Lucid dream frequency was measured using the 8-point scale (0 = “Never” and 7 = “Several times a week”), as well as the age they first occurred.
- Attitude towards dreams was measured using 8 items, such as “How strong is your interest in dreams?”, all items were rated on a scale of 0 = “Not at all” to 4 = “Totally”. The scores for each item were summed and averaged to create a dream attitude score, but only for those participants that completed all items. Higher scores indicated more positive attitude towards dreams.
- Participants were asked how often: they tell their dreams to others, record their dreams, their dreams affect their mood, their dreams give creative ideas, their dreams help to solve problems, and the experience of déjà vu. All these items were measured on the 8-point scale from 0 = “Never” to 7 = “Several times a week”.
- Finally, two questions asked whether participants have read about the topic of dreams (“No, “One to two times”, or “Several times”), as well as if this helped them better understand their dreams (“Yes” or “No”).

Finally, participants completed the Typical Dreams Questionnaire (TDQ; Nielsen et al., 2003). This provides 55 different dream topics that a person could encounter. Participants went through each item and stated whether they had experienced that particular dream topic by ticking a box. Examples of dream topics include “Seeing an angel” and “Being locked up”. Participants were also asked to state which theme occurred most often in life and earliest in life. One question was removed (“How many dreams of any kind do you recall in an average month? And how many nightmares?”) as this was covered by the MADRE. As well as

exploring the types of dream topics participants selected, the total number of dream topics selected was totalled to dream a Dream Content Score.

Procedure

Participants were recruited to take part either using an advert on social media or through the university participant pool. Once they chose to participate, they clicked a link which directed them to a Qualtrics (Qualtrics, Provo, UT) questionnaire. Firstly, an information sheet was provided with all the study details. Participants provided informed consent at this point and moved onto the questionnaire. They were asked to provide demographic information (age, gender, ethnicity, education level). Participants completed the questionnaires in the following order: BQ-18, HSPS, BFI-10, STAI, MADRE, TDQ. All items on the scales were voluntary, participants did not have to respond. Once they had completed these, they were fully debriefed.

Statistical analysis

Correlations between the personality variables of HSPS score, NSR, PSR, STAI, extraversion, openness to experience, agreeableness, conscientiousness, and neuroticism were conducted. Multiple regressions were also conducted the determine the amount of variance in HSPS score, NSR, and PSR accounted for by the Big Five traits. Summaries of the dream variables (percentages, frequencies, means (SD), and medians) are provided following the ordinal nature of the MADRE questionnaire, as well as a summary of the type of dream topics experienced by participants (TDQ).

Correlations were also used to test for associations between SPS (HSPS score, NSR, PSR), thin boundaries, and the dream variables. Spearman's rho were used due to the ordinal nature of the dream data. To test the unique predictions of NSR and PSR on five dream variables (DRF, Dream Emotional Intensity, Dream Emotional Valence, NMF, and Nightmare Distress), a series of ordinal regressions were conducted. Three models were calculated, the first model (Model 1) included the three Big Five traits of neuroticism, extraversion, and openness to experience, as well as STAI and thin boundaries (with age and gender included as covariates). NSR and PSR were added to Model 2. In Model 3, depending on the dependent variable, dream recall frequency (DRF) and nightmare frequency (NMF) were included as control variables. NMF was not included in the model predicting DRF. For Dream Emotional Intensity and Dream Emotional Valence, only the first two models were calculated, as emotional intensity and valence of dreams is not dependent on dream recall or nightmare frequency.

Finally, replicating the analysis of Schredl (2020), a series of logistic regressions were conducted to test the predictions of, firstly, thin boundaries, and secondly, NSR and PSR on dream topics concerning being something else. These dream topics were dreaming of being an object, a member of the opposite sex, an animal, or being a child again. Participants responded to having these dream topics with 1 = Yes or 0 = No. The first set of logistic regressions included only thin boundaries, DRF, age, and sex (the latter three as covariates) as predictors to replicate Schredl (2020). Secondly, to test the predictions of NSR and PSR, two models were run. The first model (Model 1) included thin boundaries, the three Big Five traits, DRF, age, and sex. NSR and PSR were added to the second model (Model 2).

Results

Descriptive statistics of personality variables

The descriptive statistics for the personality variables and trait anxiety are displayed in Table 4.1.

Table 4.1. Descriptive statistics for the personality variables, including means, standard deviations (SD), minimums and maximums.

	Mean	**SD**	**Minimum**	**Maximum**
Thin Boundaries	34.16	8.45	8.00	56.00
HSPS Score	4.30	0.92	1.59	6.48
NSR	4.12	1.09	1.16	6.53
PSR	4.49	0.99	2.00	7.00
Extraversion	6.33	2.05	2.00	10.00
Agreeableness	7.21	1.71	2.00	10.00
Conscientiousness	7.33	1.74	2.00	10.00
Neuroticism	6.81	2.18	2.00	10.00
Openness to Experience	6.83	1.67	2.00	10.00
Trait Anxiety (STAI)	49.91	11.36	25.00	80.00

Correlations between Personality Variables

Correlations between the personality variables (HSPS, NSR, PSR, STAI, extraversion, openness to experience, agreeableness, conscientiousness, neuroticism and boundariness) are

displayed in Table 4.2. STAI score was significantly associated with HSPS score and NSR, but not with PSR. As expected, there were significant correlations of HSPS score with extraversion and neuroticism, in that high HSPS score was associated with lower extraversion and higher neuroticism. HSPS score did not significantly correlate with openness to experience, and once corrected for multiple tests, PSR was not significantly associated with the trait. NSR was particularly associated with lower extraversion and increased neuroticism. HSPS score, NSR, and PSR were moderately associated with thin boundariness.

Table 4.2. The correlations between personality variables (coefficient, p-value). Spearman's rho were conducted for agreeableness, conscientiousness, neuroticism due to non-normality (r_s). Correcting for multiple correlations, significance is set at $p < .001$; highlighted in bold. All dfs = 234

	HSPS Score	NSR	PSR	STAI	Extraversion	Openness	Agreeableness (r_s)	Conscientious-ness (r_s)	Neuroticism (r_s)
NSR	**.967, *p* < .001**								
PSR	**.577, *p* < .001**	**.364, *p* < .001**							
STAI	**.488, *p* < .001**	**.539, *p* < .001**	.036, *p* = .579						
Extraversion	-.172, *p* = .008	**-.217, *p* < .001**	.071, *p* = .280	**-.348, *p* < .001**					
Openness	.128, *p* = .050	.087, *p* = .185	.200, *p* = .002	.002, *p* = .975	.008, *p* = .898				
Agreeableness (r_s)	-.113, *p* = .084	-.117, *p* = .073	.015, *p* = .821	-.197, *p* = .002	.188, *p* = .004	.058, *p* = .377			
Conscientious-ness (r_s)	-.088, *p* = .176	-.147, *p* = .024	.167, *p* = .010	**-.250, *p* < .001**	.158, *p* = .015	-.099, *p* = .129	.119, *p* = .067		
Neuroticism (r_s)	**.443, *p* < .001**	**.497, *p* < .001**	-.043, *p* = .516	**.620, *p* < .001**	**-.447, *p* < .001**	.061, *p* = .348	-.170 *p* = .009	-.204, *p* = .002	
Thin Boundaries	**.489, *p* < .001**	**.459, *p* < .001**	**.318, *p* < .001**	**.440, *p* < .001**	-.149, *p* = .022	.162, *p* = .013	-.030, *p* = .643	**-.249, *p* < .001**	**.293, *p* < .001**

Regressions predicting HSPS score and subscales from the Big Five Traits

Determining the amount of variance in SPS accounted for by the Big Five, a multiple linear regression was conducted. A significant regression equation was found, $F(5, 230) = 11.927$, $p < .001$, with an R^2 of 0.206, the Big Five personality traits accounted for 20.6% of the variance in HSPS score. Interestingly, only neuroticism significantly predicted HSPS Score (b = .443, $p < .001$).

Testing the individual subscales, it was revealed that the Big Five personality traits account for 27.2% of the variance in NSR score ($F(5, 230) = 17.182$, $p < .001$), with neuroticism as a significant predictor (b = .507, $p < .001$). 26.7% of the variance in PSR score was accounted for by these traits ($F(5, 230) = 3.539$, $p = .004$), openness ($p < .001$), and conscientiousness ($p = .019$) were significant predictors.

Descriptive statistics of MADRE dream variables

A summary of participants' dream and nightmare occurrences are displayed in Tables 4.3 and 4.4. 23.3% and 22.4% of the sample recalled their dreams about once a week and several times a week (respectively). 36.2% of participants experience dreams that are somewhat intense in terms of emotion, and over 50% described their dreams as on average neutral valence. Only 7.2% of the sample experience nightmares several times a week, whereas 12.7% never experience nightmares. Additional descriptive statistics are displayed in Appendix F.

Table 4.3. The descriptive statistics summarising the dream experience variables measured by MADRE, including the percentage and frequency of responses per option, as well as means and medians of each variable. The total number of responses are also provided per dream variable as the questions were optional, resulting in missing data.

	Percentage of Responses	Frequency
Dream Recall Frequency		
Never	7.8	18
Less than once a month	12.9	30
About once a month	11.6	27
About 2-3 times a month	12.5	29
About once a week	23.3	54
Several times a week	22.4	52
Almost every day	9.5	22
Total Number of Responses	232	
Mean (SD)	3.36 (1.79)	
Median	4.00	
Dream Emotional Intensity		
Not at all intense	12.3	29
Not that intense	24.7	58
Somewhat intense	36.2	85
Quite intense	15.7	37
Very intense	11.1	26
Total Number of Responses	235	
Mean (SD)	1.89 (1.16)	
Median	2.00	
Dream Emotional Valence		
Very Negative	3.8	9
Somewhat Negative	29.8	70
Neutral	56.2	132
Somewhat Positive	9.8	23
Very Positive	0.4	1
Total Number of Responses	235	
Mean (SD)	-0.27 (0.70)	
Median	0.00	

Table 4.4. The descriptive statistics summarising the nightmare experience variables measured by MADRE, including the percentage and frequency of responses per option, as well as means and medians of each variable. The total number of responses are also provided per dream variable as the questions were optional, resulting in missing data.

	Percentage of Responses	Frequency
Nightmare Frequency		
Never	12.7	30
Less than once a year	8.9	21
About once a year	9.3	22
About 2 - 4 times a year	21.6	51
About once a month	16.5	39
About 2 - 3 times a month	14.4	34
About once a week	9.3	22
Several times a week	7.2	17
Total Number of Responses	236	
Mean (SD)	3.37 (2.05)	
Median	3.00	
Nightmare Distress		
Not at all distressing	6.1	10
Not that distressing	17.8	29
Somewhat distressing	43.6	71
Quite distressing	21.5	35
Very distressing	11.0	18
Total Number of Responses	163	
Mean (SD)	2.13 (1.03)	
Median	2.00	

Summary of Typical Dreams

The most common five dream topics that participants reported experiencing were falling (77.5% experienced), being chased or pursued (75.4%), trying again and again (58.1%), sexual experiences (55.5%), and being on the verge of falling (53.4%). The five least common dream topics were being an object (3.0% experienced), seeing a UFO (3.0%), encountering God (3.0%), being at a movie (3.8%) and seeing aliens (4.2%). The total number of dream topics that participants experienced was calculated, and the mean was 13.25 (SD = 9.22), with a minimum of 0 and maximum of 42 topics selected.

Correlations between SPS, Thin Boundaries, and dream variables

Correlations between SPS, thin boundaries, and dream variables are displayed in Table 4.5. Correlations with the Big Five traits are presented in Appendix G. HSPS score and NSR were significantly associated with dream recall, and correlation coefficients were similar in size to previous research (Carr et al., 2020; Schredl et al., 2022). All three SPS variables were moderately (positively) associated with emotional intensity of dreams. HSPS score and NSR were negatively related to the emotional tone of dreams, in that higher HSPS/NSR are associated with more negative dreaming. HSPS score and NSR correlated with higher nightmare frequency and nightmare distress. In line with previous research, thin boundariness was significantly associated with dream recall frequency, nightmare frequency, nightmare distress, dream emotional intensity, and attitude towards dreams. Correlations with lucid dream frequency, age at which lucid dreaming first occurred, and dream attitude are displayed in the Appendix G.

Table 4.5. Spearman's rho correlations (coefficient, p value, degrees of freedom (df)) between the SPS variables (total HSPS score, NSR, and PSR), trait anxiety (STAI), and thin boundaries with the dream variables. Correcting for multiple correlations, significance is set at $p < .001$; highlighted in bold.

	HSPS Score	NSR	PSR	STAI	Thin Boundaries
Dream Recall Frequency (DRF)	**.228, *p* < .001, df = 230**	.202, *p* = .002, df = 228	.148, *p* = .024, df = 230	.097, *p* = .140, df = 230	.158, *p* = .016, df = 230
Dream Emotional Intensity	**.424, *p* < .001, df = 233**	**.379, *p* < .001, df = 233**	**.329, *p* < .001, df = 233**	**.311, *p* < .001, df = 233**	**.284, *p* < .001, df = 233**
Dream Emotional Valence	**-.228, *p* < .001, df = 233**	**-.228, *p* < .001, df = 233**	-.062, *p* = .341, df = 233	**-.270, *p* < .001, df = 233**	-.086, *p* = .191, df = 232
Nightmare Frequency	**.376, *p* < .001, df = 234**	**.385, *p* < .001, df = 234**	.113, *p* = .082, df = 234	**.330, *p* < .001, df = 234**	**.302, *p* < .001, df = 234**
Nightmare Distress	**.316, *p* < .001, df = 161**	**.315, *p* < .001, df = 161**	.135, *p* = .085, df = 161	.204, *p* = .009, df = 161	.164, *p* = .037, df = 161

Ordinal regressions testing the predictions of personality traits on dream experiences

A series of ordinal regression were conducted to test the predictions of NSR, PSR, thin boundaries, and STAI on the dream and nightmare measures. Firstly, extraversion, neuroticism, openness to experience, age and sex (as control variables), STAI and thin boundaries were added to Model 1. NSR and PSR were then added to Model 2. A third model was tested to control for NMF and DRF (except for emotional intensity and emotional valence of dreams) to see if predictions changed when controlling for these variables.

Firstly, dream recall frequency was tested, all statistics are displayed in Table 4.6. In both models, the only significant predictor of dream recall was openness to experience (Model 2; b = 0.175, p = .020).

Secondly, STAI (b = 0.047, p = .003), sex (b = 2.364, p = .046), NSR (b = 0.559, p = .001) and PSR (b = 0.305, p = .048) positively predicted the intensity of dream emotions. NSR became non-significant (p = .05) once nightmare frequency and dream recall frequency were added to the model (models in Table 4.9). STAI was the only significant predictor of emotional valence of dreams (Model 2; b = -0.059, p < .001) (Table 4.7).

Thin boundaries (Model 2; b = 0.047, p = .007), age (Model 2; b = -0.019, p = .039), and NSR (Model 2; b = 0.591, p < .001) predicted nightmare frequency. Controlling for dream recall frequency did not change the predictions. STAI score was significant in Model 1 (b = 0.040, p = .006), but became non-significant in Model 2 (p = .095). Results are demonstrated in Table 4.8.

Finally, in Model 1, neuroticism positively predicted nightmare distress (b = .218, p = .022), however, when NSR and PSR were added to Model 1, neuroticism became non-significant (p = .068), and sex became significant (p = .034). NSR also positively predicted nightmare frequency (b = 0.417, p = .048). In Model 3, nightmare frequency was added as a control variable. The prediction of neuroticism was significant (b = 0.236, p = .024), NSR (p = .209) and sex (p = .061) became non-significant. (Models in Table 4.10).

Table 4.6. Ordinal regressions testing dream recall frequency. NSR and PSR were added to Model 2. Model with nightmare frequency added did not change the predictions, so are not presented. Significance is highlighted in bold. B = beta, SE = standard error, p = p value.

	Dream Recall Frequency (Model 1)			**Dream Recall Frequency (Model 2)**		
	B	SE	p	B	SE	p
Extraversion	0.101	0.067	.131	0.101	0.067	.129
Neuroticism	-0.027	0.074	.714	-0.046	0.078	.556
Openness to Experience	0.189	0.075	**.011**	0.175	0.075	**.020**
STAI	0.008	0.015	.583	0.004	0.015	.790
Thin Boundaries	0.031	0.016	.062	0.020	0.017	.251
Age	-0.014	0.009	.124	-0.012	0.009	.193
Sex (0 = Male, 1 = Female)	-1.302	1.048	.214	-1.173	1.050	.264
NSR				0.212	0.162	.189
PSR				0.112	0.148	.449
X^2	19.69			23.77		
p	0.006			0.005		
N	218			218		
Nagelkerke R^2	0.106			0.106		

Table 4.7. Ordinal regressions testing Dream Emotional Intensity. NSR and PSR were added to Model 2. Significance is highlighted in bold. B = beta, SE = standard error, p = p value.

	Dream Emotional Intensity (Model 1)			**Dream Emotional Intensity (Model 2)**		
	B	SE	p	B	SE	p
Extraversion	0.122	0.069	.074	0.121	0.069	.081
Neuroticism	-0.044	0.076	.561	-0.096	0.081	.238
Openness to Experience	0.095	0.076	.211	0.066	0.077	.391
STAI	0.055	0.015	**< .001**	0.047	0.016	**.003**
Thin Boundaries	0.043	0.017	**.011**	0.014	0.018	.445
Age	0.002	0.009	.806	0.006	0.010	.518
Sex (0 = Male, 1 = Female)	2.036	1.200	.090	2.364	1.186	**.046**
NSR				0.559	0.170	**.001**
PSR				0.305	0.154	**.048**
X^2	40.59			65.32		
p	< .001			< .001		
N	221			221		
Nagelkerke R^2	0.177			0.269		

Table 4.8. Ordinal regressions testing the Emotional Valence of Dreams. NSR and PSR were added to Model 2. Significance is highlighted in bold. B = beta, SE = standard error, p = p value.

	Dream Emotional Valence (Model 1)			**Dream Emotional Valence (Model 2)**		
	B	SE	p	B	SE	p
Extraversion	-0.079	0.073	.284	-0.070	0.074	.345
Neuroticism	0.038	0.082	.643	0.076	0.087	.382
Openness to Experience	0.005	0.082	.952	0.022	0.083	.786
STAI	-0.065	0.017	**< .001**	-0.059	0.017	**< .001**
Thin Boundaries	0.007	0.018	.677	0.023	0.019	.240
Age	-0.002	0.010	.813	-0.004	0.010	.702
Sex (0 = Male, 1 = Female)	-1.147	1.152	.319	-1.306	1.160	.260
NSR				-0.305	0.180	.090
PSR				-0.080	0.164	.628
X^2	20.98			25.81		
p	0.004			0.002		
N	221			221		
Nagelkerke R^2	0.103			0.125		

Table 4.9. Ordinal regressions testing the Nightmare Frequency. NSR and PSR were added to Model 2. Model with dream recall frequency added did not change the predictions, so are not presented. Significance is highlighted in bold. B = beta, SE = standard error, p = p value.

	Nightmare Frequency (Model 1)			**Nightmare Frequency (Model 2)**		
	B	SE	p	B	SE	p
Extraversion	0.006	0.066	.928	-0.004	0.066	.956
Neuroticism	-0.023	0.073	.758	-0.112	0.078	.153
Openness to Experience	-0.049	0.074	.504	-0.055	0.075	.458
STAI	0.040	0.015	**.006**	0.025	0.015	.095
Thin Boundaries	0.056	0.016	**< .001**	0.047	0.017	**.007**
Age	-0.025	0.009	**.007**	-0.019	0.009	**.039**
Sex (0 = Male, 1 = Female)	1.129	1.055	.285	1.589	1.071	.138
NSR				0.591	0.164	**< .001**
PSR				-0.144	0.148	.330
X^2	54.63			67.10		
p	< .001			< .001		
N	222			222		
Nagelkerke R^2	0.22			0.27		

Table 4.10. Ordinal regressions testing Nightmare Distress. NSR and PSR were added to Model 2, and nightmare frequency was added as control variables in Model 3. DRF did not change the predictions and is thus not reported. Significance is highlighted in bold. B = beta, SE = standard error, p = p value

	Nightmare Distress (Model 1)			**Nightmare Distress (Model 2)**			**Nightmare Distress (Model 3)**		
	B	SE	p	B	SE	p	B	SE	P
Extraversion	0.125	0.085	.138	0.121	0.085	.155	0.139	0.086	.107
Neuroticism	0.218	0.095	**.022**	0.186	0.102	.068	0.236	0.104	**.024**
Openness to Experience	-0.053	0.098	.591	-0.098	0.101	.333	-0.122	0.102	.231
STAI	0.018	0.019	.346	0.007	0.019	.702	0.003	0.02	.884
Thin Boundaries	0.028	0.022	.202	0.002	0.023	.916	-0.01	0.024	.669
Age	-0.014	0.012	.263	-0.013	0.012	.314	-0.008	0.013	.522
Sex (0 = Male, 1 = Female)	2.260	1.200	.060	2.539	1.195	**.034**	2.261	1.205	.061
NSR				0.417	0.211	**.048**	0.271	0.216	.209
PSR				0.189	0.191	.322	0.162	0.193	.400
NMF							0.46	0.106	**< .001**
X^2	21.09			29.25			47.05		
p	.004			<.001			<.001		
N	152			152			152		
Nagelkerke R^2	0.138			0.186			0.283		

Logistic regressions predicting dream topics concerning being something else

The dream topics examined here were being an object, being a member of the opposite sex, being an animal, and being a child again. Table 4.11 demonstrates the responses to each dream topic. Responses were coded where 1 = Yes (experienced the dream topic) and 0 = No (has not experienced the dream topic). A replication of the logistic regressions conducted by Schredl (2020) is displayed in Table 4.12. Similar results were found, although the only discrepancy is that thin boundaries did not reach significance when predicting being an object in the current study (b = 0.088, p = .156). Age also predicted being a member of the opposite sex (b = -0.077, p = .040) and being an animal (b = -0.165, p = .041), and DRF predicted being a child again (b = 0.283, p = .004).

Table 4.11. The frequency and percentage of participants who had experienced (yes) and had not experienced (no) each dream topic concerning being something else.

	Frequency		**Percentage**	
	Yes	**No**	**Yes**	**No**
Being an object	7	229	3.0	97.0
Being a member of the opposite sex	12	224	5.1	94.9
Being an animal	16	220	6.8	93.2
Being a child again	74	162	31.4	68.6

Additionally, four further logistic regressions were conducted to test the prediction of the additional variables in the current study on the dream topics. Firstly, thin boundaries, extraversion, neuroticism, openness, DRF, age, and sex were included as predictors. In the second model, NSR and PSR were added. There were no changes to any of the models after the inclusion of NSR and PSR, thus only the second models are reported. All regression statistics are displayed in Table 4.13. Firstly, PSR (b = 1.723, p = .041) and DRF (b = 1.641, p = .026) predicted whether participants had dreamt about being an object. Secondly, age (b = -0.093, p = .023) and sex (b = -2.875, p = .039) predicted being a member of the opposite sex. Thin boundaries (b = .234, p = .008), neuroticism (b = -0.831, p = .017), and age (b = -0.261, p = .017) predicted being an animal. Finally, thin boundaries (b = 0.088, p < .001) and DRF (b = 0.269, p = .008) predicted being a child again.

Table 4.12. Logistic regressions testing the predictions of thin boundaries, DRF, age, and sex on dream topics concerning being something else. These regressions replicate the analysis found in Schredl (2020).
Significance is highlighted in bold. B = beta, SE = standard error, p = p value.

	Being an object			**Being a member of the opposite sex**			**Being an animal**			**Being a child again**		
	B	SE	p	B	SE	P	B	SE	p	B	SE	p
Thin Boundaries	0.088	0.062	.156	0.089	0.045	**.047**	0.137	0.062	**.029**	0.104	0.024	**< .001**
DRF	0.869	0.420	**.038**	0.304	0.206	.139	0.445	0.300	.138	0.283	0.098	**.004**
Age	-0.061	0.044	.163	-0.077	0.037	**.040**	-0.165	0.081	**.041**	-0.015	0.013	.237
Sex (0 = Male, 1 = Female)	-17.769	22145.603	.999	-3.028	1.334	**.023**	18.710	22409.511	.999	0.315	1.286	.806
X^2	13.260			23.208			20.094			42.007		
DF	4			4			4			4		
p	.010			< .001			< .001			< .001		
Cox & Snell R^2	0.059			0.101			0.088			0.175		
Nagelkerke R^2	0.239			0.266			0.326			0.247		

Table 4.13. Logistic regressions testing the predictions of NSR, PSR, and thin boundaries on the dream topics concerning being something else. Extraversion, neuroticism, openness, dream recall frequency (DRF), age, and sex were included as control variables. Two models were calculated, the first without NSR and PSR, the second with NSR and PSR added. Only Model 2 is reported as there were no changes with the addition of NSR and PSR. Significance is highlighted in bold. B = beta, SE = standard error, p = p value.

	Being an object			**Being a member of the opposite sex**			**Being an animal**			**Being a child again**		
	B	SE	p	B	SE	P	B	SE	p	B	SE	p
NSR	-0.991	0.641	.122	-0.245	0.413	.554	-0.663	0.654	.311	0.178	0.211	.401
PSR	1.723	0.843	**.041**	0.524	0.380	.169	0.197	0.570	.729	0.131	0.200	.512
Thin Boundaries	0.095	0.071	.181	0.075	0.050	.134	0.234	0.088	**.008**	0.088	0.025	**< .001**
Extraversion	0.076	0.228	.740	-0.309	0.186	.096	-0.366	0.296	.216	0.030	0.092	.745
Neuroticism	0.260	0.283	.359	-0.058	0.193	.764	-0.831	0.347	**.017**	0.080	0.100	.423
Openness	-0.700	0.371	.059	0.168	0.190	.376	-0.073	0.261	.779	0.013	0.106	.904
DRF	1.641	0.738	**.026**	0.311	0.213	.144	0.266	0.341	.436	0.269	0.102	**.008**
Age	-0.083	0.054	.127	-0.093	0.041	**.023**	-0.261	0.109	**.017**	-0.011	0.013	.397
Sex (0 = Male, 1 = Female)	16.847	20082.709	.999	-2.875	1.396	**.039**	18.107	21935.195	.999	0.309	1.313	.814
X^2	22.92			28.39			35.71			45.52		
DF	9			9			9			9		
p	.006			< .001			< .001			< .001		
Cox & Snell R^2	0.100			0.122			0.151			0.188		
Nagelkerke R^2	0.404			0.322			0.560			0.266		

Discussion

This study aimed to provide an investigation of the associations between Sensory Processing Sensitivity (SPS), dreaming experiences, and other aspects of personality, including thin boundaries. There has been a lack of research exploring SPS and dreams, possibly because only small associations between score on the Highly Sensitive Person Scale (HSPS) and dream recall and dream intensity were revealed in Aron and Aron (1997). The rationale for this investigation was that there have been many findings of associations between Hartmann's thin boundariness construct and dream variables, and there are commonalities between thin boundariness and SPS. Despite these commonalities, the association between them has not been empirically assessed hitherto, nor overlaps assessed with existing personality traits such as openness to experience. Correlations were revealed between HSPS, NSR, PSR and thin boundaries implying that both the positive and negative aspects of SPS relate to Hartmann's construct (Hartmann, 1989; Hartmann, 1991), even though the original background characterisation of thinner boundaries are more related to PSR, and both have been related to openness to experience (Aron, 2010; Harrison et al., 2006; Schredl & Erlacher, 2007; Smolewska et al., 2006; Tabak et al., 2022).

Total HSPS score positively and negatively correlated with neuroticism and extraversion (respectively), suggesting Highly Sensitive Persons score higher on neuroticism and introversion, which is supportive of previous chapters and literature (Grimen & Diseth. 2016; Hellwig & Roth, 2021; Smolewska et al., 2006; Yano et al., 2019). As expected, PSR was related to higher openness to experience, and NSR with higher introversion and neuroticism, again, supporting the previously found associations. However, correlation coefficients were smaller in this study when compared with previous chapters, especially between PSR and openness (r = .20 compared with r = .61 in Chapter 3). Also, the Big Five traits accounted for only 20.6% of variance in HSPS score, 26.7% in PSR, and 27.2% in NSR. Again, these values are smaller than in Chapter 3, which used the more extensive 44-item Big Five Inventory (John et al., 1991; John & Srivastava, 1999), compared with the shorter 10-item version used in the current investigation.

The BFI-10 has been evidenced to have sufficient psychometric properties, as well as good validity (Rammstedt, Kemper, Klein, Beierlein, & Kovaleva, 2013), however, research has suggested that shorter versions of personality measures can severely underestimate the role that

the Big Five traits hold in behavioural associations. Crede, Harms, Niehorster, and Gaye-Valentine (2012) explain that using one or two items to measure a construct can inflate the chance of Type I errors, especially when exploring the variance of one predictor above other personality traits and the relationships between the predictor and short-measured traits. Therefore, it is possible that the Big Five traits play a larger role in the associations between dreaming and SPS, and that the BFI-10 was insufficient in capturing this. Nevertheless, shorter questionnaires can save time during extensive testing, which can help promote participant adherence (Galesic & Bosnjak, 2009; Spennemann, 2022). Future research should use more extensive versions of Big Five questionnaires to measure these constructs in their entirety, such as the 240-item NEO PI-R (Costa & McCrae, 1992; McCrae, Costa, & Martin, 2005) which is used to capture the facet-level of each trait.

Moving on, the dream variables explored in terms of SPS were dream recall, emotional intensity of dreams, emotional valence of dreams, nightmare frequency, and nightmare distress. Total HSPS score and NSR correlated with all these dream variables, and PSR had a small but significant association with dream recall frequency, and a moderate correlation with emotional intensity of dreams. Furthermore, NSR and PSR both significantly predicted dream emotional intensity, and NSR predicted nightmare frequency, while controlling for the Big Five traits. The only other significant predictions revealed were openness on dream recall, STAI on emotional valence (i.e., more emotionally negative dreaming), and neuroticism on nightmare frequency. These findings have similarities to the relationships previously found between thin boundariness and dream recall and dream content variables.

The finding of associations between SPS and emotional intensity of dreams provides support for the enhanced emotional processing of Highly Sensitive Persons. According to the Continuity Hypothesis (Hall & Nordby, 1972), dream life is a continuation of waking-life conceptualisations, concerns, and interests (Domhoff, 2017). Thus, if Highly Sensitive Persons have more emotional experiences in their everyday (waking) life (Van Reyn, Koval, & Bastian, 2022), then this may be translated into dreaming, resulting in more emotionally intense dreams. It may also be that Highly Sensitive Persons have a stronger relationship between their wake and dream lives. Also, the positive and negative aspects of SPS predicted emotional dreaming, implying that both play a unique role in the intensity of dreams. PSR corresponds to an enhanced awareness and a deeper, more emotional processing of subtleties, whereas NSR describes the propensity to becoming overwhelmed by stimulation, negative emotional

reactivity, and physical responsivity to sensory discomfort. Accordingly, both PSR and NSR are related to emotional processing, possibly explaining their associations with the emotional intensity of dreaming. In addition, NSR (as well as total HSPS score) correlated with and predicted the frequency of nightmares, and held relationships with nightmare distress, supporting the notion that Highly Sensitive Persons are more prone to nightmare experience (Carr & Nielsen, 2017; Carr et al., 2020).

Although NSR was related to, overall, more negatively-valenced dreams, the regression model predicting emotional valence of dreams revealed no significant predictions of SPS, although NSR approached significance. This result could be due to a lack of sufficient power in detecting the effect of NSR, or perhaps this could be due to the retrospective nature of the study. Participants were asked to reflect on their dream experiences in the last month and give a response best suited to their average dream. Participants could have under- or over-estimated the average emotional valence, possibly as a result of the last dream they recalled. NSR corresponds to reactivity to stimuli, evidencing the unique associations of PSR and NSR with emotional dreaming. Nevertheless, as stated in Carr et al. (2020), further research is required to test the emotionality of dreams, as well as how dreams can be affected by changes in daily stress or daily emotional experiences, and how this interacts with SPS. In terms of Differential Susceptibility, Highly Sensitive Persons may experience both positive and negative emotions more intensely and thus have a heightened experience of such emotions within dreams, which is then a potential cause of nightmares (Carr & Nielsen, 2017).

In addition, SPS (and both facets of the HSPS) was shown to have associations with the frequency of lucid dreaming, although coefficients were small, especially for PSR. This finding may suggest that Highly Sensitive Persons hold the ability to lucid dream. Lucid dreaming can prove beneficial for the experiencer as it can encourage creative cognition and promote learning during sleep (Konkoly et al., 2021), and no adverse effects on sleep quality have been revealed (Ribeiro, Gounden, & Quaglino, 2020). Lucid dreaming is also associated with increased self-reflection and thought awareness (Yu & Shen, 2020). The finding that highly sensitives may be more prone to lucid dreaming is also greatly beneficial in the treatment of nightmares (Carr et al., 2020; Carr et al., 2022). Treatment using lucid dreaming involves training the individual to induce lucidity during a nightmare, to either change the course of the nightmare content or to alert that the dream is not real, thus reducing overall distress. A review suggests that lucid dreaming can foster self-control (i.e., taking control of a dream and/or

situations in waking life), such as encouraging the belief of "this is just a dream", as well as being beneficial for non-recurrent nightmares, as an alternative to Image Rehearsal Therapy (de Macedo, Ferreria, de Almondes, Kirov, & Mota-Rolim, 2019).

Furthermore, thin boundaries significantly predicted heightened nightmare frequency (Hartmann, 1991; Kráčmarová & Plháková, 2015; Pietrowsky & Kothe, 2003; Schredl et al., 2008). Of relevance here is the finding by Beaulieu-Prevost and Zadra (2007) that boundariness is related to retrospective DRF but not prospectively assessed DRF, the latter being arguably a more accurate estimate of the actual occurrence of dreams.

Replicating Schredl's (2020) findings, thin boundaries predicted dreaming of being a member of the opposite sex, being an animal, and being a child again, while controlling for age, sex, and dream recall. The only dream topic that did not reach significance was being an object, potentially due to a smaller sample size than in Schredl (2020), suggesting that this study was not powerful enough to detect the intended effect, potentially leading to Type I errors. In the regression models with the SPS subscales, PSR predicted only being an object in dreams, while controlling for the three Big Five traits (neuroticism, introversion, and openness to experience). However, thin boundaries became non-significant in predicting being a member of the opposite sex; again, this could be due to a lack of power with the addition of the extra predictors in the models (four predictors in the original models; nine in the new models). Overall, the replication results indicate that PSR and thin boundaries are related to a degree of dream complexity, assessed as individuals imagining themselves as being something else in a dream. Corroborating the findings of Schredl (2020), this could indicate that highly sensitive people and those with thin boundaries experience increased imaginativeness and fluidity of thoughts during waking, which is then reflected in their dreaming life. However, the single finding of PSR predicting being an inanimate object is unusual and cannot be explained as highly sensitives putting themselves in the mind or experience of others, in other words, a result of increased empathic response (Acevedo, Aron, Pospos, & Jessen, 2018; Aron, 2010; Elst et al., 2019).

Strengths and limitations

Two strengths of this study include the lack of information provided upon recruitment regarding the dreaming aspect of the study, thus reducing self-selection bias associated with interest in dreams, as well as the cross-sectional nature allowing for a greater number of

responses to be collected from participants. However, one limitation of cross-sectional research is the subjective reflection of prior experience. As mentioned previously, this could cause individuals to under- or over-estimate the extent of their experience, including the frequency, intensity, and valence of dreams, as a result of biases, including the availability heuristic. Furthermore, the majority female sample (81.8%) means that the results may not be generalisable, nor is the sample representative of the general population's experiences of dreaming. However, an attempt to combat this inequality was made by including sex in all regression models to control for this individual difference factor.

In addition to this, measures of sleep quality were not included, a useful factor when considering dream (especially emotional dream) experiences in clinical and non-clinical samples (Conte et al., 2021). Sleep quality has been implicated in dream recall frequency (e.g., Frankl et al., 2022), and poor sleep quality can result in increased daily stress and negative reactivity (Bower, Bylsma, Morris, & Rottenburg, 2010; Minkel et al., 2012), as well as higher nightmare frequency (Conte et al., 2021). Finally, the changeable nature of dreams is shown to be affected by daily events, specifically emotional events and especially for individuals who experience emotions more intensely, like highly sensitives (Carr & Nielsen, 2017).

Conclusion and future research

Due to the lack of research on SPS and dreaming experiences, this investigation aimed to give an extensive investigation of such associations, both cross-sectionally and longitudinally. It also aimed to conceptually replicate the literature on relationships between thin boundariness, as a measure of stimulus sensitivity, and dream variables. Firstly, thin boundaries was shown to be associated with HSPS score and both the positive and negative facets of high SPS, suggesting similarities between these two sensitivity measures. Secondly, SPS had relationships with dream recall frequency and emotional intensity, which could result from the increased emotional processing of daytime events during sleep, which impacts dream formation and dream content (as according to the continuity hypothesis: Domhoff, 2017; Hall & Nordby, 1972; Schredl, 2017), or a higher propensity for recall of that dream formation and content. Interestingly, SPS was not correlated or predictive of dream valence, and high PSR individuals were more likely to dream of being an object. Overall, high SPS individuals may have both positive and negative dreams due to Differential Susceptibility to context, that is, when situated in negativity, dreams may reflect this, and then the same for positive contexts.

In addition, highly sensitives may also have increased dream complexity, possibly resulting from an enhanced processing of internal and external subtleties.

However, measures of sleep quality were not included, an important factor when considering emotional and dreaming experiences. Therefore, the next chapter (Chapter 5) aims to longitudinally explore the changes in dreaming as a function of daily emotional experiences, daily stress and sleep quality, high SPS, as well as trait anxiety (Carr et al., 2020; Samson-Daoust et al., 2019) and overall sleep quality.

Chapter 5. A Longitudinal Investigation of Daily Affect, Dream Emotions, and Sensory Processing Sensitivity.

The findings of Chapter 4 revealed associations between Sensory Processing Sensitivity (SPS) and the emotional intensity of dreaming when explored cross-sectionally, suggesting that Highly Sensitive Persons experience more emotionally intense dreams overall. Although the correlations with emotional valence (i.e., how positive or negative their dreams are) were non-significant, the negative facet of SPS (Negative Sensory Responsivity; NSR) predicted nightmare frequency and held relationships with nightmare distress. However, Chapter 4 was unable to test the longitudinal predictions of SPS on emotional dreaming, and how dreaming can change based on daily life experiences. Thus, research is required to investigate the changes of dreaming as a function of daily emotions, and to explore the impact dream emotions have on the waking emotions of highly sensitives.

Highly Sensitive Persons have the heightened ability to process, detect, and react to emotional stimuli within the environment, and they feel and experience emotion more intensely. The findings of Chapter 4, as well as previous literature showing the enhanced emotional processing of Highly Sensitive Persons, imply that SPS may be related to aspects of emotional dreaming (Chapter 4; Aron & Aron, 1997; Carr & Nielsen, 2017; Carr et al., 2020; Carr et al., 2022; Schredl et al., 2022). One reason for heightened experience of emotional experiences, including dreaming, amongst Highly Sensitive Persons is Differential Susceptibility, which is defined as a susceptibility to experience and respond to adversity (diathesis stress) and positivity (vantage sensitivity) more intensely (Bakermans-Kranenburg, & van Ijzendoorn, 2011; Ellis, Boyce, Belsky, Bakermans-Kranenburg, & van Ijzendoorn, 2011). Carr and Nielsen (2017) posit that SPS is linked to "*for better or for worse*" outcomes, including in terms of dreaming, as this heritable personality trait results in heightened emotional reactivity that intensifies environmental awareness and increased vulnerability of experiencing both positive and negative emotions (Homberg & Jagiellowicz, 2022). This is due to the adaptive nature of SPS, including faster reactions to clear threats, but also encouraging a pause before acting.

Carr and Nielsen (2017) proposed a new framework of nightmare experiences and implicated SPS as a common trait amongst nightmare sufferers. As a result, and according to their

Differential Susceptibility of nightmares framework, increased reactivity to negative stimuli in waking life results in increased nightmare experience and distress due to amplified imaginal representations. On the other hand, highly sensitive individuals (e.g., nightmare sufferers) may also be adaptive to positive or supportive contexts, and experience more positive dreaming during periods of low stress, and these positive dream experiences may be adaptive in waking life (e.g., having beneficial effects on mood), and have implications for the treatment of nightmares (e.g., encouraging a focus on positivity rather than negativity, thus enabling a reduction of negative imagery).

Supporting this theory, Carr et al. (2020) tested nightmare frequency and nightmare distress of high, medium, and low SPS participants, and assessed how these relate to measures of mental wellbeing. They found that nightmare frequency and nightmare distress were higher in the high and medium SPS groups compared with the low SPS group. Also, lower mental wellbeing correlated significantly with nightmare frequency within the high and medium SPS groups, and the correlation with nightmare distress was only significant for high SPS individuals. These correlations were not significant for the low SPS group. This demonstrates that not only do nightmares occur for high and medium sensitive persons under conditions of lower mental wellbeing, distress for the nightmares also occurs for Highly Sensitive Persons only. However, this study was cross-sectional and thus could not test changes in nightmare occurrence and distress as a function of changes in mental wellbeing and stress. Also, whether there is a predisposition to general emotionally negative dreaming was not tested, as well as a predisposition towards positive dreaming in Highly Sensitive Persons with good mental wellbeing.

Continuity hypothesis for cognitions and emotions in wake and dreaming

The continuity hypothesis for dreaming was first conceptualised by researcher Calvin Hall and colleagues (e.g., Hall, 1953; Hall & Nordby, 1972). According to Domhoff (2017), the continuity hypothesis proposes that dreams contain and enact the "… same conceptions, personal concerns, and personal interests that animate waking thought", that dreams are the "embodiment of thoughts" (p. 16), and that they "express (enact, embody, dramatize) personal conceptions and ongoing concerns relating to the important people and activities in the dreamers' waking lives" (p. 25). In an expansion of this, Schredl (2017) proposes no restrictions on the type of waking life experiences that can be continued from waking life into

dreaming, with the definitions of personal concerns, conceptions, and preoccupations thus being very broad and continuity extended to include episodic memories.

The Continuity Hypothesis can refer to two levels of timespan. Firstly, trait variables, or variables that are averages across a period, such as mood over the previous month, can be correlated with retrospective dream variables that cover a lengthy timespan, such as frequency of nightmares. The second time span is more immediate, relating dream content on one night to wake life variables from the previous day. These two timespans will now be addressed.

Relationships between dream content and trait or time interval variables

The main relationships found between dream content and trait or time-extended variables concern frequencies of particular contents. For example, lucid dreaming frequency, measured retrospectively and covering the lifespan, is associated with internal Locus of Control (Blagrove & Hartnell, 2000). Similarly, retrospective measures of frequencies of bad dreams and nightmares are associated with higher stress and depressive symptoms (Solomonova et al., 2021), as well as lower psychological wellbeing (Blagrove, Farmer, & Williams, 2004; Carr, Matthews, Williams, & Blagrove, 2021; Gilchrist et al., 2007; Pesant & Zadra, 2005).

Relationships between pre-sleep variables and dream content

Research has also addressed influences of state variables assessed during the day on dreams the following night. For example, dreams have been found to incorporate daily events, including personal concerns and waking life experiences, and including stimuli from social media (Schredl & Goritz, 2019), work and employment (Schredl, Anderson, Kahlert, & Kumpf, 2020), world events (e.g., the COVID-19 pandemic; Schredl & Bulkeley, 2020), and daily life activities (Schredl & Hofmann, 2003). Eichenlaub et al. (2018) woke twenty participants for dream reports in REM and slow wave sleep (SWS) while monitored using electroencephalography. Eighteen participants reported at least one REM dream and 14 at least one SWS dream. Participants completed a daily log before coming to the lab, in which wake life experiences were recorded, and a rating made of the emotionality of each experience. The emotional intensity of waking-life experiences from the two days before the dream that were incorporated into dreams was higher than the emotional intensity of experiences that were not incorporated. This effect was found for SWS and REM sleep dreams, and for positively and negatively valenced experiences.

In terms of affective continuity, the literature has evidenced the incorporation of daily emotions within dreaming, and there are thus impacts of stress, depression, and anxiety, as well as positivity, on dream content. There seems to be clear evidence to suggest dream incorporation of experiences with negative affect (Schredl, 2003; Nielsen et al., 1991), and dreams tend to exaggerate the negative intensity of daytime events (Veloce et al., 2019), and emotionally negative and positive waking life experiences are incorporated into dreams (Eichenlaub et al., 2018). However, aside from the latter paper and Schredl (2003), there is limited research on the incorporation of positive daily experiences into dreams, although Sikka et al. (2018) highlighted a higher proportion of positive home dream reports (55.8%) than negative reports (35.3%), and Schredl and Reinhard (2009) found that the more positive the day prior to dreaming, the more positivity was experienced in dreams.

An investigation of 212 Italian participants found that positivity experienced in the day prior to dreaming was significantly reduced in dreams, whereas the opposite was found for negative emotions (Conte et al., 2020). In support of this, items of negative and neutral valence presented prior to dreaming were most likely to be incorporated into imagery than positive items (Veloce et al., 2019). Furthermore, Levin and Nielsen's (2009) model of a fear reduction function for dreaming proposes that dreaming is responsible for reducing negative and fearful emotions, and accords with Cartwright, Luten, Young, Mercer, and Bears' (1998) finding that dreaming was successful in moderating negative mood (e.g., depressive symptoms), regardless of interruptions of REM sleep.

These relationships were also addressed in a longitudinal study by Samson-Daoust, Julien, Beaulieu-Prevost, & Zadra (2019), who collected information on 128 participants' personality, trait anxiety, and past traumatic experience. Participants were asked to complete a series of daily questionnaires (morning and evening), for a maximum of four weeks, to measure dream content, dream affect, and perceived daily stress. The results showed that perceived daily stress and bedtime stress were highly correlated, and both were followed by negative dream valence, although the association with daily stress was larger. Regardless, trait anxiety was the strongest predictor of negative dream valence, and daily stress did not significantly predict subsequent dream emotion the morning after, or emotions in dreams 2 to 7 days after the experienced stress (dream lag; Nielsen et al., 2004). These findings suggest that it is an individual's overall anxiety levels that influence negative dreaming, and daily variations in stress to a lesser extent (perhaps due to variance caused by contingencies of daily experiences). However, this study did not use

an established and validated measure of perceived stress, and instead, measured daily stress using only one item. This item asked participants to rate their daily stress on a scale of 0 (not stressed at all) to 9 (extremely stressed). Therefore, the research is limited, particularly the longitudinal exploration of changes to dreaming, and the incorporation of both positive and negative emotions into dream life based on daily life events, and any interaction with personality, requires further investigation.

There have been proposals for an adaptive basis for the relationships between waking life state variables and dream content. Emotions are present in almost all dreams (Nielsen, Deslauriers, & Baylor, 1991), which may be related to the role REM sleep plays a role in selectively consolidating emotional stimuli and memories (Nishida, Pearsall, Buckner, & Walker, 2009). For example, sleep-deprivation is shown to cause differential responsivity to low-stress tasks, including increased levels of stress, anger, and anxiety (Mikel et al., 2012). Also, increases in activity of regions of the brain involved in emotional and memory processing are shown during REM sleep and dreaming, such as cortical regions, the amygdala, and hippocampus (e.g., Eichenlaub et al., 2018; Girardeau, Inema, & Buzsaki, 2017; Killgore, 2013). Reactivity of the amygdala decreases after sleep, and this is accompanied by decreases in the intensity of emotions (van der Helm et al., 2011), while dysfunction of the amygdala and its interconnectivity is shown after periods of sleep deprivation (Motomura et al., 2013; Yoo et al., 2007). Furthermore, Lai et al. (2020) hypothesised that the amygdala and its interconnected networks play a vital role in enriching insight and responding to challenges by integrating creativity and the dream experience. Thus, the activations of these regions, as well as disruptions following periods of wake, may support an emotion processing function of sleep and also of dreaming.

Relationships between dream content and post-sleep variables

In addition to daily life affecting dream content and emotions, research has also demonstrated a link between dreams and affective states upon awakening. Sikka, Engelbrektsson, Zhang, and Gross (2022) tested 40 participants (33 female) on daily dream affect, waking affect, sleep quality, and affect regulation upon awakening. Upon analysis of 180 dream diaries, the authors revealed that negative emotions in dreams predicted negative affect in the morning, and positive dream emotions predicted positive morning affect. As well as this, lower sleep quality was related to lower positive affect in the morning, suggesting a role of sleep quality on the emotions experienced upon awakening (Bower, Bylsma, Morris, & Rottenburg, 2010).

Furthermore, Gilchrist, Davidson, & Shakespeare-Finch (2007) identified correlations between positive and negative dream emotions and positive and negative waking emotions (respectively). Also, dream sadness and apprehension were related to neuroticism, low optimism, and a lack of satisfaction with life. Mallet et al. (2021) corroborated that dreams of anxiety and death were related to negative morning mood, and leisurable dreams were associated with more positive mood. Thus, there are implications of negatively perceived dreams on daily life. Similarly, Gilchrist et al. (2007) found that dream-experienced joy, contentment, love, and excitement were highly correlated with emotions felt upon awakening. Lucid dreams are also associated with more positive dream experiences, as well as positive emotions upon awakening (Stocks et al., 2020).

To summarise, dreaming has been shown to be continuous with prior waking life experiences, concerns, and personal conceptions (Domhoff, 2017; Schredl, 2003; Schredl, 2017), which typically hold emotional characteristics, in studies that have addressed a range of timespans of the waking life and dream variables. These findings have led to suggestions of a possible role of dreaming in emotion regulation, emotion processing, and memory consolidation. The dream content and emotions then impact mood upon awakening, posing implications for quality of life, optimism, satisfaction with life, and levels of depression and anxiety. However, there is less research on the effect of positive as opposed to negative experiences on dream content, and on whether positive dreams affect the individual's outlook on life. Furthermore, most studies are cross-sectional and rely on retrospective self-reports of dream content and mood.

Of importance for the theme of the current thesis, however, is whether SPS might interact with the above effects, and thus might also be a predisposing factor for particular types of dream content. The interaction of SPS with low levels of mental health can lead to nightmares. The study reported in this chapter addresses whether SPS interacts with other wake life variables to affect dream content variables, and whether dream content interacts with SPS to affect post-dream wake life variables.

Aims and hypotheses

The first aim of the current study is to assess longitudinal relationships between daily mood and dream content, and then between dream content and post-waking mood, and the interaction of these relationships with SPS. The study aims to investigate the day-to-day variations in

emotions in waking life and their relationship to those in dreams, including daily emotional tone and dreaming, and dreaming emotional tone and daily mood. As high SPS may result in nightmares and bad dreams (including increased frequency and distress) as a response to negative environmental experiences, such as daily stressors, and/or low psychological wellbeing (e.g., depression, trait anxiety) (Carr & Nielsen, 2017; Carr et al., 2020), the study aims to address whether high SPS participants will have emotionally positive dreaming as a result of positive experiences during the day and general positive wellbeing.

The second aim is to use a longitudinal design to measure variables across twenty-one days with an established measure of perceived stress to address the limitations of a previous study (Samson-Daoust et al., 2019), as well as to capture relationships with SPS, trait anxiety, and sleep quality. Sleep quality is particularly important to include as a factor when investigating the relationships between emotional dream experiences and waking life, as lower sleep quality can impact stress and negative reactivity in waking life (Bower et al., 2010; Minkel et al., 2012), which may be further exaggerated in Highly Sensitive Persons who demonstrate enhanced emotional reactivity.

It was firstly hypothesised that daily emotion and stress would be related to subsequent dream emotion, i.e., increased negative daily emotion and daily stress would lead to more negative dreaming, and positive daily emotions (and perhaps less stress) to positive dreaming. In addition, SPS was hypothesised to be related to more negative dreaming in negative waking life contexts, and following the Differential Susceptibility Framework, Highly Sensitive Persons would experience more positive dreaming when in positive contexts (Carr & Nielsen, 2017). Furthermore, it was hypothesised that NSR, and not PSR, would be associated with more negative dreaming, as this facet of the HSPS has been implicated in emotional processing and potentially dysregulation, as well as in nightmare experiences. To further test the Differential Susceptibility Framework (Carr & Nielsen, 2017), and to extend Hypothesis 2, interactions were explored between PSR and NSR and daily mood, perceived daily stress, and trait anxiety in predicting dream emotions. These analyses were to be performed post-hoc, to add to any main effect of PSR/NSR on dreaming experience. Finally, interactions between SPS and positive and negative dream emotions in predicting post-sleep daily emotions were hypothesised, so as to understand any effect that dream affect has on daily emotions for Highly Sensitive Persons.

Method

Participants

Participants were recruited by two different teams of researchers (UK and France cohorts). Participants were recruited from social media and the universities' participant pools. Those recruited from the participant pools were rewarded with course credit. Participants were screened for age (18-40 years), native language (English and French for the UK and France cohorts, respectively), dream recall frequency (4 to 7 times per week), and average sleep duration (7 hours). Participants were excluded based on history of psychiatric, neurological, and sleep disorders, as well as medical complaints that affect sleep, excessive alcohol intake (more than 5 units per day), excessive cigarette use (more than 7 per day), and the use of recreational drugs. In total, 142 participants took part in the study (Mean age = 20.71 years, SD = 3.18). 21 participants were excluded from the analysis as they provided fewer than 10 dream occurrences, thus the final sample was N = 121 participants, with a mean age of 20.55 years (SD = 3.17) (111 female). Of these, n = 81 were from the France cohort, and n = 40 were from the UK cohort. The study received ethical approval from both universities' Research Ethics Committees.

Materials

Retrospective measures

The retrospective measures (Phase One) were provided to participants firstly and were completed once. Sleep quality was measured using the 19-item Pittsburgh Sleep Quality Index Questionnaire (PSQI; Buysse et al., 1989). On this, participants rate different aspects of their sleep over the past month. A total score is provided ranging from 0 (no difficulty) to 21 (severe sleep difficulties). PSQI scores were calculated according to the standard instructions provided.

The State-Trait Anxiety Inventory (form Y) (STAI-T; Spielberger, 1983) was used to measure trait anxiety, it has 20 items referring to anxiety-related feelings (e.g., "*I am jittery*" and "*I am presently worrying over possible misfortunes*"). Participants rate how they generally feel on a Likert scale ranging from 1 (almost never) to 4 (almost always). The responses to each item were added to create a total STAI score.

The Highly Sensitive Person Scale (Aron & Aron, 1997) (HSPS) was used to measure SPS. Participants were asked to respond to 27 questions with reference to a 7-point Likert scale (1 =

Not at all; 7 = Extremely). Examples of questions include, "*Are you easily overwhelmed by strong sensory input?*" and "*Do you startle easily?*". The responses to each question were added together to give a total HSPS score, and a mean score was calculated, with a higher score representing higher SPS. The mean scores for each of the subscales were also calculated according to Tabak et al.'s (2022) two subscales of PSR and NSR.

Prospective measures

The prospective measures (Phase Two) were completed daily for approximately 21 days. In the morning, participants were asked if they had dreamt during the night. If they did, they were asked to rate the positive and negative affect in their dream. Two items were taken from the Positive and Negative Affect Schedule (Watson et al., 1988). These items were "*In your dreams, to what extent did you experience positive emotions, such as feeling enthusiastic, excited, inspired, interested, or proud?*" and "*In your dreams, to what extent did you experience negative emotions, such as feeling afraid, ashamed, guilty, nervous, or scared?*". Participants responded according to a 5-point Likert scale of 1 (Very slightly / Not at all) to 5 (Extremely), and this provided a dream positive emotion and negative emotion score. If participants did not dream, this question was skipped.

An adapted version of the Karolinska Sleep Diary (Åkerstedt et al., 1994a, 1994b, 2012) was used to measure nightly sleep quality. Items selected measured time of going to bed, time of awakening, sleep quality, level of calmness in sleep, whether they had slept throughout the night, and ease of falling asleep. A Sleep Quality Index (SQI) score was calculated based on these items, which were all rated according to 5-point Likert scales.

For the night-time questionnaire, the same two questions measuring dream affect were amended for daily life. Participants were asked to rate the emotions felt during the day according to the two questions "*During the day, to what extent did you experience positive emotions, such as feeling enthusiastic, excited, inspired, interested, or proud?*" and "*During the day, to what extent did you experience negative emotions, such as feeling afraid, ashamed, guilty, nervous, or scared?"* Participants responded according to a 5-point Likert scale of 1 (Very slightly / Not at all) to 5 (Extremely), and this provided a daily positive emotion and negative emotion score.

In addition, the Perceived Stress Scale (PSS; Cohen, 1988) was completed to measure daily stress. This includes items such as "*How often have you felt nervous and "stressed"?*" and "*How often have you felt that you were on top of things?*", participants rated how often they had felt those ways that day according to a 5-point Likert scale (1 = Never; 5 = Very often). Items were added together, and a total stress score was calculated per day.

Procedure

Participants were recruited to participate in a study titled "Dreaming, Everyday Life, and Emotions" through social media and the universities' participant pools. If they signed up on the participant pool, they were contacted by email and provided an online link to complete the eligibility questionnaire using Qualtrics. The same link was attached to an advertisement on social media, people could freely choose to complete the questionnaire if they wanted to take part. The eligibility questionnaire asked for an email address and all further communication occurred via email.

Eligible participants were contacted and provided with an information sheet and additional link to complete a consent form. Once the consent form had been completed, participants were sent the details of Phase One, which included a Qualtrics link to the retrospective measures of sleep quality (PSQI), trait anxiety (STAI-T), and SPS (HSPS). Once completed, the details of Phase Two were provided. They were given the following instructions:

> "*Following your participation in Phase One, we can now begin Phase Two of the study. As a reminder, during this phase, a short questionnaire is completed every morning upon getting up, and every evening at bedtime, over a period of 21 consecutive days. That is, we would like you to complete them twice a day, every day, for 21 days. Throughout this period, it is important that you complete the morning questionnaire immediately after waking up in the morning, and the evening questionnaire just before falling asleep at night. Below is the link for carrying out Phase Two of the study. If filling out the questionnaire after waking up, please select "Morning" when asked. Alternatively, select "Night" if you are completing it before bed. It is requested that you start Phase Two this evening. So that you do not forget to complete these questionnaires every morning and every evening, it is advisable to put an indicator on this email (e.g., select it as "important"), or use a daily reminder (e.g., on your phone at the same time).*"

During Phase Two, a series of prospective questions were filled out twice a day for an approximate period of 21 days. Another link was provided, and upon clicking the link, participants were presented with the question "*Which questionnaire would you like to complete? Please select from the responses below*." The options were "Morning" or "Night", and each option branched to a specific set of questions. Measures of daily affect (positive and

negative emotions) as well as stress during the day (measured by the PSS) were completed in the night (these were "Day" questionnaires) before going to bed. In the morning upon awakening, participants responded to the two items referring to emotions during dreaming (if they had a dream). If participants did not dream, they skipped the question relating to affect. They also completed the items from the Karolinska Sleep Diary. These were the "Sleep" questionnaires. Participants were emailed on day 7 and day 14 with reminders, as well as if the researcher noticed multiple missed questionnaires. Once the study had finished, a final email was sent which contained debrief information.

Data Processing and Statistical Analyses

Missing data

Three participants had missing data on the PSQI, their final score was computed by adding the score of the remaining components. For the STAI-T (one participant) and HSPS (two participants), missing responses were replaced using mean imputation.

Data pre-processing (prospective questionnaires)

Firstly, prospective questionnaires that were incomplete were excluded. Secondly, questionnaires that were not complete in a certain time window were excluded. This window was 14 hours for both Sleep (measured in the morning) and Day (measured at night) questionnaires; for the Day questionnaire, this window was between 6pm and 8am, for the Sleep questionnaire, between 3am and 5pm. This constraint allowed us to exclude unexpected entries. Thirdly, when multiple questionnaires were completed for only one entry, the last response was retained. Finally, participants who had fewer than 10 dream occurrences during the study were excluded.

Statistical analysis

Firstly, correlations were conducted between the retrospective measures of PSQI, STAI, PSR and NSR, as well as with age. Secondly, multilevel modelling analysis was used. A multilevel model is a regression model that is applied when the data has a hierarchical structure (Leyland & Groenewegen, 2020). The prospective measures were captured within-participants (Level 1), whereas the retrospective measures were between-participants (Level 2), creating a hierarchical, nested structure. In particular, the prospective variables of daily affect, dream affect, SQI, and PSS were nested within participants (Minimum days completed = 14 days,

maximum days completed = 29 days, Mean days = 21.53 days). That is, participants completed the same measures across multiple days, with the number of days and measures completed per day differing depending on the participant. Multilevel models address missing data, without the need to eliminate or impute scores for these occurrences (Hoffman & Rovine, 2007).

There were four models to individually test the outcome variables of positive dream emotions, negative dream emotions, positive day emotions, and negative day emotions. Due to the nature of the data, there were two active datasets to test four models. The first dataset contained the outcome variables of negative dream emotions and positive dream emotions, which were predicted by the within-subject variables (Level 1 predictors) of SQI, PSS, and daily affect (i.e., positive and negative day emotions). Thus, Day questionnaires and subsequent Sleep questionnaires were matched (Day -> Sleep match). For example, the "Day" questionnaire completed on the first evening of the experiment was matched with the "Sleep" questionnaire completed on the second morning of the experiment.

The second dataset contained the outcome variables of negative day emotions and positive day emotions, predicted by the within-subject variables of SQI, PSS, and dream affect (positive and negative dream emotions) (Level 1 predictors) to test whether dream emotions have a lasting effect on subsequent daily emotions. This means that Sleep questionnaires were matched with the subsequent Day questionnaire (Sleep -> Day match). For example, the "Sleep" questionnaire completed on the first morning of the experiment was matched with the "Day" questionnaire on the same evening.

Each dataset also contained the Level 2 predictors (between-subjects) of PSR, NSR, PSQI, STAI, gender, and age. Gender (dummy coded, 0 = Male, 1 = Female) and age were included as control variables. All Level 1 predictors were cluster-mean centred (centred to each participant's mean value), and Level 2 predictors were grand-mean centred.

To fit the models, the statistical program R (version 3.6.3) was used. Multilevel models with maximum likelihood estimation were calculated, using the *lmer* function as part of the lme4 R package. Because of the different types of matches, as well as missing data, there were different numbers of observations for each model. Multicollinearity (VIF) was checked for each of the four models using the *vif* function of the "car" package. No VIF value exceeded 3.0, suggesting no issues with multicollinearity.

For both daily and dream emotions, post-hoc tests were conducted to explore the interactions between Level 1 emotion predictors and sleep quality (SQI), and Level 2 predictors of STAI, PSQI and SPS. This is to understand if the effects apply to the entire sample, or if they are mediated by other factors.

Results

Descriptive Statistics

The descriptive statistics of the retrospective and prospective measures are displayed in Table 5.1.

Table 5.1. The descriptive statistics, including the mean, standard deviation (SD), minimum (min), and maximum (max) values for the retrospective (PSQI, STAI, HSPS, PSR, and NSR) and prospective measures.

	Mean	SD	Min	Max
Sleep Quality (PSQI)	5.12	2.36	1.00	12.00
Anxiety (STAI)	45.25	11.05	23.00	76.00
HSPS Score	4.51	0.89	2.56	6.59
PSR	5.09	0.88	2.67	7.00
NSR	4.24	1.07	2.00	6.42
Positive Day Emotions	3.49	0.51	2.26	4.60
Negative Day Emotions	2.32	0.51	1.20	3.74
Daily Stress (PSS)	14.15	5.06	1.80	27.95
Number of Dreams	16.20	3.14	10.00	24.00
Positive Dream Emotions	3.05	0.54	1.41	4.46
Negative Dream Emotions	2.58	0.59	1.00	4.23
Nightly Sleep Quality (SQI)	15.34	2.23	7.80	19.62

Correlations

Correlations between the retrospective measures (as well as with age) are provided in Table 5.2. PSQI and age were non-normal, and thus Spearman's rho correlations were conducted for these variables. HSPS score and NSR correlated significantly with STAI and PSQI ($p < .01$), correlations with PSR were non-significant ($p > .05$).

Table 5.2. Correlations (coefficient, p-value) between the retrospective measures (and age).

Pearson's r correlations were conducted for all except correlations with PSQI and age, where Spearman's rho (r_s) correlations were conducted due to non-normality. Significance is highlighted in bold. All dfs = 119.

	PSQI (r_s)	STAI	HSPS Score	PSR	NSR
STAI	**.427, p < .001**				
HSPS Score	**.273, p = .002**	**.502, p < .001**			
PSR	.064, p = .484	.093, p = .311	**.545, p < .001**		
NSR	**.282, p = .002**	**.525, p < .001**	**.970, p < .001**	**.336, p < .001**	
Age (r_s)	.002, p = .986	**-.267, p = .003**	-.112, p = .222	.009, p = .925	-.119, p = .195

To test the bivariate correlations between positive and negative affect in daily life and dreams, each participants' average affect score was calculated for positive daily, negative daily, positive dream, and negative dream emotions. There were significant negative correlations between the average positive and negative daily emotions across the study period ($r(119) = -.356$, $p < .001$), and between average positive and negative dream emotions ($r(119) = -.455$, $p < .001$). Also, positive emotions during the day significantly correlated with positive dream emotions ($r(119) = .557$, $p < .001$), and negative daily emotions correlated with negative dream emotions ($r(119) = .433$, $p < .001$). The correlations between positive daily emotions and negative dreaming, as well as between negative daily emotions and positive dreaming, were non-significant ($p > .05$). The correlations between positive and negative emotions in dreams were only of moderate size and thus support the design decision to assess and analyse negative and positive emotions separately, rather than together in a single (bipolar) scale.

Multilevel Models

Four multilevel models were calculated to predict positive dream emotions, negative dream emotions, positive day emotions, and negative day emotions.

Multilevel models predicting dream emotions from day emotions, daily stress, STAI, PSR, NSR, and PSQI

The average positive affect experienced in dreams was 3.05 and the average negative affect was 2.58. The Intraclass Correlation Coefficient (ICC) was calculated for the two individual models to determine the necessity for multilevel modelling. The ICC was 0.187 for positive dream emotions and 0.163 for negative dream emotions. This suggests that 18.7% and 16.3% of the variance in positive and negative (respectively) dream emotions can be attributed to between-subject differences. Positive and negative emotions during the day were included as predictors in both models, as well as daily stress (PSS) and daily sleep quality (SQI) and the retrospective measures (STAI score, PSR, NSR, and PSQI). Daily (prospective measures) scores were cluster-mean centred, and retrospective scores were grand-mean centred. Gender and age were included as control variables. Results of the models are displayed in Table 5.3. SQI (b = 0.085, $p < .001$) and PSQI (b = -0.047, $p = .045$) significantly predicted positive emotions in dreams (Figure 5.1). Additionally, SQI (b = -0.086, $p < .001$), daily stress (b = 0.012, $p = .049$) (Figure 5.1), and PSR (b = 0.156, $p = .014$) (Figure 5.2) predicted negative dream emotions.

Table 5.3. Results of multilevel model predicting positive and negative emotions in dreams. Number of observations = 1774. Significance is highlighted in bold.

	Beta	Standard Error	p-value	Lower	Upper
Positive Emotions in Dreams					
Positive Day Emotions	0.040	0.029	.178	-0.018	0.097
Negative Day Emotions	-0.043	0.030	.156	-0.102	0.016
Daily Stress (PSS)	-0.004	0.005	.429	-0.014	0.006
SQI	**0.085**	**0.007**	**< .001**	**0.071**	**0.099**
PSQI	**-0.047**	**0.023**	**.045**	**-0.093**	**-0.001**
STAI	-0.002	0.006	.745	-0.013	0.010
NSR	0.021	0.057	.713	-0.092	0.134
PSR	-0.051	0.060	.392	-0.169	0.066
Gender	-0.025	0.205	.904	-0.429	0.379
Age	-0.014	0.017	.433	-0.048	0.021
Negative Emotions in Dreams					
Positive Day Emotions	0.041	0.034	.227	-0.026	0.108
Negative Day Emotions	0.059	0.035	.093	-0.010	0.128
Daily Stress (PSS)	**0.012**	**0.006**	**.049**	**0.000**	**0.023**
SQI	**-0.086**	**0.009**	**< .001**	**-0.103**	**-0.069**
PSQI	0.007	0.024	.772	-0.041	0.055
STAI	0.011	0.006	.087	-0.002	0.023
NSR	0.018	0.060	.766	-0.100	0.136
PSR	**0.156**	**0.063**	**.014**	**0.033**	**0.280**
Gender	-0.021	0.215	.923	-0.446	0.405
Age	-0.008	0.018	.665	-0.044	0.028

Figure 5.1. The associations between dream emotions and the significant predictors. Pane 1 shows the relationship between positive dream emotion and daily sleep quality, Pane 2 the relationship between negative dream emotion and daily sleep quality, and Pane 3 the relationship between negative dream emotion and daily stress. Each line represents a participant. Predictors (x-axis) were cluster-mean centred.

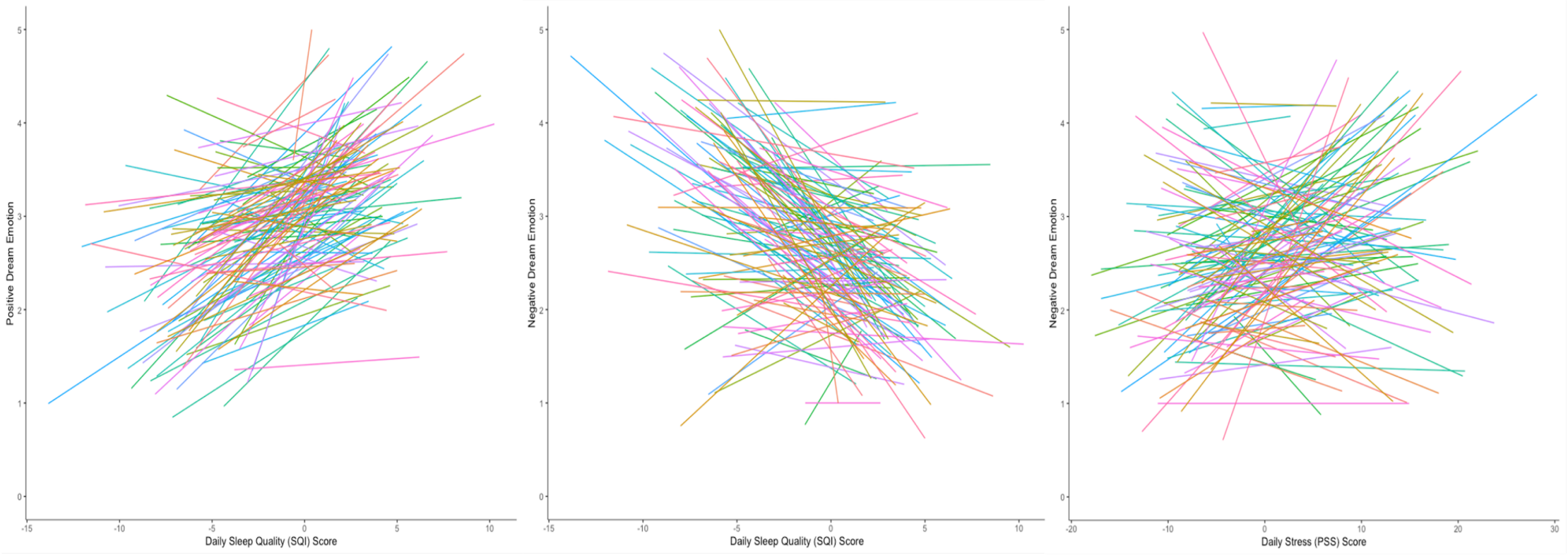
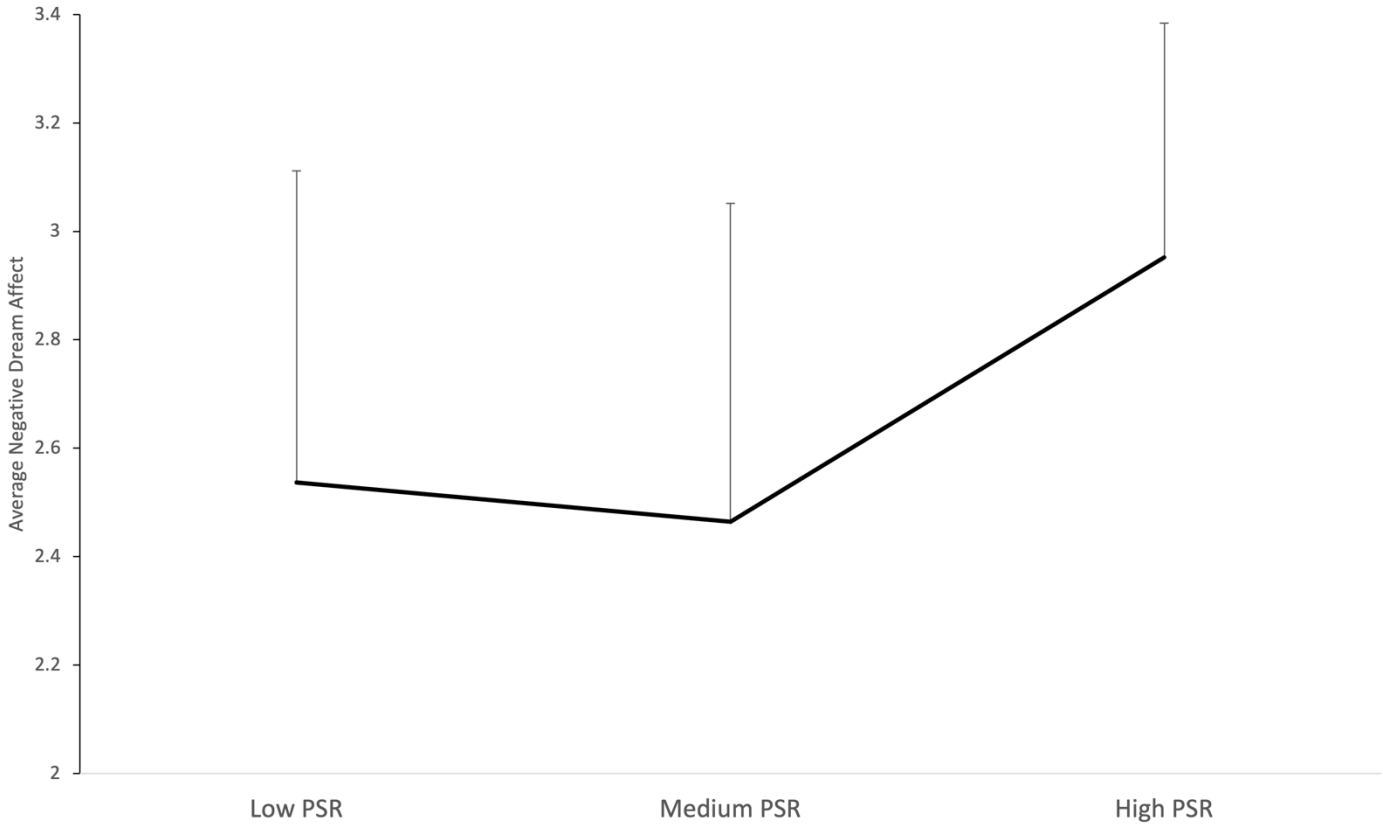


Figure 5.2. The association between PSR and the average negative emotions in dreams, for illustrative purposes only. PSR was tertiary split based on the cut-off points in Lionetti et al. (2018); Low PSR = 34.7% of the sample, Medium PSR = 41.3%, High PSR = 24%. Error bars represent standard deviations.



Multilevel models predicting day emotions from dream emotions, daily sleep quality, STAI, PSR, NSR, and PSQI

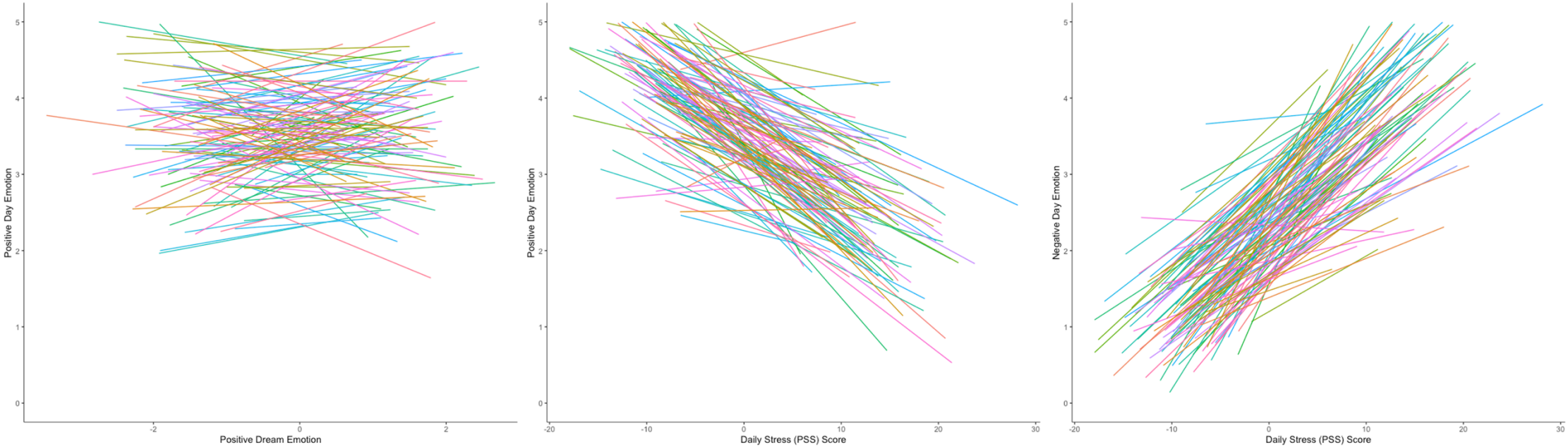
The average positive daily affect was 3.49 and the average negative daily affect was 2.32. The Intraclass Correlation Coefficient (ICC) was calculated for the two individual models to determine, again, the necessity for multilevel modelling. The ICC was 0.196 for positive day emotions and 0.151 for negative day emotions. This suggests that 19.6% and 15.1% of the variance in positive and negative (respectively) day emotions can be attributed to between-subject differences. Both positive and negative emotions in dreams were included as predictors in both models, as well as daily sleep quality (SQI) and the retrospective measures (STAI score, PSR, NSR, and PSQI). Daily (prospective measures) scores were cluster-mean centred, and retrospective scores were grand-mean centred. Gender and age were included as control variables. Results of the models are displayed in Table 5.4. Positive dream emotions positively predicted positive daily emotions (b = 0.050, p = .041) and daily stress predicted decreased positive emotions (b = -0.069, p < .001) (Figure 5.3). Daily stress (b = -0.109, p < .001) (Figure

5.3) and STAI score (b = 0.018, p = .001) predicted increased negative emotions during the day.

Table 5.4. Results of multilevel model predicting positive and negative emotions during the day. Number of observations = 1694. Significance is highlighted in bold.

	Beta	Standard Error	p-value	Lower	Upper
Positive emotions during the day					
Positive Dream Emotions	**0.050**	**0.024**	**.041**	**0.002**	**0.097**
Negative Dream Emotions	0.033	0.020	.112	-0.008	0.073
Daily Stress (PSS)	**-0.069**	**0.003**	**< .001**	**-0.075**	**-0.063**
SQI	-0.001	0.007	.833	-0.014	0.011
PSQI	-0.030	0.022	.168	-0.073	0.013
STAI	-0.010	0.005	.080	-0.020	0.001
NSR	-0.009	0.053	.869	-0.112	0.095
PSR	0.023	0.055	.670	-0.085	0.131
Gender	0.020	0.188	.914	-0.352	0.391
Age	-0.022	0.016	.176	-0.053	0.010
Negative emotions during the day					
Positive Dream Emotions	0.024	0.024	.322	-0.023	0.071
Negative Dream Emotions	0.039	0.020	.057	-0.001	0.079
Daily Stress (PSS)	**0.109**	**0.003**	**< .001**	**0.103**	**0.115**
SQI	-0.004	0.007	.573	-0.016	0.009
PSQI	0.000	0.020	.981	-0.041	0.040
STAI	**0.018**	**0.005**	**.001**	**0.008**	**0.028**
NSR	0.038	0.050	.450	-0.060	0.136
PSR	0.068	0.052	.194	-0.035	0.170
Gender	0.148	0.178	.408	-0.202	0.500
Age	-0.010	0.015	.514	-0.040	0.020

Figure 5.3. The associations between emotions in the day and significant predictors. Pane 1 shows the relationship between positive day emotion and positive dream emotions, Pane 2 the relationship between positive day emotions and daily stress scores, and Pane 3 the relationship between negative day emotion and daily stress. Each line represents a participant.



Post-hoc multilevel models testing interactions between SPS and daily emotions in predicting dream emotions

Post-hoc tests were conducted to explore any interactions between daily emotions, daily stress, sleep quality, and trait anxiety with PSR and NSR. All variables were included in the models. Predicting negative dreaming, the results revealed no significant interactions between PSR and NSR and daily positive emotions, daily negative emotions, PSS score, or STAI score ($p > .05$). There was a significant interaction between PSR and positive daily emotions in predicting positive dream emotion (b = -0.086, $p = .019$), suggesting that increased PSR interacted with positive daily emotions to produce reduced dream emotions. All other interactions were non-significant ($p > .05$).

Post-hoc multilevel models testing interactions between SPS and dream emotions in predicting daily emotions

Finally, testing the interactions between NSR and PSR with positive and negative dream emotions, and daily sleep quality to predict daily emotions, all interactions were non-significant ($p > .05$). However, the interaction between positive dream emotions and PSR (b = -0.049, $p = .090$) and negative dream emotions and PSR (b = -0.037, $p = .092$) in predicting positive daily emotions approached significance, as well as PSR and PSS score in predicting negative daily emotions (b = 0.048, $p = .095$).

Discussion

This chapter aimed to test the relationships between daily variations in emotional experiences in waking life and in dreams, as well as the associations between these changes and trait anxiety, daily stress, sleep quality, and Sensory Processing Sensitivity (SPS). Building on previous literature, this study specifically included an established measure of perceived stress (Samson-Daoust et al., 2019), while longitudinally exploring the emotional dream experiences of Highly Sensitive Persons (Chapter 4; Carr et al., 2020).

Dream and daily emotions

Multilevel modelling revealed that daily variations in stress were predictive of negative dream affect, and overall daily affect and trait anxiety were not significant predictors. This provides support for the continuity hypothesis, and in particular, affective continuity, in that dreams reflect a continuation of daily negativity (Cartwright et al., 1998; Schredl, 2017; Veloce et al.,

2019). There was, however, no significant effect of positive daily emotions, daily stress, or trait anxiety on positive dreaming. This contradicts the literature that states positive events are integrated into dreams (Nielsen et al., 1991; Schredl, 2003; Schredl & Reinhard, 2009), and instead supports the notion of a reduction of emotions of positive daily events when incorporated into dreams (Conte et al., 2020; Veloce et al., 2019).

While the continuity hypothesis makes no assumption about whether dreaming has an emotion processing function, the current findings can be interpreted as support for a possible emotion regulation function of dreaming. Sleep and especially REM sleep is implicated in restoring, processing, and regulating daily emotional stress (Vandekerchkove & Cluydts, 2010). Emotional assimilation during sleep might involve a role for dreaming in strengthening and/or dampening emotional memories, resulting also in creativity and insight (Malinowski & Horton, 2015). Sleep has been shown to have memory consolidation effects (e.g., Reid et al., 2022), REM sleep more specifically, and dreaming, may play a role in selectively consolidating emotional stimuli and memories (Conte et al., 2020; Nishida, Pearsall, Buckner, & Walker, 2009). But there may be a further effect if there is suppression of emotional thoughts during the day, individuals who are more likely to suppress negative thoughts may then dream more of their negative daily experiences (Malinowski, 2017). Supporting this, Malinowski, Carr, Edwards, Ingarfill, & Pinto (2019) reveal that suppressed negative thoughts experience a "rebound" effect, in which they appear more in dreams than for a condition where thoughts are not suppressed. As well as this, participants in this study also had more positive emotional responses to successfully suppressed, unpleasant thoughts that were experienced in dreams. Overall, the findings above suggest that dreams serve to decrease the negativity associated with negative daily experiences.

This finding of daily stress predicting subsequent negative dream affect is contradictory to Samson-Daoust et al. (2019) who demonstrated that trait anxiety is the strongest predictor of negative dreaming. A potential explanation for this could be that Samson-Daoust et al. (2019) did not use an established measure of perceived daily stress, and instead, used just one item that rated stress on a scale of "not stressed at all" to "extremely stressed". Considering perceived stress as multi-faceted and using a more comprehensive scale may be more rigorous than for the one-item measure (Crede et al., 2012).

The results are also important in showing the effects that sleep quality has on dream emotions. Specifically, poor nightly sleep quality predicted the presence of less positive and more negative dreams, and overall poor sleep quality (as measured by PSQI) predicted less positive daily emotions (Bower et al., 2010; Sikka et al., 2022). Although the effects of sleep quality on daily emotions were non-significant, sleep quality has been shown to impact the individual's daily mood (Triantafillou et al., 2019) and seeking to improve the quality of sleep may help in promoting positive daily experiences. In addition, such improvements can aid in increasing health outcomes, such as reducing stress, depression, and anxiety (Scott, Webb, James, Rowse, & Weich, 2021).

Sensory Processing Sensitivity and dream emotions

Considering the findings of SPS, the positive subscale of PSR predicted greater negative dreaming. However, no interactions were revealed between daily mood, perceived stress, or trait anxiety with SPS in predicting affect in dreams, which contradicts the Differential Susceptibility hypothesis as well as the notion that highly sensitives with low mental wellbeing are vulnerable to negative dreaming (nightmares), and that high sensitives with good mental wellbeing are susceptible to positive dreaming (Carr et al., 2020). Furthermore, the positive aspect of SPS was predictive of more negative dreaming, which is surprising as the negative facet tends to be characterised by emotional reactivity. As well as this, an interaction between PSR and positive daily emotions was associated with *reduced* positive emotions in dreams. Again, this contradicts Differential Susceptibility, which would expect positive emotions during the day to predict positive dream emotions amongst high PSR individuals. This could suggest a very post-hoc speculation that dreaming serves an emotional modulation function for everyday life responses, such a function having been proposed for nightmares by Sterpenich, Perogamvros, Tononi, and Schwartz (2019) and for ordinary dreams by Vallat et al. (2017), and this could be more in evidence amongst highly sensitives (specifically because of the positive aspect of SPS). However, as the main effect of PSR on positive dreaming was not significant, these findings are difficult to fully interpret.

That the expected interaction of SPS to produce emotionally negative dreams was not found may indicate a difference between negatively toned dreams and nightmares, as this interaction has been found (although cross-sectionally) for nightmares. Indeed, Fireman, Levin, and Pope (2014) theorise that while negative dreams are an indicator of regulation and consolidation, nightmares could signify deficits and emotional dysregulation and even the failure of dream

function (Levin & Nielsen, 2007). Support for a distinction between nightmares and bad dreams is given by Zadra and Donderi (2000), in that they have differences in their correlations with waking life psychopathology variables. Carr and Nielsen (2017) posit an alternative theory of nightmare suffering, which does not rely on any putative function of dreams, in that SPS is a common trait amongst nightmare sufferers, and highly sensitives that experience increased negativity (e.g., adverse environments, lower mental wellbeing) may also experience increases in nightmare frequency and distress (Carr et al., 2020). It may be that the theory and findings of a relationship between SPS and nightmares does not extend to emotionally negative dreams in general, and that the Differential Susceptibility model for nightmares cannot be extended to emotionally negative or positive dreams in general.

Limitations

It is important to consider the limitations of this research. Firstly, as in Chapter 4, the majority of the sample was female (92%), and although gender was included as a covariate in the models, the sample may not be representative and generalisable. Secondly, ongoing personal concerns and/or events, that could emotionally or physiologically impact an individual, and subsequently affect dreams, were not considered (other than mental health/neurological disorders, and drug consumption). As one example, pregnancy can influence dreaming, and this change varies depending on trimester (Schredl et al., 2016) and is thought to reflect cognitive processes when awake (Lara-Carrasco et al., 2013).

Furthermore, the method only involved self-ratings of dream emotions, resulting in subjective, potentially biased scores. For instance, Barbeau et al. (2022) found differences between self-perceived and judge-rated positive emotions in dreams, suggesting that individuals over-estimate the propensity of positivity experienced, showing a "positivity bias" in contrast to judge ratings. No such bias was revealed for negative emotions. This has implications for how researchers measure emotions in dreams. Future research could include dream reports as part of the method, dream content can then be rated by the participant as well as by an external judge, although this method is then more onerous for participants. Additionally, including dream reports and daily diaries can allow researchers to test for specific daily incorporations of waking life experiences into dreams, and to investigate the origin of daily emotions and memories that are incorporated into dreams, such as in Eichenlaub et al. (2018). Lastly, although the current study included a daily measure of affect, this was measured at night (just before bed) and was not measured throughout the day.

Conclusion

In conclusion, support for the continuity hypothesis of dreaming was revealed, in that daily stress was associated with negative emotions in dreams, demonstrated using a comprehensive and established measure of perceived daily stress. Sleep quality was also shown to have a strong impact upon dream emotions, predicting both positive and negative dream affect, although further research using extensive emotional measures and objective methods of sleep quality tracking should explore the effects of sleep quality on dream emotions and on daily mood and mental health outcomes. However, contradicting Differential Susceptibility, PSR predicted increased negative dream emotions and interacted only with daily positive mood in reducing positive dream affect, which could imply a functional, emotional regulation role of positive sensitivity. From the results here, the Differential Susceptibility model for nightmares cannot be extended to emotionally negative or positive dreams in general.

Chapter 6. A Protocol Testing the Implications of Sensory Processing Sensitivity on a New Treatment of Nightmares in a Clinical Sample

Nightmares, mental health, and nightmare treatments

Previous chapters have addressed whether Sensory Processing Sensitivity (SPS) is a predisposing trait for the frequency of nightmares and for the intensity of emotions in dreams. This chapter addresses the literature around whether SPS is related to the frequency of intense nightmares in a clinical sample, and to the outcomes of the treatment for nightmares. In the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) and the International Classification of Sleep Disorders (ICSD-3) the medical definition of a nightmare is an "extended, extremely dysphoric" dream that "usually involves efforts to avoid threats to survival, security, or physical integrity" (Gieselmann et al., 2019). Nightmare disorder is further defined as "the repeated occurrence of nightmares that cause clinically significant distress or impairment in social, occupational, or other important areas of functioning", that is not due to other conditions or substance use. Whereas for the general population the average incidence of nightmares is one to two per year, about 4–8% of people have a "current problem" with nightmares, with this being greater in females than males (Spoormaker & van den Bout, 2006). The study addresses such problematic nightmares, with a sample whose nightmares present as a symptom of or are comorbid with an existing mental disorder.

Nightmares are associated with poor mental health and wellbeing (Blagrove, Farmer, & Williams, 2004), deficits in emotional processing (Liu, Liu, & Jia, 2022; Wong et al., 2023), and with stress, paranoia, and sleep disturbances (Schredl et al., 2019; Rek, Sheaves, & Freeman, 2017). Nightmares are also commonly reported as a symptom of mental health disorders, such as generalised anxiety and phobias (Rimsh & Pietrowsky, 2022), depression (Agargun et al., 2007; Hedstrom et al., 2021; Yang, Liu, Liu, Jia, & Liu, 2022), post-traumatic stress disorder (PTSD) (Habukawa et al., 2018; Leskin, Woodward, Young, & Sheik, 2002) and bipolar disorder (Ma et al., 2018). Importantly, nightmares have been implicated as a risk factor for suicidal behaviours (Tanskanen et al., 2001), especially in those with mental health disorders. For example, small and

moderate (respectively) associations were found between suicide risk and nightmare frequency and distress in a study of adolescents with major depressive disorder (Song et al., 2022). Furthermore, Geoffroy et al. (2022) conducted a naturalistic investigation of patients hospitalised in a psychiatric room for suicidal crisis. The majority of patients presented with depressive symptoms. On average, nightmares appeared three months before a suicidal crisis, with dreams containing suicidal scenarios appearing approximately two months before.

The prevalence of nightmares and the impacts on individuals with (and without) mental health issues reinforce the need for treatment of nightmares. With treatment, nightmare distress and frequency can decrease, as well as the severity of symptoms (Lancee, Spoormaker, & van den Bout, 2010; Sheaves, Rek, & Freeman, 2023). There are many treatments for nightmares, including medication (e.g., Prazosin for nightmare symptoms in PTSD sufferers; Berger et al., 2009), cognitive behavioural techniques (for reviews, see Carona & Fonseca, 2022 and Lancee, Spoormaker, Krakow, & van den Bout, 2008), lucid dreaming therapy (Holzinger & Saletu, 2015), exposure and desensitisation (Hansen, Hofling, Kroner-Borowik, Stangier, & Steil, 2013; Lancee et al., 2010), and eye movement desensitisation and reprocessing (EMDR) (e.g., Woo, 2014). A commonly accepted treatment of nightmares is Imagery Rehearsal Therapy (IRT), which involves changing and rescripting the nightmare in waking life, and practising this in conscious thoughts during the day, which changes the narrative of the nightmare when asleep. IRT has been evidenced as a highly effective treatment for nightmares (e.g., Gill et al., 2023; Moore & Krakow, 2007; van Schagen, Lancee, de Groot, Spoormaker, & van den Bout, 2015). Thunker and Pietrowsky (2012) tested the effectiveness of a German version of IRT on nightmares in PTSD sufferers, depression sufferers, and primarily nightmare sufferers. They found that nightmare frequency and nightmare distress decreased from pre-treatment to post-treatment (and follow-up), with younger people benefiting more from IRT than older individuals. Furthermore, IRT may also be used in conjunction with other treatments, such as cognitive behavioural therapy (Belleville, Dube-Frenette, & Rousseau, 2018) and targeted memory reactivation (Schwartz, Clerget, & Perogamvros, 2022), to enhance the benefits for nightmare sufferers.

Recently, a new variant of IRT, referred to as the Dream Completion Technique (DCT), has been developed by psychotherapist Justin Havens, based on the Planned Dream Intervention approach

(Havens, Hughes, McMaster, & Kingerlee, 2019) for use amongst therapists within the National Health System (NHS) in the United Kingdom. This technique involves influencing nightmare and/or sleep experiences by asking of a recent dream where waking occurred 'What do I want to happen next that feels good?' It differs from the common IRT in that it can be applied to residual emotions from sleep where a dream cannot be recalled. Here also the patient can think 'What do I want to happen next?' or 'How do I want to get rid of this feeling/sensation?' DCT empowers the individual to practice either changing the nightmare content itself or changing the subsequent dreaming or sleep experience. This has benefits for those who cannot remember their dream content, as they do not have to rehearse changing the specific nightmare.

The therapist handout created by Justin Havens provides examples of how specific dream topics (first sentence in each of the following) can be altered:

- Dreaming of being attacked: "*I woke up at the moment my attacker jumped on me. Now I pull out a massive two handed 'Braveheart' sword and he is history. It is all over and I have a smile on my face."*
- Not remembering dream content: *"I woke up regularly lashing out, but couldn't remember my dreams. My new dream idea was to I imagine I was the Incredible Hulk throwing everyone off of me in an uncontrollable rage, which felt good."*

Available: https://justinhavens.com/admin/uploads/files/Dream_Completion_Technique_The.pdf

DCT can be taught to the nightmare sufferer in one session using simple materials (a YouTube video and a handout), with a therapist's support alongside their usual therapy, thus making it low in resources and time demands. Additionally, the aim of DCT is to not only alleviate nightmares, but to also increase sleep quality. For instance, after an awakening due to nightmares, individuals can prepare a conscious thought to take with them into a subsequent dream, regardless of whether the nightmare was remembered, so as to reduce negative dream content. This, in turn, helps to increase sleep quality by allowing the individual to return to sleep. Good sleep quality is thought to aid in decreasing symptom severity of mental disorders (Lancee, et al., 2010; Sheaves et al., 2023), thus, not only is the aim for DCT to help reduce nightmares, but also the severity of problem descriptors. However, this technique has received no empirical validation (except for feedback from group therapy sessions amongst veterans suffering from PTSD), and there is no evidence to

suggest DCT is more beneficial than pre-existing nightmare treatments, such as IRT. Therefore, an investigation of DCT in those who experience nightmares, including with pre-existing mental disorders (e.g., PTSD), is required. This chapter reports the start of such an investigation.

Sensory Processing Sensitivity, mental health, and nightmares

SPS may predispose individuals not only to experiencing nightmares but also to developing mental health disorders (Aron, 2010; Assary et al., 2024). Discussed in Chapter 5, Carr and Nielsen (2017) developed a novel framework for the experience of nightmares, which states that high trait SPS may characterise nightmare sufferers. Referred to as the Differential Susceptibility Framework of Nightmares, this highlights the negative aspects of this trait as predisposing individuals to poor outcomes (e.g., nightmares), but also how Highly Sensitive Persons can positively adapt to adequate environments, which has implications on treatments (see below). As described in previous chapters (Chapters 4 and 5), Carr, Matthews, Williams and Blagrove (2020) tested this model with a non-clinical sample and found that high SPS individuals with lower mental wellbeing report greater nightmare frequency and distress than do medium or low SPS individuals, supporting the idea that Highly Sensitives Persons that have negative experiences have poorer outcomes and thus experience heightened negativity in other aspects of their life (in this case, their dream life), compared to low HSPS individuals, and compared to a situation of more positive experiences. Furthermore, while controlling for the Big Five traits, Carr et al. (2022) revealed associations between the subscales of the Highly Sensitive Person Scale (HSPS; Aron & Aron, 1997) and nightmare frequency and distress, specifically with Aesthetic Sensitivity and Low Sensory Threshold.

In previous chapters, the associations and predictions of SPS on emotionally negative dreaming and nightmares were tested. Firstly, Chapter 4 found that score on the HSPS correlated with greater nightmare frequency and distress, and specifically, these associations emerged for the negative subscale of the HSPS only. Ordinal regressions also revealed that both subscales of the HSPS (Positive Sensory Responsivity; PSR and Negative Sensory Responsivity; NSR) predict the emotional intensity of dreams, suggesting that Highly Sensitive Persons experience more intense dreams, although no significant predictions of emotional valence (i.e., how positive or negative dreams are) emerged for the HSPS subscales. Furthermore, a longitudinal study conducted in

Chapter 5 revealed that PSR was associated with the presence of greater night-to-night negative emotions in dreams across a period of 21.5 days, although this was not specific to nightmares and only negative affect in dreams was considered.

Highly Sensitive Persons may be more susceptible to mental health vulnerabilities and lower mental wellbeing because of an enhanced processing of negativity, emotional dysregulation, ease of overstimulation, lack of effective coping mechanisms (Aron, 2010) and internalisation of problems (Lionetti et al., 2022). Chapters 4 and 5 evidenced moderate to strong associations between SPS (particularly the negative subscale of the HSPS) and trait anxiety, further supported by the literature (e.g., Takahashi, Kawashima, Nitta, Kumano, 2020). Also, research shows that SPS has associations with depressive tendencies (Lionetti et al., 2022; Yano, Kase, Oishi, 2021). Wu, Zhang, Li, Feng, & Yan (2021) investigated the brain correlates of SPS with stress and depression in 244 Chinese college students. A negative subscale of SPS (Ease of Excitation; EOE; as according to Smolewska et al., 2006) correlated with stress and depression scores. EOE also interacted with perceived stress in predicting depression scores, suggesting that those with higher EOE and greater stress experience greater depression severity, supporting the Differential Susceptibility and diathesis stress theories of environmental sensitivity. EOE was also associated with reduced grey matter volumes in the dorsal anterior cingulate cortex and the right cerebellum, both implicated in emotion processing. Overall, this study suggests that high SPS, combined with negative environments (e.g., stress), results in the development of mental health issues (e.g., depressive symptomology).

These ideas are extended in Karam et al. (2019), who explored the effect of childhood adversities, exposure to war, and environmental sensitivity (SPS) on PTSD symptoms. SPS was measured using the Highly Sensitive Child Scale (HSCS) (Pluess et al., 2018). PTSD severity was found to be significantly correlated with SPS, and the results revealed that those with low and middle childhood adversity levels experienced a greater effect of war exposure on PTSD with increasing sensitivity, whereas high childhood adversity children experienced similar associations between war exposure and PTSD regardless of sensitivity. The lack of finding for highly sensitives at the highest level of childhood adversity shows that, for some highly adverse circumstances, SPS is no longer an interacting factor.

Findings that high SPS may be a predisposing factor for the experience of nightmares (Carr & Nielsen, 2017; Carr et al., 2020) and mental health vulnerabilities (e.g., Aron, 2010; Lionetti et al., 2022; Takahashi et al., 2020; Yano et al., 2021) have a corollary in the Differential Sensitivity framework that Highly Sensitive Persons may also be more responsive to positive conditions, perhaps due to a difference in genetic make-up (Pluess et al., 2022). For the purposes of this chapter, one type of positive condition is a psychological intervention to alleviate a disorder (de Villiers, Lionetti, & Pluess, 2018). For example, Pluess and Boniwell (2015) demonstrated that providing a preventative intervention for depression in school-age children resulted in significantly lower depressive symptoms after 12 months for individuals high in SPS compared to low SPS, as well as a control group that did not receive the intervention. The low SPS and control groups did not differ in outcomes. Similarly, Nocentini, Menesini, and Pluess (2018) found that children with high SPS, especially boys, tend to respond more positively to anti-bullying interventions. The authors suggest that, in part, this could be due to the intervention allowing sensitive children to empathise more readily with victims of bullying, thus reducing the chance of carrying out such negative behaviours. However, the two studies were conducted with school-age children, and children may be more susceptible and open to change (Foulkes, Leung, Fuhrmann, Knoll, & Blakemore, 2018) compared with adults. On the other hand, highly sensitives with childhood adversity may be more receptive to positive environments in adulthood than are low sensitives, showing enhanced wellbeing in beneficial contexts and evidencing resilience to previous negativity (Paola, Nocentini, & Lionetti, 2022). Furthermore, a study conducted on postgraduate students revealed a reduction in mood disturbances amongst highly sensitives after a yoga intervention for mental health, with post-intervention scores resembling those of low sensitives (Amemiya et al., 2020). Low sensitives did not differ from pre- to post-intervention, and scores were significantly different between high and low sensitives at pre-intervention. This suggests that Highly Sensitive Persons are more accepting of behaviour change, such as adapting techniques during interventions, as well as being more receptive of positive contexts in general. This chapter investigates this further.

Proposed aims and hypotheses

There remains little research regarding SPS and nightmare frequency and distress, and further research is required to understand Highly Sensitive Persons' vulnerability to experiencing nightmares in response to adverse environments and co-morbidities with mental disorders. This study is unique compared with previous research (e.g., Carr et al., 2020) as the sample consists of individuals who are seeking help for their mental health and nightmare symptoms. The study proposes the method and preliminary data, that will investigate whether a greater associations between mental wellbeing and nightmare experience for Highly Sensitive Persons occur in a clinical subsample of the population. As well as this, it is important to recognise the positive aspects of high SPS, in that Highly Sensitive Persons can be more predisposed to positive outcomes, such as interventions to encourage behaviour change. The aims of the study will be as follows:

- To explore the prevalence of mental disorders and nightmares (and co-morbidities) in a clinical sample and to assess whether Highly Sensitive Persons differ from non-sensitives in the sample on these measures. It is hypothesised that SPS will correlate with problem descriptor measures, as well as measures of general anxiety and depression.
- To determine whether DCT is effective for reducing nightmares and sleep disturbances. It is expected that the addition of DCT to treatment as usual will reduce the frequency and severity of nightmares when compared with just treatment as usual.
- To determine whether DCT improves the outcomes of treatment for mental disorders (PTSD, social phobia, panic disorder, and obsessive-compulsive disorder). It is hypothesised that there will be a decrease in symptom severity for those receiving DCT when compared with just treatment as usual.
- To investigate the effectiveness of nightmare treatment (DCT) amongst Highly Sensitive Persons (compared with low sensitives) in reducing nightmare frequency and severity. It is expected that DCT will be more effective for highly sensitives due to adherence to treatment, increased acceptance of behaviour change, and their sensitivity to treatment considered as a stimulus.

- To investigate the effects of nightmare treatment (DCT) as well as treatment as usual on symptom severity in Highly Sensitive Persons compared with non-sensitives.

Method

Participants

The data are being collected by the Pennine Care NHS Foundation Trust. Participants are recruited from Step-3 of the Improving Access to Psychological Therapies (IAPT) service, which is run by the NHS in England. Step-3 provides high intensity therapy (Cognitive Behavioural Therapy) for those with, for example, severe depression and anxiety, phobias, panic disorders, and PTSD (The National Collaborating Centre for Mental Health; NHS, 2023). Participants in the study are from Step-3 individual therapy waiting lists in the Pennine Care NHS Foundation Trust. Participants were firstly screened for the following eligibility criteria: 16 years or older, experience regular nightmares or sleep disturbances (weekly), with a problem descriptor of PTSD or another Step-3 IAPT disorder (social phobia, panic disorder, and obsessive-compulsive disorder). Exclusion criteria include those with co-morbid serious mental illness (e.g., personality disorder, psychosis, bi-polar disorder) and those who presented as complex or as on an enhanced support pathway. Participants were free to withdraw at any point of the study.

Materials

Standard IAPT Questionnaires:

The Generalised Anxiety Disorder Assessment (GAD-7) (Spitzer et al., 2006) measures anxiety symptoms. This questionnaire provides 7 items referring to problems that may or may not have been experienced over the prior two-week period (e.g., “Feeling nervous, anxious, or on edge?”). Items were rated on a scale of 0 = Not at all to 3 = Nearly every day. The score for each item was summed to create a total GAD-7 score.

To measure depression symptoms, the Patient Health Questionnaire (PHQ-9) (Kroenke, Spitzer & Williams, 2001) is administered. This is a 9-item questionnaire that asks participants to rate on a scale of 0 (Not at all) to 3 (Nearly every day) how often they have been bothered by each item.

For example, “Poor appetite or overeating?”. The score for each item was summed to create a total PHQ-9 score.

The Work and Social Adjustment Scale (WSAS) (Mundt, Marks, Shear, & Greist, 2002) is completed to measure impairment in functioning in everyday life due to mental health. The questionnaire has 5-items which are rated on a scale of 0 (Not at all) to 8 (Very Severely), for example, “Because of my mental health, my private leisure activities (done alone, such as reading, gardening, collecting, sewing, walking alone) are impaired.” A total WSAS score was obtained by summing the responses to all items.

Problem Descriptor Questionnaires:

Depending on the participants’ problem descriptor, one of the following questionnaires was provided to participants.

The PTSD Checklist for DSM-5 (PCL-5) (Weathers et al., 2018) is used to measure PTSD symptom severity. This is a 20-item questionnaire which provides the checklist symptoms of PTSD, by which participants rate how much they have been bothered by each particular problem (0 = Not at all; 4 = Extremely). For example, “Trouble remembering important parts of the stressful experience?”. A total score PCL-5 was provided by summing each individual item. This questionnaire was only completed by those whose problem descriptor is PTSD.

Social Phobia severity is measured using the 17-item Social Phobia Inventory (SPIN) (Connor et al., 2000). Participants read each item and indicated how much the statement applied to them in the last week on a scale of 0 (Not at all) to 4 (Extremely), for example, “I would do anything to avoid being criticized”. All items were summed to give a total SPIN score. This questionnaire was only completed by those whose problem descriptor is social phobia.

The Panic Disorder Severity Scale (PDSS) (Shear et al., 1997) measures panic disorder severity. The questionnaire consists of 7 items, such as “How many panic and limited symptom attacks did you have during the week?” Each item has individual response options, but all range from 0 (No symptoms / Not at all) to 4 (Extreme symptoms / Constant). A total PDSS score was given by

summing all items. This questionnaire was only completed by those whose problem descriptor is panic disorder.

The 42-item Obsessive Compulsive Inventory (OCI) (Foa et al., 2002) measures obsessive compulsive disorder (OCD). Participants rated each statement according to how much it has distressed them in the last month (e.g., "I repeatedly check doors, windows, drawers, etc"). The scale is made up of seven individual subscales (washing, checking, doubting, ordering, obsessions, hoarding, and neutralising). Participants rated each item according to the frequency of occurrence (OCI-F) and distress caused (OCI-D), on a scale of 0 = Not at all to 4 = Extremely. A total OCI-F and OCI-D score was calculated. This questionnaire was only completed by those whose problem descriptor is OCD.

Nightmare measure:

The Nightmare Assessment Scale (NAS) is a 6-item questionnaire used to assess nightmare experience. Four items refer to frequency of occurrence (e.g., "Over the last week, how often have you avoided going to sleep because you feared having nightmares?") and two items refer to nightmare severity (e.g., Over the last week, when you could remember it, how disturbing was the nightmare or dream content to you?"). A total frequency of severe nightmare score (NAS Score) is calculated by averaging all items, following Kelly and Mathe (2019).

Other measures:

The 27-item Highly Sensitive Person Scale (HSPS) (Aron & Aron, 1997) is administered to capture SPS. Participants responded to each question according to a 7-point Likert scale (1 = Not at all, 7 = Extremely). The mean HSPS score was calculated for each participant, as well as mean NSR and PSR scores (Tabak et al., 2022).

Procedure

Participants are recruited from Step-3 of the IAPT service. All participants were screened for eligibility at the start of enrolment, i.e., that they met the criteria for Step-3 IAPT services, and that they experience nightmares at least weekly. Demographic information is collected (age, gender, and problem descriptor).

If identified as eligible, respondents were added to the waiting list for IAPT, which usually lasts three to four months. At this point, they are invited to participate in the study by a Research Assistant by telephone. They are provided with an Information Sheet to read in their own time as well as an Informed Consent Form. Once consent is provided, Time 0 (T0) measures are completed over the phone; the HSPS and NAS to measure SPS and nightmares respectively, and the IAPT measures and problem descriptor questionnaires (depending on the participants' problem descriptor). Participants then begin their treatment (randomly allocated to DCT and TAU, see "Future Research" section). All participants again complete the standard IAPT questionnaires (GAD-7, PHQ-9, WSAS) as well as their unique problem descriptor questionnaire at every session of treatment (12-16 sessions). NAS is to be completed at T0, Session 1 (T1; their first treatment session), in two further treatment sessions (T2, T3) and at the final session of treatment (Final Session). Participants are then to be contacted 3 months after they finished their treatment (post-treatment) to complete the standard IAPT measures, problem descriptor questionnaire, and NAS once more (Follow-up). The IAPT and problem descriptor questionnaires completed at these sessions (T1, T2, T3, Final, and Follow-up) are to be used in the analysis.

Preliminary results and discussion

Participants and preliminary questionnaire information

Preliminary data analysis occurred April 2024. As of this date, there was a sample of N = 41 participants recruited to participate in the trial (32 females, 9 males; mean age of 39.47 years; age range 18-64 years). 26 participants had PTSD as a problem descriptor, 3 had complex trauma, 3 had general anxiety disorder, 2 had a depressive episode, and 4 had no problem descriptor. Only data for the NAS, HSPS, and standard IAPT measures (GAD-7 and PHQ-9) were available at the time of analysis. Table 6.1 demonstrates the number of responses per questionnaire at the different times (T0, T1, T2, T3, Final Session, and Follow-up), as well as the descriptive statistics of each.

Table 6.1. The descriptive statistics (mean, SD, minimum, and maximum) of the questionnaires at the different time points, as well as total number of responses per questionnaire (N).

	Mean	SD	Minimum	Maximum	N
HSPS Score	5.37	0.91	3.22	6.85	41
NSR	5.27	1.04	2.89	7.00	41
PSR	5.47	1.05	3.17	7.00	41
T0 Scores					
NAS	2.73	0.75	1.00	3.83	40
GAD-7	-	-	-	-	-
PHQ-9	-	-	-	-	-
T1 Scores					
NAS	2.28	1.03	0.00	3.83	21
GAD-7	1.99	0.75	0.57	3.00	18
PHQ-9	1.97	0.63	0.89	2.89	18
T2 Scores					
NAS	1.91	1.02	0.00	3.33	16
GAD-7	2.04	0.69	0.86	3.00	16
PHQ-9	1.81	0.60	0.44	2.78	16
T3 Scores					
NAS	1.93	1.12	0.00	3.33	10
GAD-7	1.94	0.76	1.00	3.00	9
PHQ-9	1.69	0.65	0.44	2.33	10
Final Session Scores					
NAS	0.96	0.91	0.00	2.17	4
GAD-7	0.91	0.85	0.00	2.29	5
PHQ-9	0.87	0.72	0.00	2.00	5
Follow-up Scores					
NAS	0.83	1.23	0.00	3.17	6
GAD-7	1.83	1.14	0.43	3.00	6
PHQ-9	1.52	1.00	0.67	2.78	6

HSPS Score (mean = 5.37) was higher in the current sample than was found for participants in Chapters 3 (mean = 4.28), 4 (mean = 4.30) and 5 (mean = 4.51), and in Aron and Aron (1997) (mean = 4.69 in Study 3 and mean = 4.80 in Study 4).

Correlations between SPS and NAS score at T0

Correlation coefficients and p-values are displayed in Table 6.2. HSPS Score, NSR, NAS Score all violated the assumption of normality, and thus Spearman's rho correlations were conducted. HSPS score and NSR score correlated positively with NAS score (p = .013 and p = .005).

Table 6.2. Spearman's rho correlations (coefficient, p-value, df) between SPS and the nightmare variable (NAS) at T0.
Significance is highlighted in bold.

	NSR	PSR	NAS (T0)
HSPS Score	**.963, p < .001, df = 39**	**.606, p < .001, df = 39**	**.388, p = .013, df = 38**
NSR		**.415, p = .007, df = 39**	**.433, p = .005, df = 38**
PSR			.121, p = .457, df = 38

Correlations between SPS, depression, and anxiety at T1

Spearman's rho correlations (Table 6.3) were conducted between the SPS variables and scores on the GAD-7 (generalised anxiety) and PHQ-9 (depression), to explore the propensity for Highly Sensitive Persons to present negative mental health symptomology. T1 scores were used as this was the first time point where GAD-7 and PHQ-9 were captured. HSPS score and NSR both positively correlated with generalised anxiety and depression (p < .05).

Table 6.3. Spearman's rho correlations (coefficient, p-value, df) between SPS and mental health measures at T1. NAS scores are not reported as correlations were non-significant ($p > .05$). Significance is highlighted in bold.

	GAD-7 (T1)	PHQ-9 (T1)
HSPS Score	**.623, p = .006, df = 16**	**.549, p = .018, df = 16**
NSR	**.646, p = .004, df = 16**	**.525, p = .025, df = 16**
PSR	.161, p = .523, df = 16	.097, p = .703, df = 16

Discussion

In summary, the baseline correlations revealed relationships between HSPS Score and NSR with greater nightmare experience in a clinical sample and supporting previous findings of a relationship between SPS and nightmare frequency and distress (Carr & Nielsen, 2017; Carr et al., 2020; Carr et al., 2022; Chapters 4 and 5). In addition to this, HSPS Score was higher in the current sample than was found for participants in the previous chapters (Chapters 3, 4, 5), and in Aron and Aron (1997), and HSPS score and NSR were moderately related to greater scores on anxiety and depression measures. This could potentially indicate that high SPS is a common personality trait in individuals with clinically severe nightmares or poor mental health outcomes.

Future research

Given the finding here that SPS is significantly related to nightmare frequency the question arises whether, under the vantage characteristic of SPS, that SPS will also be significantly correlated with successful response to treatment and to alleviation of other problem descriptors. An extensive plan for the next steps of the research is displayed in Appendix H. As an overview, participants

are randomly allocated to one of two groups, Treatment as Usual (TAU) or the Dream Completion Technique (DCT) and TAU group (DCT+TAU). The DCT+TAU group receives information on DCT at the beginning of their usual treatment. Individuals receive 12-16 sessions of treatment. Participants complete the IAPT measures, the unique problem descriptor questionnaires, and NAS before treatment, at each session of treatment (12-16 sessions), and at a 3-month follow-up. The data collected at sessions T0, T1, T2, T3, Final and Follow-up will be used in the subsequent analyses (see above for information on the different time points).

Statistical analyses will then be carried out to test the effectiveness of DCT on the frequency of nightmare severity (NAS), as well as its effect on symptom severity. Investigating SPS, analyses will be conducted with NAS, the IAPT measures, and each problem descriptor questionnaire at the different time points to assess the associations between SPS and nightmares, SPS and mental health vulnerabilities, as well as highly sensitives adherence to treatment. Full details of statistical analyses are provided in Appendix H.

Chapter 7. Exploring Item 18 of the Highly Sensitive Person Scale: The Aversion to Violence in Movies and Real Life.

Violence and Sensory Processing Sensitivity

Item 18 of the Highly Sensitive Person Scale states "Do you make a point to avoid violent movies and TV shows?" The inclusion of the item in the scale follows from findings that those high in Sensory Processing Sensitivity (SPS) (Highly Sensitive Persons) hold a tendency to avoid media containing upsetting, unsettling, or cruel materials. The development of this item derived from interviews with individuals who identified as "either highly introverted… or easily overwhelmed by stimulation" (Aron & Aron, 1997; p. 350). The item was included in the initial questionnaire in Study 2 and remained part of the HSPS throughout the investigation and since. The support for its inclusion is from exploratory and confirmatory factor analyses exploring the dimensionality of the HSPS, for example, in Smolewska et al. (2006), Tabak et al. (2022), Pluess et al. (2020), and Attary and Ghazizadeh (2021). However, there has been no experimental validation or investigation of the specificity of Highly Sensitive Persons in their reactions to violence other than one study which investigated the reactions of highly sensitives to depictions of terrorism in the media and found that these individuals held higher perceptions of threat (Rubaltelli et al., 2018). This chapter addresses the relationship of self-ratings on this item to HSPS scores, to other personality measures, and to responses to videos containing real and fictional violence.

Violence and the effects of viewing violent media

According to Hamby (2017), violent behaviour should be defined by four essential elements; it must be intentional, unwanted, nonessential, and harmful. With the development of technology, violence is now widely available to consume through television (TV), movies, video games, music, as well as through the Internet, such as on social media and video sharing platforms (e.g., YouTube). Violence is usually unavoidable in media, particularly on TV and in movies. Krongard and Tsay-Vogel (2020) found that there were 5.9 violent occurrences per hour in commonly, what they referred to as "binge-watched" television shows. A context analysis by Smith, Nathanson, and Wilson (2002) revealed that 69% of programmes shown during primetime contained violent scenes, and even primetime TV shows for children contain high levels of violence, often with more scenes of violence than for shows intended for adults

(Martins & Riddle, 2022). Furthermore, films considered "Universal" under the British Board of Film Classification (BBFC) and thus deemed suitable for all audiences, are allowed to contain "mild violence" (BBFC Classification Guidelines, 2019). These findings demonstrate the inescapability of viewing violence, as this is highly prevalent, even during normal viewing times (i.e., not "late night" viewing) and within children's media. Due to this, the impacts that violent media has on the population has been central to socio-cognitive research, and with a surge in availability (e.g., Bleakley, Jamieson, & Romer, 2012) in the twenty-first century, it remains highly topical.

There are many detriments to violent media. Firstly, although disputed, research has provided evidence that viewing violence is linked to aggressive behaviour (Barlett & Rodeheffer, 2009; Bender, Plante, & Gentile, 2018; Ferguson et al., 2015; Fikkers, Piotrowski, & Valkenburg, 2016), despite cultural differences/influences on aggression (Anderson et al., 2017). These effects have particularly been explored for children and adolescents (e.g., Coker et al. 2015; Huesmann, Moise-Titus, Podolski, & Eron, 2003). For example, a meta-analysis found small-to-moderate correlations between exposure to media violence and the presence of aggressive behaviour and aggressive thoughts, as well as a moderate relationship with feelings of anger (Bushman & Huesmann, 2006). Also, children display higher effects of violence when tested longitudinally than do adults. Furthermore, after playing violent video games, a relationship is demonstrated between increased arousal and aggressive behaviours (Fikkers et al., 2016), although results from passive violent media viewing (e.g., on TV and film) may differ compared to actively participating in a video game.

Secondly, desensitisation to violence after prolonged exposure to violent media can be an issue, especially in developing individuals, potentially altering their perceptions of the world around them. For example, Mrug, Madan, Cook, and Wright (2015) found that participants experienced a decrease in emotional distress and empathy across viewing five different clips of violent movies, and males who had experienced higher exposure to real-life violence were less distressed by the violent movie clips. Additionally, research has shown that parental desensitisation to perceived justified violence in movies is linked to the likelihood that their children would be allowed to view such violence (Romer, Jamieson, Jamieson, Lull, & Adebimpe, 2018).

In addition to links to aggression and desensitisation, violence may impact emotions, mental health, and mood. A study on young children revealed that exposure to violence in news programming is associated with increased fear, worry, anger, and sadness (Buijzen, Walma van der Molen, & Sondij, 2007), although it is unknown whether children's reactions to violence can be extended to adults, who may have fully developed emotional processing. Adults have been shown to demonstrate more negative and aggressive thoughts and feelings following violent gameplay, specifically realistic violent gameplay (Bartlett & Rodeheffar, 2009). Stockdale, Morrison, Kmiecik, Garbarino, & Silton (2015) suggest that exposure to violence results in a reduced ability to identify emotional facial expressions, which implies that emotional processing becomes stunted by the viewing of violence.

Madan, Mrug, and Wright (2014) conducted a study investigating the effects of media violence viewing on anxiety in young adults (aged 18-22 years). The sample was split into a control group and experimental group, the control group watched non-violent clips from movies and the experimental group watched violent clips. Cardiovascular (heart rate, blood pressure) and state anxiety measures were taken before and after exposure to media violence. The results revealed that anxiety levels increased after watching violent movie clips compared with non-violent clips, although there were no differences between the groups in cardiovascular measures. Participants with a lack of exposure to real-life violence displayed slightly higher increases in blood pressure during the violent clips than those with high levels, thus supporting the desensitisation account of violent viewing. These results support the account that viewing violence increases anxiety, and that an individual's physiological processing is further impacted when their usual exposure to violence is low. Nevertheless, Merritt, LaQuea, Cromwell, and Ferguson (2016) found no long-term association between media violence exposure and depressive and anxiety symptoms, contradicting the claim that violence is associated with detrimental mental health symptomology. The authors suggest this is due to individuals' choice of selecting violent media, individuals choose what media to engage in and this self-selection diminishes negative effects in terms of emotion. There are complexities here, however, in that viewing a genre does not necessarily equate to liking a genre (Krcmar & Kean, 2009) and violent media can be inescapable during current times (Krongard & Tsay-Vogel, 2020; Martins & Riddle, 2022).

Personality and viewing violent images

Considering media preferences, research has investigated the types of preferences held by individuals and how these differ depending on individual differences, such as gender and personality. According to the Differential Susceptibility to Media Effects Model (DSMM; Valkenburg & Peter, 2013), the use of different media is determined by three Differential Susceptibility variables, which in turn, impact on the responsive states, as well as on the effects that different media has on an individual. One of these variables includes dispositional susceptibility, that is, the person-factors that influence media use and effects, including beliefs, attitudes, cognitions, gender and individual differences in temperament and personality. For instance, demonstrating gender differences, the literature has evidenced that males may be less sensitive to viewing violent media than are females (Nicklin, Swain, & Lloyd, 2020), which accords with findings that school-age boys watch and enjoy more violent cartoons and action-adventure films than do girls (Aluja-Fabregat & Torrubia-Beltri, 1998). Also, females tend to demonstrate more of a preference for happy films, whereas males prefer high-arousal films (Banerjee, Greene, Krcmar, Bagdasarov, & Ruginyte, 2008).

In addition, personality may impact the preference for different media use. An early article found that high neuroticism males report engaging more in information-based, drama, and tragedy genres of television/movies than do females, whereas they display less engagement in situation-comedy and adventure genres (Weaver, 1991). Also, Chory and Goodboy (2010) more recently found that, of the Big Five traits, agreeableness was negatively, and openness was positively associated with engagement in violent gameplay. Individuals whose most-played game did not feature strong violence were significantly higher in neuroticism and agreeableness, and those whose most-played game featured violence were significantly higher in openness to experience. This suggests that high neuroticism and agreeableness individuals tend to avoid violent media, whereas those who are more open to experience engage more in violent media. However, as mentioned previously, video games may present different results than passively viewed violent TV and films.

Investigating engagement in violent television and the facet-level of the Big Five traits, Krcmar and Kean (2009) found that the neuroticism facet of impulsivity and the aesthetics facet of openness to experience predicted watching violence, and that the activity level and excitement seeking facets of extraversion (negatively and positively respectively) predicted liking media violence, further suggesting that neurotic, open, and (to a lesser extent) extraverted individuals

have an inclination to prefer and engage in media violence. The study also revealed negative relationships between agreeableness and the viewing and liking of violent images, possibly due to the tenderness and modesty of agreeable individuals. Overall, the literature suggests that personality is associated with choice and effects of viewing violent media, although for traits like neuroticism, these associations may vary depending on whether the trait-level or facet-level are investigated.

Real-life and fictional violence

It is important to consider any differences between images of real-life violence and fictional violence, such as in movies and television shows. Real-life violence may be experienced first-hand, for instance, witnessing a violent event, or may be viewed in the media, such as on the news, on social media, and on video sharing platforms. Thus, viewing violence that is known to be real may invoke different responses than violence which is recognised as being fictional. However, the literature demonstrating the emotional responses to viewing real-life versus fictional violence is limited. One student research paper (Martin, 2022) demonstrated that participants had higher fear, sympathy, and anger scores in response to a real-life violent situation compared with fictional violence. However, Atkin (1983) found that participants who viewed fictional violence and participants who viewed real-life violence both scored higher in aggression compared with controls, suggesting that violence, regardless of the reality, is associated with aggressive tendencies.

Highly Sensitive Persons and the choice and effects of viewing fictional and non-fictional violence

A possible explanation for the hypothesised avoidance of violence amongst Highly Sensitive Persons is Differential Susceptibility. This suggests that Highly Sensitive Persons respond more negatively in the face of adversity (e.g., daily stress, overstimulation, negative environments) (Wu, Zhang, Li, Feng, & Yan, 2021), but can differentially respond to positivity, leading to better reactions and experiences to stimuli. Supporting this account, Brindle, Moulding, Bakker, and Nedeljkovic (2015) identify a lower tolerance for negative stimuli amongst Highly Sensitive Persons, potentially resulting in disrupted emotion regulation and increased negative mood, as well as impacting upon beliefs, coping mechanism, and tolerance of negative emotional states. Thus, Differential Susceptibility implies that when faced with adversity, Highly Sensitive Persons experience heightened emotional responsivity and reactivity (Homberg & Jagiellowicz, 2022; Jagiellowicz, Aron, & Aron, 2016), leading to more

extreme negative feelings, and (potentially over time) the development of avoidance behaviours to reduce the chance of experiencing such negativity. The viewing of violence could be classed as an example of such adversity.

As suggested in one news article (Keegan, 2013), a mechanism for the hypothesised avoidance by highly sensitives of violence in the media could be due to enhanced empathy and processing of others' emotions, and this may be a result of mirror neurons. Mirror neurons are responsible for observing and potentially imitating the acts of others and were initially found in the brains of monkeys (for reviews, see Acharya & Shukla, 2012 and Kilner & Lemon, 2013). These neurons have been implicated in emotion and empathy (Preston & de Waal, 2002). Lamm and Majdandzic (2015) posit two explanations for the function of mirror neurons, that they either serve action understanding or reflect action understanding; either explanation leads to the conclusion that their role in empathy enables the individual to make sense of others' actions by simulating the actions oneself.

In the news article, a quote from Elaine Aron suggests that "Sensitive people have more active mirror neurons." (Keegan, 2013). Supporting this, although not specific to SPS, Brown, Acevedo, and Fisher (2013) revealed that individuals with a higher score on prosocial/empathetic temperament (measured by the Fisher Temperament Inventory; Brown, et al., 2013) exhibited higher activations in the brain regions associated with mirror neurons, one of these regions being the inferior frontal gyrus (IFG), an area involved in empathy (Zhao, Ding, Zhang, Zhang, Hu, & Luo, 2021). Similarly, Acevedo, Aron, Pospos, and Jessen (2018) found that high SPS was associated with increased activity in brain areas responsible for empathy, self-reflection, and self-control, including the IFG, supporting the role of mirror neurons in empathic processing in Highly Sensitive Persons. Therefore, according to this account of violence avoidance, it would seem that in viewing violent actions against an individual, high SPS may result in greater empathy towards the victim(s) of violent acts. This, in turn, results in greater negative feelings towards violence when experienced from the victim's perspective, and highly sensitives would thus avoid violence to reduce the likelihood of experiencing this negativity.

In summary, both views (increased empathy and Differential Susceptibility) suggest that highly sensitives experience negativity more intensely than non-sensitives, and this could be particularly heightened when viewing violence. The importance of researching the avoidance

of violence hypothesised to be present in highly sensitives is vast. Firstly, regardless of the above theories of why Highly Sensitive Persons may tend to avoid violence, there is currently (to the author's knowledge) a lack of experimental literature to support Item 18 of the HSPS. Secondly, violent media can be inescapable (Krongard & Tsay-Vogel, 2020; Martins & Riddle, 2022; Smith et al., 2002), and is widely available on television, in video games, and on the internet. In particular, with the growth of social media and algorithm-based posting (e.g., recommended posts, posts with high interaction), violence may be more so available than previously on platforms such as Facebook and YouTube, even when this is not actively sought. For instance, The Statista Research Department (2023) found that Facebook acted against 110.7 million pieces of violent and graphic content in 2022. Thus, although these platforms have regulations in place, the risk remains of encountering such content, possibly resulting in negative outcomes for Highly Sensitive Persons. Also, violence in the media does not always come with clear warnings (such as on the News), and real-life violence can be encountered every day, such as in the street, on the way to work, etc.

It is thus important to assess the relationship of SPS to the viewing of violence and providing individuals with explanations (such as being high in SPS) for being avoidant and reactive to violent media content would also be important. This allows measures to be put in place to ensure that violence is more likely to be avoided, such as blocking social media posts, avoiding television at certain times, and becoming more aware of content warnings (e.g., before watching a film/show), and also learning specific coping mechanisms to reduce negative emotions. Avoiding violence can have benefits for highly sensitives, such as lowered aggression, and may also evidence an increased empathy account of SPS (particularly in social contexts), which encourages helping behaviour (e.g., Elst et al. 2019; Farrelly & Bennett, 2018; Vieira, Schellhaas, Enstrom, & Olsson, 2020) and positive relationship outcomes (Weisz & Cikara, 2021).

Therefore, the following research questions are posed: Are Highly Sensitive Persons more avoidant of and reactive to violent media than are non-sensitives, and is this limited to real violence or extends to fictional violence in movies and TV shows? This study aimed to explore emotional responses to violence in movies and on television, as well as videos of real-life violence. A paradigm was designed which presented participants with a series of video clips. In part one, participants watched violent scenes in movies as well as high action control clips (with no violence). In part two, participants watched violent real-life scenes, captured on, for

example, mobile phones or CCTV, as well as control clips containing everyday life activities (e.g., sporting events, music). After each of these videos, participants rated the video in terms of the level of violence depicted, their emotional response, level of discomfort, empathy for the victim, and enjoyability of the clip. They also completed questionnaires on SPS, the Big Five, and the types of media they engage with, as well as their state stress before and after the task.

Highly Sensitive Persons were expected to have more negative responses to violence, including a more negative emotional state, heightened discomfort and empathy, and less enjoyability. It was also expected that Highly Sensitive Persons would rate the violent video clips as more violent than do non-sensitives. There were no expectations of differences between fictional and real-life violence. However, in terms of the (limited) previous literature, it is possible that Highly Sensitive Persons characterise real-life as more violent and more emotional than movies, with higher empathy for the victims. Alternatively, response to violence may be similar whether the scene is real or fictional.

An increase in stress was expected to emerge for participants from before to after the task. For Highly Sensitive Persons, this increase was hypothesised to be greater. This follows from Gerstenberg's (2012) finding that participants high in Low Sensory Threshold (LST; a negative subscale of the HSPS, according to Smolewska et al., 2006) experienced an increase in stress from before to after completing a visual detection task, which may be considered less stressful than viewing many videos of active violence.

Method

Participants

Participants were recruited from two sources. 56 participants were recruited from social media, these participants opted to receive a £10 voucher. 35 participants were recruited from the Swansea University participant pool. There was a total sample size of N = 91, with 17 Males, 68 Females, and 6 Non-Binary. The mean age was 25.08 years (SD = 8.94), ranging from 18 to 58 years. The majority of the sample were of White ethnicity (n = 78; 85.7%), n = 8 were Asian, n = 3 were Mixed Ethnicities, and n = 2 stated Arab. The education levels of participants are displayed in Table 7.1. This study received ethical approval from Swansea University's

School of Psychology Research Ethics Committee and full informed consent was provided by participants.

Table 7.1. The frequency and percentage of participants that had achieved educational qualifications.

	Frequency of Responses	Percentage of Sample
Doctoral Degree or Equivalent	1	1.10
Master's Degree or Equivalent	11	12.09
Bachelor's Degree or Equivalent	18	19.78
A-Levels or Equivalent	53	58.24
GCSE's A*-C or Equivalent	6	6.59
Other Qualifications	2	2.20
No Qualifications	0	0.00
No Response	0	0.00

Sample size and power calculation: A prior sample size calculation was not conducted due to the time and resource restraints that limited this investigation. The study recruited participants for one month because of strict deadlines, and thus collected as many participants as possible within this timeframe. Also, there was a limit on the number of vouchers and credits that could be provided to participants. A sensitivity analysis conducted using G*Power software (Faul, Erdfelder, Buchner, & Lang, 2007) revealed a sample size of N = 91 would be sensitive enough to detect an effect size of $r = .257$ or $f = 0.388$ ($f^2 = 0.151$) for an ANCOVA with four conditions and four covariates at 80% power.

Materials

The task was split into two parts to test separately the responses to violence in movies and in real-life.

Part One:

The stimuli were extracted from Madan et al. (2014). The corresponding author was contacted via email and the movie clips were received. Ten movie clips were presented to participants. Each clip lasted between 2-3 minutes. Five of these contained violence (violent movies), and five were non-violent (non-violent movies) but matched on the level of action and engagement and included situations of natural threat. The violent clips were selected from Man on Fire (2004), a shootout scene in a street; Platoon (1986), a soldier torturing a civilian; Precious (2006), a physical fight between mother and daughter; Leon: The Professional (1994), a

shootout scene in an apartment; and Saving Private Ryan (1998), a physical knife fight. The non-violent clips were from Speed (1994), saving civilians from a bus; Twister (1996), a family in a tornado shelter; Crash (2004), a woman being saved from a car crash; and Castaway (two scenes) (2000), one scene depicts a plane crash and the other a man trying to raft on the ocean. These non-violent movie clips acted as controls for the violent clips.

Part Two:

The stimuli used were taken from the RWF-2000 Video Database for Violence Detection (Cheng, Cai, & Li., 2019). This database was designed to teach algorithms to automatically detect violence and criminal scenes on CCTV footage and on the internet. It contains 1000 videos of real-life violence (e.g., videos captured on CCTV and recordings on mobile phones that are publicly accessible on the internet). Each video lasts between 5-10 seconds, and usually depicts violence amongst two or more persons, for example, fights involving physical force. These videos do not contain (or contain very minimal) depictions of blood and do not include violence with weapons (e.g., guns, knives, etc). Also, death is not implied in any video. 25 of these videos were selected based on level of violence and clarity of the video, with the involved persons who appeared to be a mix of different genders and ethnicities. The database contains 1000 videos of non-violent activities, such as sporting events, musical instruments, and conversations between people. 22 videos were selected as non-violent control clips, each lasting between 5-10 seconds.

Questionnaires

To measure state anxiety, the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1968) Form Y-1 was used (Cronbach's alpha = .95). This is a self-evaluation stress questionnaire, which provides 20 statements regarding the individual's current state. For example, "I feel calm" and "I am worried". Participants respond according to how they currently feel, on a 4-point Likert scale, ranging from 1 (Not at all) to 4 (Very much so), with positive items being reverse scored. This questionnaire was provided before Part One and after Part Two of the violence task, to measure any changes in state anxiety. Thus, all items were summed on the two occasions, and two total scores were calculated: STAI before, and STAI after. A change score was calculated by subtracting the before score from the after score.

The Highly Sensitive Person Scale (HSPS; Aron & Aron, 1997) was used to measure SPS (Cronbach's alpha = .90). This scale provides 27 questions about environmental sensitivity, to which participants respond with reference to a 7-point Likert scale (1 = Not at all; 7 = Extremely). Items include "Are you easily overwhelmed by strong sensory input?" and "Are you deeply moved by the arts or music?". All items were summed and averaged to create a HSPS score. Also, two subscale scores of Positive Sensory Responsivity (PSR; a = 0.72) and Negative Sensory Responsivity (NSR; a = 0.88) were calculated according to Tabak et al. (2022).

The Big Five Inventory-10 (BF10; Rammstedt & John, 2007) was provided to capture each Big Five trait, in order to control for these variables (particularly neuroticism, openness to experience, and introversion). This scale is a short, 10-item questionnaire, which measures each core trait using two items each. Participants rate each item on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree) (some opposite items being reverse scored). The two items per scale were summed to create a total score for agreeableness (a = .42), conscientiousness (a = .59), extraversion (a = .46), neuroticism (a = .80), and openness to experience (a = .24).

Finally, to explore exposure to media violence (e.g., on TV and in movies), the Content-based Media Exposure Scale (C-ME; Hamer et al., 2017) was administered (Cronbach's alpha = .78). The C-ME provides 17 different types of media content (e.g., "the news", "people who use drugs") and participants are instructed to respond according to how often they watch this content on a 5-point Likert scale ranging from 1 = Never to 5 = Very Often. Although this scale does not exclusively measure exposure to violence in media, it was used to capture a basic and initial idea of what participants tend to watch in terms of media. There were three items that referred to violence against other people (item 1 = People who fight; item 4 = People who destroy someone else's belongings; and item 5 = people who shoot at another person). These three items were averaged to create a Violent Media Engagement score.

Procedure

A link was provided on social media and the participant pool to an external experiment titled "Violence and Personality", hosted by Gorilla Experiment Builder (www.gorilla.sc; Anwyl-Irvine et al., 2019). Upon clicking the link, participants were provided with an information sheet. The information sheet contained full details of the violent aspect of the investigation as

the videos could cause heightened distress if participants were deceived to this aspect. Details of the type of personality traits being measured and questionnaires used were not included. After reading, participants provided informed consent by ticking a box on the screen.

Participants then completed the STAI scale (to measure state anxiety before completing the task) and demographics questionnaire, to capture details of their age, gender, ethnicity and education level. An overview of both parts of the task was then provided:

> *"Next, you will be asked to complete a task that involves watching a number of videos. The task is split into two parts; however, the instructions will be very similar for both parts. Firstly, you will watch a series of videos which each last around 2-3 minutes. These videos contain sound, so it is advised you turn up your volume to a comfortable noise level. After each video, you will be asked a number of questions about the video you just watched. This means you need to pay close attention to the video in order to answer the questions as accurately and honestly as possible. Secondly, you will watch another series of videos, each of these lasting between 5-10 seconds. These videos do not contain sound. Again, you will be asked questions about the video after each one. This means you need to pay close attention to the video in order to answer the questions as accurately and honestly as possible. In both parts of the task, you will see videos that depict violent scenes. If, at any point, you feel uncomfortable and no longer want to take part, then you are free to close] the browser to end your participation. Also, if you want to take a break, then you will be given time in between each video to do so. PLEASE PUT YOUR BROWSER IN FULLSCREEN FOR OPTIMAL VIEWING. If your browser is not in fullscreen, parts of the task may be cut off. When you are ready to begin, please click the button below to read the instructions for Part One."*

Part One:

Participants clicked a button to move to the next screen which provided more specific instructions to the first part of the task. The first part of the task involved watching 10 clips from movies, and between each movie clip, participants were asked a series of questions. The following instructions were given:

> *"The first part of the task involves you watching a series of videos on the screen. Before each video plays, you will be presented with a screen that instructs you to click a button when you are ready to watch the video. Upon clicking this button, the video will automatically play on the screen after a fixation point. These videos contain sound, so please ensure you have your volume turned up to a comfortable noise level. Feel free to wear headphones or use a speaker to listen. PLEASE WATCH THE VIDEO CAREFULLY. Each video lasts between 2 and 3 minutes. Once the video is finished, the task will automatically move on to the questions. In between each video, you will be asked a few questions on the video. This means you need to pay close attention to the video in order to answer the questions as accurately and honestly as possible. You will also be given the opportunity to report any errors that occurred during the video. If you encounter any issues with the experiment at any point, and are unable to report*

these when asked, please let the researcher know as soon as possible. When you are ready to begin, please click the button below."

The participant then clicked a button on-screen, moving to a "proceed" screen that stated "Please press the "Next" button when you are ready to watch the next video." This was presented before each individual clip so the participant could be ready for watching. Once ready, a button was clicked on-screen. A fixation point appeared on the screen for 250 milliseconds (ms) after a pre-display of 100ms, and the clip automatically played after a post-display time of 100ms. Each clip lasted between 2 and 3 minutes. The screen moved on automatically after the clip finished and presented participants with a series of questions:

- *"How much did you enjoy the video you just watched? Please rate this using the slider below, where 1 = Not at all enjoyable and 10 = Extremely enjoyable."*
- *"How violent would you rate the video you just watched? Please rate this by using the slider below, where 1 = Not at all violent and 10 = Extremely violent."*
- *"In terms of emotion, how did the video make you feel? Please rate this using the slider below, where 1 = Extremely negative and 10 = Extremely positive."*
- *"How uncomfortable did the video make you feel? Please rate this using the slider below, where 1 = Not at all uncomfortable and 10 = Extremely uncomfortable."*
- *"How much empathy do you have with the victim in this video? Please rate this using the slider below, where 1 = No empathy at all and 10 = A lot of empathy."*

Each question was rated using an on-screen slider ranging from 1 to 10, participants clicked or dragged the slider using their mouse to the number they felt was relevant. These were forced choice. In addition to this, participants were asked to state whether they had seen the movie previously by clicking a "Yes" button or a "No" button on the screen. Therefore, each trial consisted of the proceed screen, fixation, stimulus (clip), and six questions. Once the last clip ended and all questions were answered, a screen was displayed to show the end of Part One, and informed participants that they could take a break if needed to avoid any effects of fatigue.

Part Two:

Part Two of the task was similar to Part One. Instead of watching movie clips, participants were provided with 47 videos lasting between 5 and 10 seconds, either depicting violence in real-life or depicting non-violent real-life activities. A set of instructions was firstly provided to participants:

"The second part of the task involves you watching a series of videos on the screen. Before each video plays, you will be presented with a screen that instructs you to click a button when you are ready to watch the video. Upon clicking this button, the video will automatically play on the screen after a fixation point. These videos do not contain sound. PLEASE WATCH THE VIDEO CAREFULLY. Each video lasts between 5 and

10 seconds. Once the video is finished, the task will automatically move on to the questions. In between each video, you will be asked a few questions on the video. This means you need to pay close attention to the video in order to answer the questions as accurately and honestly as possible. You will also be given the opportunity to report any errors that occurred during the video. If you encounter any issues with the experiment at any point, and are unable to report these when asked, please let the researcher know as soon as possible. When you are ready to begin, please click the button below."

Again, once ready, a button was clicked on-screen. A "proceed" screen was displayed, which was presented before each clip, so the participant could choose when they were ready to begin the trial. A fixation point appeared on the screen for 250ms after a pre-display of 100ms, and the clip automatically played after a post-display time of 100ms. Once the video finished, a set of questions was provided to participants, these were the same questions provided in Part One, capturing violence, emotion, empathy, enjoyability and discomfort, each measured on a 10-point Likert scale. However, an additional aspect was added to the empathy question, as there were some control videos that did not have a victim and Gorilla does not have a feature to allow for an empty slider response. Thus, for each empathy question, participants were asked "*If you do not believe there was a victim in this video, please type "N" in the text box below*", and a text box was provided to record participants' N response. This was not provided in Part One due to there being victims in all movie clips, whether this was a victim of violence or other circumstances. See Statistical Analysis section for clarity. Therefore, each trial consisted of the proceed screen, fixation, stimulus (clip), and five questions. Once the final clip ended and all questions were answered, a screen was displayed explaining it was the end of the task and they would next complete some questionnaires.

Questionnaires and debrief

Participants completed the questionnaires in the order of STAI (to measure state anxiety after the task), HSPS, BF10, and the C-ME. Participants were then fully debriefed, and if recruited from social media, they were asked to provide an email to receive a voucher as a thank you for participating. If recruited on the participant pool, they were automatically granted five course credits.

Statistical analysis

Remaining consistent with the previous chapters, the initial analysis tested the associations between SPS (HSPS score, NSR, and PSR) and the Big Five traits, specifically extraversion,

neuroticism, and openness to experience. Pearson's correlations were conducted, as well as three multiple regressions with HSPS score, NSR, and PSR as the outcome variables, and the Big Five traits as predictors. Associations were also tested with the STAI (stress) scores before and after the task, with the change in STAI from before to after participating, and with violent media engagement scores.

During the task, participants saw four conditions of videos (violent movie, non-violent movie, real-life violence, and non-violent controls) and rated each video according to five scales, referring to violence in the video (1 = Not at all violent, 10 = Extremely violent); emotion (1 = Extremely negative; 10 = Extremely positive), empathy for the victim (1 = No empathy at all; 10 = A lot of empathy); enjoyability (1 = Not at all enjoyable; 10 = Extremely enjoyable), discomfort (1 = Not at all uncomfortable; 10 = Extremely uncomfortable).

An average score for each rating variable was calculated across each condition per participant. There were six outlier responses in the non-violent control (real-life) condition: three for empathy, two for discomfort, and one for violence. These responses were replaced with the overall mean for that participant for the rating variable in that condition. The non-violent movies included instances of danger and threat and were designed to match the high-action, violent condition. The non-violent movies did thus have victims for whom empathy could be scored, but the empathy was not for a situation of interpersonal violence. However, the non-violent control (real-life) clips did not have situations of threat, danger, or violence, and hence empathy was not relevant, and scores for this condition were not analysed.

To test the difference between the video conditions, a series of 5 repeated-measures ANOVAs were conducted, with video condition as the independent variable (violent movies, non-violent movies, real-life violence, and non-violent controls) and the five rating variables as the dependent variables in each separate model (emotion, empathy, enjoyability, discomfort, and violence). For the analyses of the empathy scores, real-life control clips were not included as the videos did not include victims. Pairwise comparisons were used to test any differences that emerged between the conditions. As this analysis aimed to assess differences between the four stimulus conditions, and as the real (violence and control) and fictional (violence and control) differed on various features, whether the video was real or fictional was not used as a within-subjects factor.

The effect of violence amongst Highly Sensitive Persons was explored as follows. Three SPS groups were created based on tertiary cut-off points as described by Lionetti et al. (2018). These were low sensitives (bottom 30.8% of the sample; n = 28), medium sensitives (middle 39.5%; n = 36) and high sensitives (top 29.7%; n = 27).

Five 3 (SPS group) x 4 (video condition) mixed ANCOVAs were conducted for each of the rating variables (emotion, empathy, enjoyability, discomfort, and violence), controlling for age, gender, neuroticism, and violent media engagement. These were chosen as covariates as these variables may impact an individual's response to viewing violence (Aluja-Fabregat & Torrubia-Beltri, 1998; Banjeree et al., 2008; Chory & Goodboy, 2010; Krcmar & Kean, 2009; Mrug et al., 2015; Nicklin et al., 2020), and neuroticism also had moderate-to-large associations with SPS. Again, for the analyses of the empathy scores, real-life control clips were not included, as the videos did not include victims, and thus a 3 x 3 ANCOVA was conducted instead. Pairwise comparisons compared differences between conditions and SPS groups where main effects were significant. To explore significant interactions between SPS group and condition on the rating variables, four further ANCOVAs were conducted on each condition separately with SPS group as the between-subjects independent variable, again controlling for the above covariates. The difference between movie violence and real-life violence was tested across the entire sample, as well as for each SPS group separately using a series of ANCOVAs with the two violent conditions as the independent variable, controlling for age, gender, neuroticism, and violent media engagement. Finally, analyses of the relationships between violence and empathy rating scores were conducted for each SPS group, to test the increased empathy account of violence avoidance, and partial correlations were conducted between HSPS score, score on Item 18 of the HSPS and mean violence, emotion, empathy, enjoyability, and discomfort ratings across the conditions (controlling for the covariates of neuroticism, age, gender, and violent media engagement).

Results

Personality, stress, and violent media engagement

The descriptive statistics for the personality variables, STAI scores, and media engagement are displayed in Table 7.2. Gender differences were tested for males and females only, as only 6 participants stated Non-Binary. Gender differences were revealed for both emotion and enjoyability ratings in the violent movie, non-violent movie, and real-life violent conditions

(all *ps* < .01), as well as the violent ratings of violent movies (p = .030), thus supporting the inclusion of gender as a covariate in the ANCOVAs. T-test results are displayed in the Appendix I.

Table 7.2. The descriptive statistics (mean, (SD), minimum, and maximums) for each of the personality, STAI (stress), and media engagement variables.

	Mean	SD	Minimum	Maximum
HSPS Score	4.47	0.91	2.19	6.70
NSR	4.33	1.05	1.53	6.68
PSR	4.63	0.98	2.33	7.00
Extraversion	5.86	1.88	2.00	10.00
Agreeableness	7.05	1.83	2.00	10.00
Conscientiousness	7.08	1.90	2.00	10.00
Neuroticism	6.93	2.20	2.00	10.00
Openness	7.19	1.73	2.00	10.00
STAI (Before)	38.48	12.14	20.00	73.00
STAI (After)	44.12	11.42	20.00	72.00
STAI (Change Score)	5.64	8.62	-15.00	29.00
Violent Media Engagement	2.49	0.82	1.00	4.67

The correlations between SPS and the Big Five traits are displayed in Table 7.3. HSPS score and NSR moderately correlated with neuroticism (p < .001). Surprisingly, no associations emerged with openness to experience or extraversion (all *ps* > .05).

Table 7.3. Pearson's correlations (coefficient, p-value) between SPS and the Big Five personality traits. Correcting for multiple correlations, significance is set at $p < .001$, highlighted in bold. All dfs = 89.

	HSPS Score	NSR	PSR	Extraversion	Agreeableness	Conscientious-ness	Neuroticism
NSR	**.971, *p* < .001**						
PSR	**.652, *p* < .001**	**.468, *p* < .001**					
Extraversion	-.143, *p* = .176	-.186, *p* = .078	.000, *p* = 1.000				
Agreeableness	.083, *p* = .432	.029, *p* = .785	.254, *p* = .015	.061, *p* = .568			
Conscientious-ness	.143, *p* = .177	.111, *p* = .293	.091, *p* = .393	.301, p = .004	.091, *p* = .389		
Neuroticism	**.514, *p* < .001**	**.560, *p* < .001**	.132, *p* = .214	-.169, *p* = .109	-.063, *p* = .555	.022, *p* = .833	
Openness	.167, *p* = .113	.157, *p* = .138	.154, *p* = .146	.005, *p* = .963	.102, *p* = .336	-.109, *p* = .304	.065, *p* = 0.543

Testing the variance accounted for by the Big Five traits in total HSPS score, a multiple regression revealed a significant model, $F(5, 90) = 8.160$, $p < .001$, with R^2 of 0.324 (32.4%). Neuroticism was the only significant predictor ($p < .001$). For NSR, the Big Five traits accounted for 36.1% of variance, with a significant regression model, $F(5, 90) = 9.613$, $p < .001$, neuroticism was the only significant predictor ($p < .001$). Finally, the traits only accounted for 10.7% of the variance in PSR, $F(5, 90) = 2.033$, $p = .082$, agreeableness was the only significant predictor ($p = .022$).

The correlation statistics with the Big Five traits and the rating variables are displayed in the Appendix K. The only trait to correlate with STAI scores was neuroticism (Table 7.4), thus, neuroticism was controlled for in the correlations between SPS and STAI. The only significant correlation with SPS was between STAI score after the task and NSR ($p = .034$), although when correcting for multiple correlations, this becomes non-significant. (Table 7.4).

Violent media engagement did not correlate with any of the SPS scores (HSPS score, $r_s(89) = -.102$, $p = .335$; NSR, $r_s(89) = -.141$, $p = .183$; PSR, $r_s(89) = -.062$, $p = .559$) (Spearman's rhos were conducted due to non-normality of violent media engagement). All correlations between the other personality variables and violent media engagement were also non-significant ($ps > .05$) (Appendix K).

Table 7.4. Pearson's partial correlations (coefficient, p-value) between SPS and the STAI (stress) scores before the task, after the task, and change score from before to after the task. Neuroticism was controlled for (dfs = 88). Bivariate correlation statistics are also displayed for neuroticism (dfs = 89).

	HSPS Score	NSR	PSR	Neuroticism
STAI (Before)	.089, $p = .406$	.089, $p = .402$	.048, $p = .656$	.274, $p = .009$
STAI (After)	.204, $p = .054$	.224, $p = .034$	.085, $p = .425$	**.458, $p < .001$**
STAI (Change Score)	.123, $p = .247$	.146, $p = .170$	.037, $p = .732$	.221, $p = .035$

Differences between violence conditions

A series of repeated-measures ANOVAs were conducted to test the difference between the conditions of videos (violent movies, non-violent movies, violent real-life, and non-violent controls) on each of the following dependent variables: emotion ratings, empathy ratings, enjoyability ratings, discomfort ratings, and violence ratings. The descriptive statistics are displayed in Table 7.5.

Table 7.5. Descriptive statistics (mean, (SD), minimum, and maximums) for the rating variables in each video condition. Each variable was rated on a scale of 1 to 10.

	Mean	SD	Minimum	Maximum
Emotion (1 = Extremely negative; 10 = Extremely positive)				
Violent Movie	3.08	1.20	1.00	6.40
Non-Violent Movie	5.01	1.29	1.60	8.60
Violent Real-Life	3.37	1.05	1.08	6.08
Non-Violent Control	6.19	1.01	4.59	8.91
Empathy (1 = No empathy at all; 10 = A lot of empathy)				
Violent Movie	7.16	1.53	3.20	10.00
Non-Violent Movie	6.91	1.57	2.20	10.00
Violent Real-Life	5.84	2.08	0.00	9.75
Enjoyability (1 = Not at all enjoyable; 10 = Extremely enjoyable)				
Violent Movie	3.36	1.76	1.00	8.40
Non-Violent Movie	4.95	1.87	1.00	10.00
Violent Real-Life	2.68	1.41	1.00	6.79
Non-Violent Control	5.09	1.87	1.00	8.41
Discomfort (1 = Not at all uncomfortable; 10 = Extremely uncomfortable)				
Violent Movie	6.31	1.92	2.00	10.00
Non-Violent Movie	4.60	1.71	1.00	9.20
Violent Real-Life	6.16	1.79	1.13	9.42
Non-Violent Control	1.48	0.59	1.00	3.59
Violence (1 = Not at all violent, 10 = Extremely violent)				
Violent Movie	7.91	1.28	4.20	10.00
Non-Violent Movie	3.12	1.55	1.00	7.80
Violent Real-Life	7.00	1.50	2.00	9.67
Non-Violent Control	1.16	0.28	1.00	2.32

Firstly, there was a significant difference between the conditions for emotion, $F(3, 270) = 178.937$, $p < .001$, $\eta p^2 = .67$. There were significant differences between all conditions ($p < .01$), non-violent control videos were rated as most positive, followed by the non-violent movies. The violent real-life and violent movie clips were rated as most negative.
Secondly, there was a significant difference between the three (violent movie, non-violent movie, and real-life violence) conditions for empathy ratings, Sphericity was violated, and thus Greenhouse-Geisser correction was used ($F(1.550, 139.524) = 26.062$, $p < .001$, $\eta p^2 = 0.23$). There was a significant difference between violent movies and real-life violent videos ($p < .001$), as well as between non-violent movies and real-life violence ($p < .001$). There was no difference between violent and non-violent movies ($p = .064$), and participants had the highest empathy ratings in these two conditions.

There was a significant difference between the enjoyability ratings for each of the four conditions, Greenhouse-Geisser was used due to violation of Sphericity, $F(2.077, 186.899) = 62.167$, $p < .001$, $\eta p^2 = 0.41$. There were significant differences between each condition ($p < .001$), except for between non-violent movies and non-violent control videos, these two conditions were rated as most enjoyable. Violent real-life videos were least enjoyable, followed by violent movies.

Furthermore, there was a significant difference between discomfort ratings (Sphericity assumed), $F(3, 270) = 289.956$, $p < .001$, $\eta p^2 = 0.76$, with significant differences between all conditions ($p < .001$) except for violent movies and violent real-life videos ($p = .372$). Both violent conditions were rated as most uncomfortable, followed by non-violent movies. The non-violent control videos were lowest in discomfort.

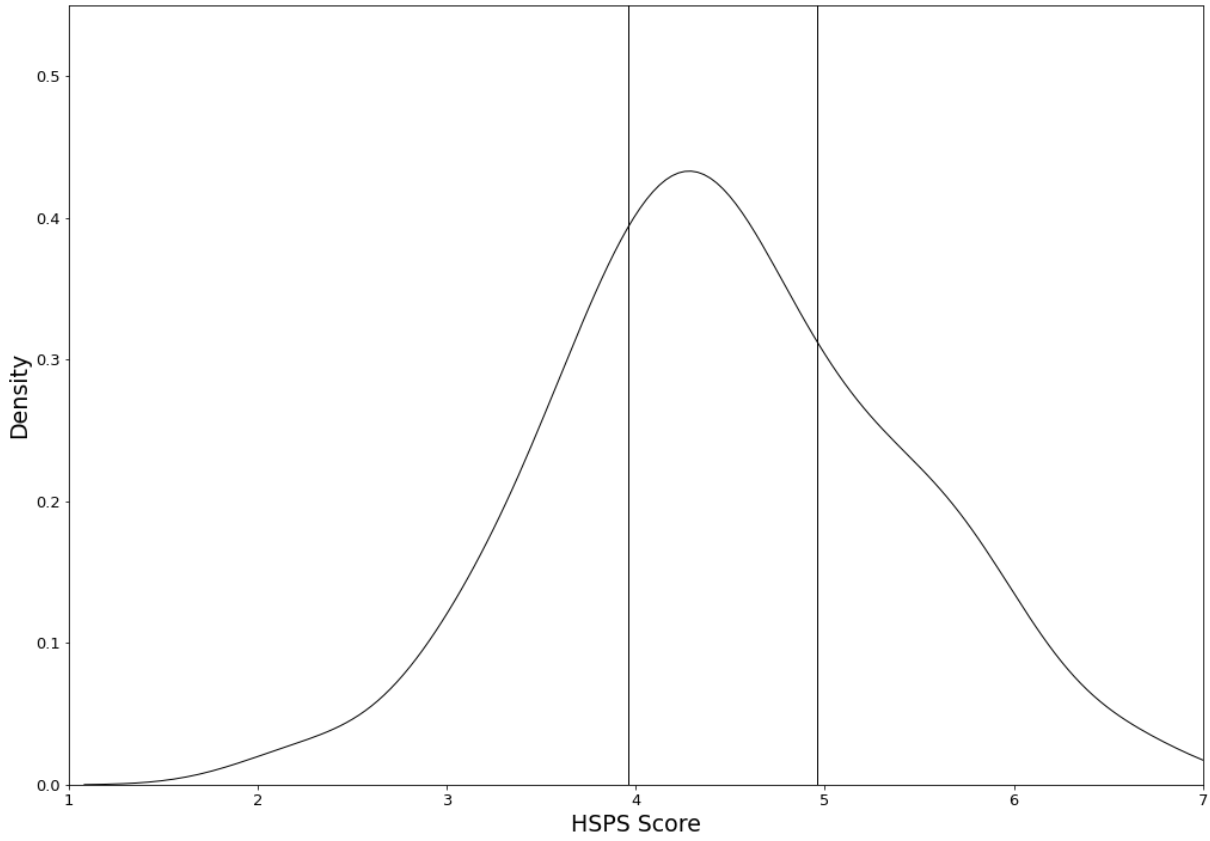
Finally, testing the violence ratings, a significant difference between the conditions was revealed, $F(2.484, 223.537) = 757.917$, $p < .001$, $\eta p^2 = .89$. There were significant differences between all conditions ($p < .001$), with violent movies being the most violent, followed by violent real-life videos, then non-violent movies, and non-violent control videos.

Testing Highly Sensitive Persons' responses to violence

In order to test for the effects of viewing of violence amongst those high in SPS, three SPS groups were created: low sensitives, medium sensitives, and highly sensitives, based on the tertiary cut-off points as according to Lionetti et al. (2018), cut-off scores are displayed in

Figure 7.1. There were n = 28 low sensitives (mean HSPS = 3.47), n = 36 medium sensitives (mean HSPS = 4.43), and n = 27 highly sensitives (mean HSPS = 5.57).

Figure 7.1. Density distribution of mean HSPS score. Lines represent cut-off points for SPS groups as according to Lionetti et al. (2018). The first line (HSPS score = 3.96) is the cut-off between the low sensitives (30.8% of the sample) and medium sensitives (39.5% of the sample) and the second line (HSPS score = 4.96) for medium and highly sensitives (29.7% of the sample).



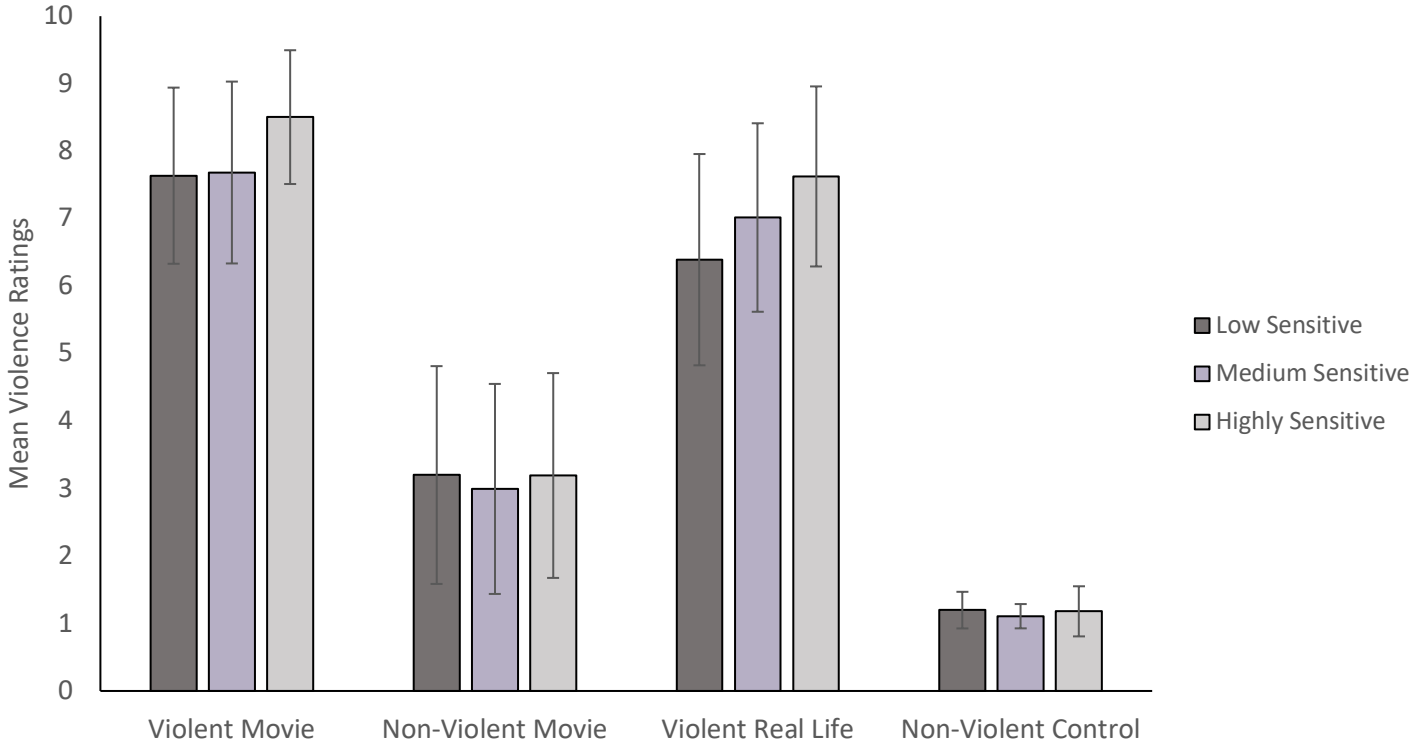
A series of 3 (SPS group) x 4 (video condition) ANCOVAs were conducted, with each of the dependent variables (violence ratings, emotion, empathy, enjoyability and discomfort). Age, sex, violent media engagement, and neuroticism were included as covariates. Post-hoc tests explored any differences between groups and/or conditions, and to test any significant interactions, a series of four further ANCOVAs were conducted for each rating variable, with the four conditions as the within subject independent variable and the three SPS groups as the between-subjects independent variable. The same covariates were also included.

SPS and Violence ratings

Firstly, violence ratings were analysed, so as to confirm intended differences between video conditions on violence, and to assess the relationship of SPS to these ratings. There was a

significant main effect of video condition on violence ($F(2.616, 219.711) = 12.208$, $p < .001$, $\eta p^2 = .127$), all conditions significantly differed ($p < .001$). There was also a significant main effect of SPS group, $F(2, 84) = 4.485$, $p = .014$, $\eta p^2 = .096$. Again, low and medium sensitives did not differ ($p = .589$) but highly sensitives differed with low and medium ($p < .01$). Highly sensitives rated the videos as more violent overall (Figure 7.2). Additionally, there was an interaction between condition and SPS group, $F(5.231, 219.711) = 2.483$, $p = .030$, $\eta p^2 = .056$. The SPS groups did not differ in terms of the non-violent conditions (non-violent movies, $p = .533$; non-violent control, $p = .331$), but they differed on violence ratings in the movie violence ($F(2, 84) = 4.320$, $p = .016$, $\eta p^2 = .093$) and the real-life violence conditions ($F(2, 84) = 5.767$, $p = .004$, $\eta p^2 = .121$). In the movie violence condition, there were differences between low and highly sensitives ($p = .008$), medium and highly sensitives ($p = .011$), but not between medium and low sensitives ($p = .569$). In the real-life violence condition, all groups significantly differed ($p < .05$).

Figure 7.2. Mean violence ratings for the SPS groups in each video condition, controlling for age, gender, violent media engagement, and neuroticism. Means are displayed for violence ratings only. Error bars represent standard deviations.



SPS and violence in movies vs. real-life violence

To test the differences in rating the violent movies compared with violent real-life videos, a series of ANCOVAs were performed with the 2 conditions, controlling for age, gender, violent media engagement, and neuroticism. Each rating variable was included as a dependent variable, and the models were calculated separately for the three SPS groups. The results are displayed in Table 7.6. All comparisons were non-significant, suggesting that the two violent conditions are rated similarly.

Table 7.6. The results of the ANCOVAs conducted to test the difference between the Violent Movie and Violent Real-life video conditions, controlling for age, gender, violent media engagement, and neuroticism. ANCOVAs were conducted for each rating variable as the dependent variables, and separately for each SPS group.

	Low Sensitive	**Medium Sensitive**	**Highly Sensitive**
Emotion Ratings	$F(1, 23) = 0.221$, $p = .643$	$F(1, 31) = 0.019$, $p = .891$	$F(1, 22) = 1.733$, $p = .202$
Empathy Ratings	$F(1, 23) = 0.187$, $p = .669$	$F(1, 31) = 1.934$, $p = .174$	$F(1, 22) = 0.019$, $p = .893$
Enjoyability Ratings	$F(1, 23) = 2.320$, $p = .141$	$F(1, 31) = 1.056$, $p = .312$	$F(1, 22) = 0.141$, $p = .711$
Discomfort Ratings	$F(1, 23) = 1.885$, $p = .183$	$F(1, 31) = 0.165$, $p = .688$	$F(1, 22) = 0.589$, $p = .451$
Violence Ratings	$F(1, 23) = 0.639$, $p = .432$	$F(1, 31) = 1.979$, $p = .169$	$F(1, 22) = 0.755$, $p = .394$

SPS and Emotion ratings

Next, considering emotion, the ANCOVA revealed a non-significant main effect of video condition ($F(2.364, 198.565) = 2.417$, $p = .082$, $\eta p^2 = .028$), and a non-significant main effect of SPS group ($F(2, 84) = 0.370$, $p = .692$, $\eta p^2 = .009$). However, there was a significant interaction between condition and SPS group, $F(4.728, 198.565) = 4.577$, $p < .001$, $\eta p^2 = .098$. There were no significant differences between the groups for emotion ratings in the violent movie, non-violent movie, and real-life violence conditions ($p > .05$). For the non-violent control condition, there were significant differences for emotion between the groups ($F(2, 84)$

= 8.403, $p < .001$, $\eta p^2 = .167$), in particular, differences emerged between low and highly sensitives, and medium and highly sensitives ($p < .01$). Highly sensitives gave more positive ratings (Figure 7.3). Low and medium sensitives did not differ ($p > .05$).

SPS and Empathy ratings

There was a non-significant main effect of condition on empathy, $F(1.578, 132.547) = 0.273$, $p = .761$, $\eta p^2 = .003$. There was a significant main effect of SPS group, $F(2, 84) = 4.876$, $p = .010$, $\eta p^2 = .104$. Pairwise comparisons revealed significant differences between low and highly sensitives ($p = .002$) (highly sensitives were more empathetic overall than low sensitives), although medium and highly sensitives ($p = .058$) and medium and low sensitives did not differ ($p = .070$). Lastly, there was a non-significant interaction between video condition and SPS group ($F(3.156, 132.547) = 0.432$, $p = .740$, $\eta p^2 = .010$. Means are displayed in Figure 7.3.

SPS and Enjoyability ratings

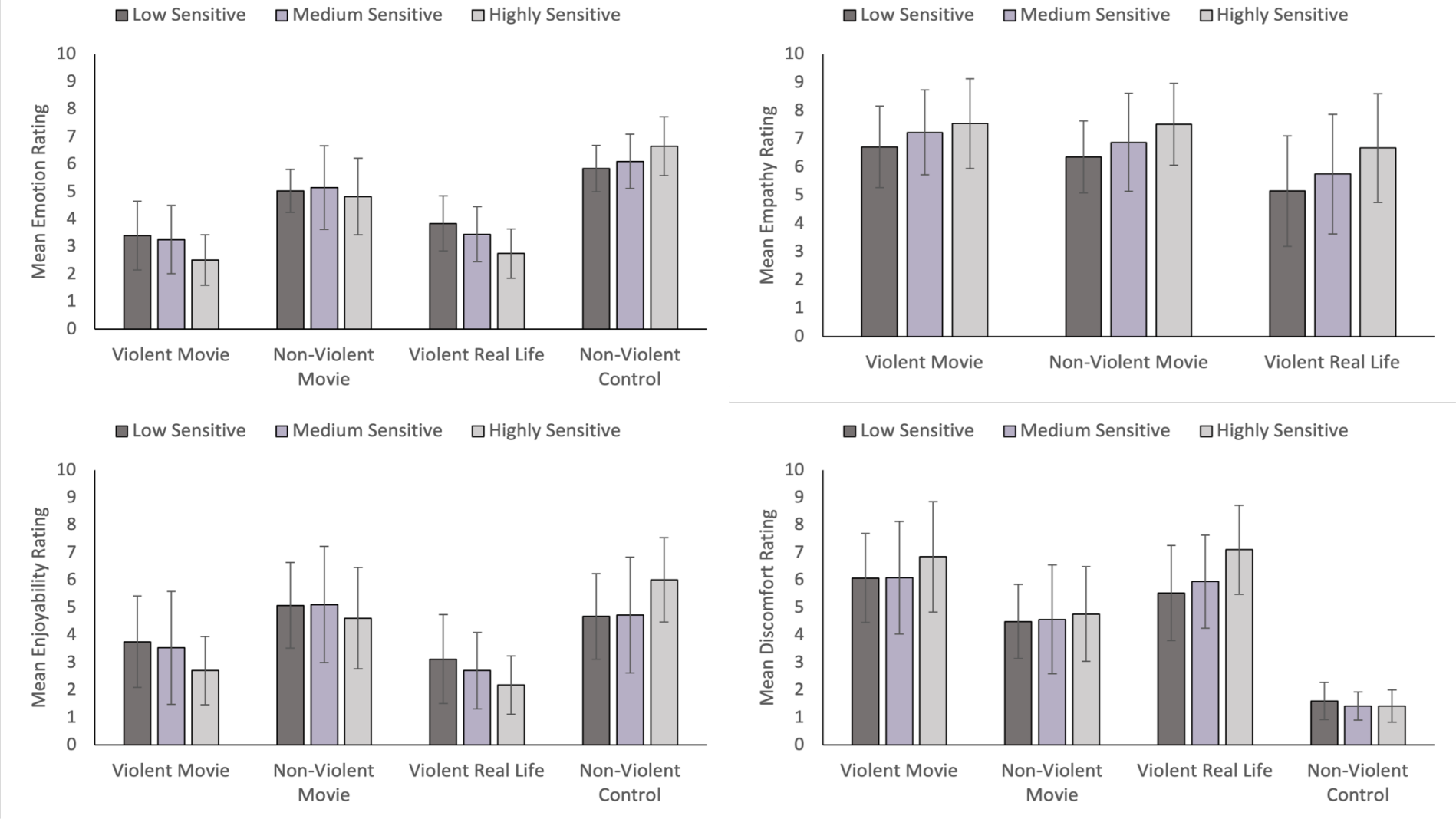
There was a non-significant main effect of video condition on enjoyability, $F(2.166, 181.903) = 0.360$, $p = .715$, $\eta p^2 = .004$. The main effect of SPS group was also non-significant ($F(2, 84) = 2.416$, $p = .095$, $\eta p^2 = .054$). There was a significant interaction between video condition and SPS group, $F(4.331, 181.903) = 3.485$, $p = .007$, $\eta p^2 = .077$. Follow-up ANCOVAs revealed no significant difference between the groups for violent movies, non-violent movies, or violent real-life videos. However, there was a significant difference for the non-violent control real-life videos ($F(2, 84) = 7.951$, $p < .001$, $\eta p^2 = .159$), there were differences between low and highly sensitives ($p < .001$), medium and highly sensitives ($p < .001$), but not between medium and low sensitives ($p = .520$). Highly sensitives found the non-violent control real-life videos more enjoyable (Figure 7.3).

SPS and Discomfort ratings

Furthermore, for discomfort, there was a significant main effect of video condition, $F(2.895, 243.175) = 3.728$, $p = .013$, $\eta p^2 = .042$. All conditions significantly differed ($p < .001$), except for violent movies and violent real-life videos ($p = .388$). There was a non-significant main effect of SPS group ($F(2, 84) = 1.792$, $p = .173$, $\eta p^2 = .041$), although the interaction between condition and SPS group was significant, $F(5.790, 243.175) = 3.455$, $p = .041$, $\eta p^2 = .051$. There were no significant differences between the SPS groups for violent movies ($p = .217$), non-violent movies ($p = .848$), or non-violent real-life control videos ($p = .309$), however, the

groups differed for discomfort ratings in the real-life violence condition ($F(2, 84) = 4.597$, $p = .013$, $\eta p^2 = .099$). for which there were differences between low and highly sensitives ($p = .004$), medium and highly sensitives ($p = .017$), but not between medium and low sensitives ($p = .286$). Highly sensitives rated the real-life violent videos as more uncomfortable (Figure 7.3).

Figure 7.3. Means of the rating variables for the SPS groups in each video condition, controlling for age, gender, violent media engagement, and neuroticism. Means are displayed for emotion (top left), empathy (top right), enjoyability (bottom left) and discomfort (bottom right). Error bars represent standard deviations.



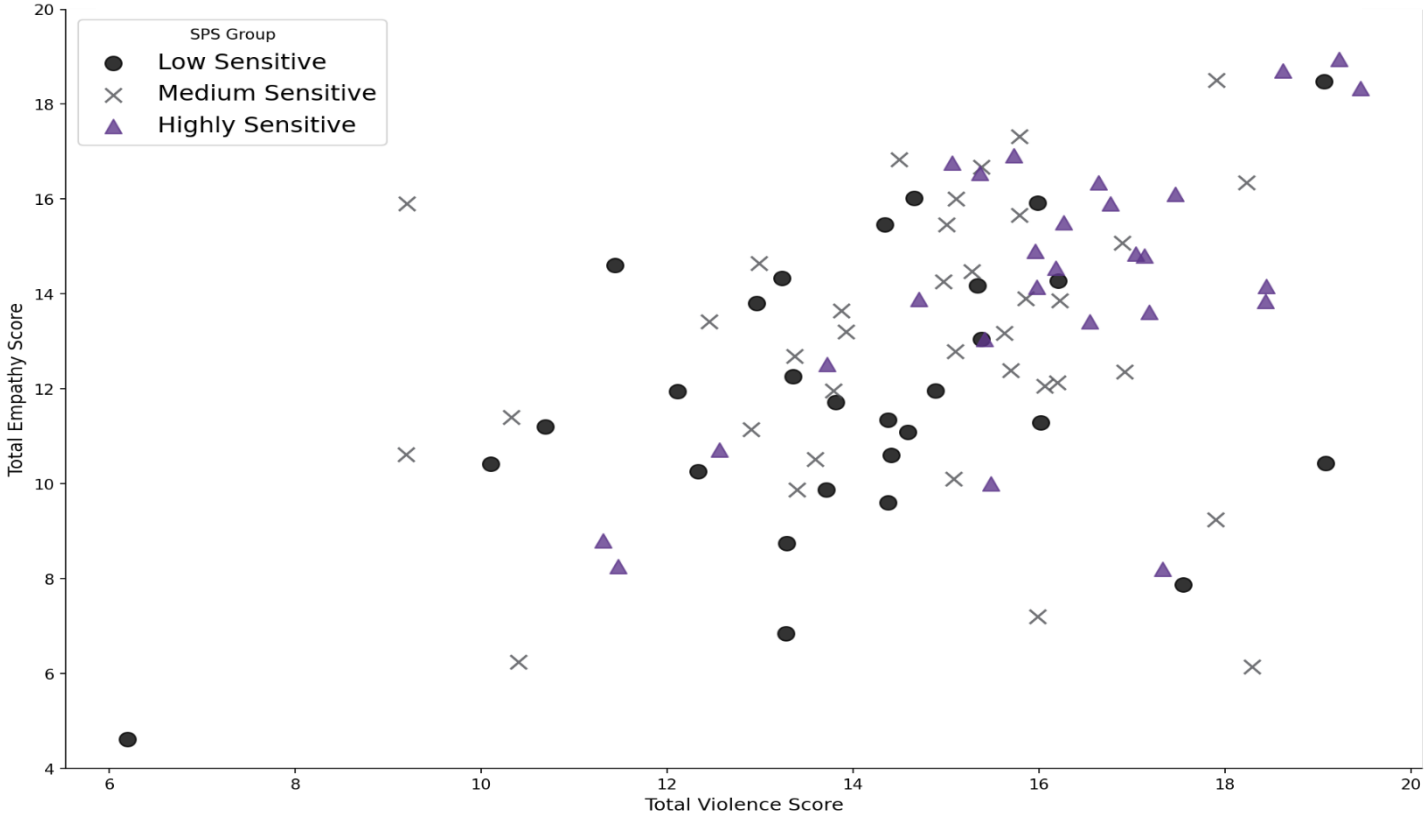
Exploratory analysis of violence and empathy scores

To explore the associations between perceived violence and empathy for victims, a total violence score and total empathy score across the two violent conditions was calculated, to test for overall violence, and a series of correlations were conducted between total violence scores and total empathy, separately for the SPS groups. Results are demonstrated in Table 7.7, and a scatterplot of scores is displayed in Figure 7.4. A scatterplot of the relationships between empathy and violence in each video condition, for each SPS group, is also presented in the Appendix L. For highly sensitives and low sensitives, violence and empathy ratings correlated significantly overall (Figure 7.4), although the coefficient for highly sensitives was larger.

Table 7.7. Pearson's correlations (coefficient, p-value) between total violence ratings and total empathy ratings for the three SPS groups.
Significance is highlighted in bold.

Low Sensitive (dfs = 28)	Medium Sensitive (dfs = 36)	Highly Sensitive (dfs = 27)
.438, *p* = .020	.163, *p* = .343	**.654, *p* < .001**

Figure 7.4. Scatterplot demonstrating the association between total violence score and total empathy score, for each SPS group separately.



Correlations of rating scores with HSPS score and HSPS Item 18

The correlation between HSPS score and HSPS Item 18 was significant, $r_s(89) = .358$, $p < .001$. Table 7.8 displays partial correlations between the rating variables in each video condition and HSPS score and score on Item 18 of the HSPS (referring to the avoidance of violence in television and TV shows). Spearman's rho analyses were conducted due to the non-normality of HSPS item 18 and certain rating variables in the video conditions. Neuroticism, age, gender, and violent media engagement were controlled for. As hypothesised, HSPS score and item 18 scores were significantly and negatively correlated with emotion for real-life videos, that is HSPS score was associated with negative emotion. HSPS score and Item 18 correlated with discomfort for violent movies. HSPS score was also significantly correlated with violence rating for violent movies. Item 18 was significantly correlated with violence rating for violent real-life clips, and marginally for violent movies.

Table 7.8. Spearman's partial Correlations (coefficient, p-value) between the rating variables in each video condition and HSPS score and Item 18 of the HSPS.
Covariates are neuroticism, age, gender, and violent media engagement. Real-life non-violent videos refer to the non-violent controls. All dfs = 85. Significance is highlighted in bold.

	HSPS Score		**HSPS 18**	
	Violent	Non-Violent	Violent	Non-Violent
Emotion				
Movie	-.137, p = .207	.111, p = .308	**-.380, p < .001**	-.101, p = .353
Real-Life	**-.257, p = .016**	**.427, p < .001**	**-.386, p < .001**	**.323, p = .002**
Empathy				
Movie	**.262, p = .014**	**.345, p < .001**	.027, p = .806	.183, p = .090
Real-Life	**.296, p = .005**	/	.021, p = .849	/
Enjoyability				
Movie	-.033, p = .759	.115, p = .289	**-.377, p < .001**	-.205, p = .056
Real-Life	-.045, p = .682	**.378, p < .001**	-.177, p = .101	**.296, p = .005**
Discomfort				
Movie	**.259, p = .015**	.132, p = .222	**.374, p < .001**	**.267, p = .012**
Real-Life	**.364, p < .001**	-.154, p = .153	**.341, p = .001**	.121, p = .263
Violence				
Movie	**.295, p = .006**	.076, p = .483	.186, p = .085	**.232, p = .031**
Real-Life	**.422, p < .001**	-.051, p = .638	**.276, p = .010**	**.292, p = .006**

Discussion

The main aim of this study was to investigate Highly Sensitive Persons' responses to violence so as to provide validation of Item 18 of the Highly Sensitive Person Scale (HSPS): "*Do you make a point to avoid violent movies and TV shows?*". It also tested whether this avoidance or negative response to violence occurs for videos of fictional as well as real-life violence. Participant ratings of the videos showed that the violent and control conditions differed significantly on violence ratings, thus confirming face validity of the materials, and showed that the materials resulted in differences between participants in reactions to and perceptions of the videos. To summarise, the violent movie condition was perceived as most negative in terms of emotion, both movie conditions (violent and non-violent) were given the highest empathy ratings, violent real-life videos were the least enjoyable, and both violent conditions were most uncomfortable. Also, the violent movies were rated most violent, followed by real-life violent videos, then the non-violent movies, and finally the non-violent control videos.

Regarding the main aims, Highly Sensitive Persons rated the real and movie violent videos as more violent than did low and medium sensitives, no differences in the non-violent conditions emerged between the SPS groups. Compared with low and medium sensitives, highly sensitives also perceived the real-life violent videos as significantly more uncomfortable. However, when comparing the two violent conditions in each sensitivity group, there were no differences between the perceptions of the two, they were rated as equally negative, uncomfortable, and violent. Only the highly sensitive group held significant associations between perceived violence and empathy scores in the violent movie condition, and they also had a stronger correlation with overall violence, although the relationship was weaker for violent real-life videos, possibly due to these videos being most violently rated amongst highly sensitives. Therefore, Highly Sensitive Persons had increased empathy for victims where videos were perceived as more violent, and this relationship was stronger than for low and medium sensitives.

As mentioned, there were no differences between the rating variables in the two violent conditions, overall, as well as for the three SPS groups separately, suggesting that violence is rated similarly regardless of whether this is real or in movies. This could evidence that fictional and non-fictional violence are processed similarly, especially amongst Highly Sensitive

Persons, who may be averse to all types of violence, thus contradicting the limited research on this (e.g., Atkin, 1983; Martin, 2022).

These findings provide important new knowledge on the effects of violence amongst Highly Sensitive Persons, and specifically provides validation for item 18 regarding violence avoidance, supporting its inclusion and retention in the HSPS. Although avoidance of violence was not explicitly tested, reactions to and perceptions of violence were tested, which can provide an initial insight into possible avoidance amongst highly sensitives. In particular, the results evidence heightened negative reactivity in response to adversity for those high in SPS (Brindle et al., 2015; van Reyn, Koval, & Bastian, 2022). As well as this, highly sensitives are suggested to have a lower tolerance of violence, implied by the increased discomfort experienced when viewing violent scenes.

Regardless of whether empathy provides the mechanism for such avoidance, the results are important in demonstrating that SPS is characterised by increased empathic response to others' emotional states and wellbeing, which extends even to people who are not known to the individual and even to fictional characters. This positive characteristic provides many benefits in the everyday life of highly sensitives. For example, when choosing a professional career, empathy towards others can prove beneficial in helping environments such as in therapy, social work, and teaching (Aron, 2010), in other words, work that requires the understanding of others. Also, empathy can promote helping behaviours (Yamagishi, Lee, & Sato, 2020; Decety, Bartal, Uzefovsky, & Knafo-Noam, 2016). Elst et al. (2019) particularly found that aspects of SPS (Aesthetic Sensitivity (AES) and LST) were associated with increased helping behaviour in the work environment, possibly resulting from increased empathy. Such helping behaviours towards others may help build relationships and provide a sense of altruism, although on the other hand, it can cause emotional exhaustion (Jang, Allen, Kim, & Cho, 2020), thus resulting in adverse effects on the individual.

Interestingly, highly sensitives rated the non-violent control clips as more positive and enjoyable than did the other SPS groups. This was the only condition to contain everyday life activities, such as sporting events, chess competitions, and music concerts. Perhaps the presence of these positive video clips "stand out" to Highly Sensitive Persons, with the three other conditions being more negative (even the high-action, non-violent movies), uncomfortable, and violent. Small amounts of positivity in amongst negativity thus seem to be

exaggerated for highly sensitives, supporting the Differential Susceptibility account of SPS (Bakermanns-Kranenburg & van Ijzendoorn, 2011; Belsky et al., 2011; Brindle et al., 2015; Carr & Nielsen, 2017; Homberg & Jagiellowicz, 2022; Jagiellowicz et al., 2016). To add to this, Highly Sensitives did not differ in any specific condition regarding empathy ratings, however, these individuals provided higher empathy scores overall, across all conditions. This suggests that Highly Sensitive Persons are more empathetic towards individuals, regardless of violence (Aron, 2010; Acevedo et al., 2018).

Correlations with Item 18 of the Highly Sensitive Person Scale

So far, Highly Sensitive Persons have been shown to differ from non-sensitives in their objectively assessed reactions to violence, and this shows a characteristic of high SPS that has not yet been investigated, to the author's knowledge. However, there is still the issue of the appropriateness and inclusion of Item 18 in the HSPS. On this, the further findings are that high scores on Item 18 correlate with adverse reactions to viewing violent films. This further supports the validity of Item 18 and its inclusion in the HSPS. However, on several measures Item 18 score also correlated significantly with adverse reactions to non-violent movies and real-life violence, further research on which is needed.

SPS, violent media engagement, and stress scores

SPS was found not to be related to lower violent media engagement, as measured by the three items on the Content-Based Media Exposure Scale (C-ME). Secondly, while controlling for neuroticism, there were no significant correlations between stress scores or change in stress scores across the task and SPS, except for NSR with stress measured after completing the task. This partially supports previous research finding the negative subscale of LST (according to Smolewska et al., 2006) was associated with an increase in stress from before to after a change detection task (Gerstenberg, 2012), although the current finding is for stress score after the task only. However, it is important to note that any increase in stress cannot be distinguished between stress because of the violence, or stress as a result of being part of a demanding and time-consuming experiment (Gerstenberg, 2012).

Limitations

There were many limitations of this study. Firstly, the sample size was small (N = 91), and a sensitivity analysis revealed this sample was sufficient to detect only a moderate-to-large effect size, thus resulting in a lack of power. Also, the majority of participants (85.7%) were White

and resided in the United Kingdom, resulting in a lack of generalisability to other ethnicities. However, studies have claimed that the effects of violence are cross-cultural (Anderson et al., 2017), although Krahé (2016) argues the need for additional research on violence in different cultural contexts.

Secondly, the study was conducted online, with the experimenter having little or no control over the participants' environment during the task. Computer type, screen size and quality, internet connection, and availability of distractions varied across participants, potentially introducing confounding effects. Also, the movie and real-life videos were presented in different parts of the task, with the movies being presented first for all participants. Although there were no differences found between the two violent conditions, it is possible that participants became desensitised to viewing violence by the second part of the task containing the real-life violent acts (Mrug et al., 2015). Fatigue effects may have been most common during this part. A solution to this is to counterbalance the presentation of the movie condition and the real-life condition, with some participants seeing the movies first and others seeing real-life videos.

In addition, the reactions to viewing violence were tested, but violence avoidance was not explicitly tested. Although the pattern of findings suggests that highly sensitives respond more negatively to violence, and more positively in terms of empathy towards victims and when viewing non-violent videos, it cannot be concluded that Highly Sensitive Persons avoid violence. Support for this inconclusive finding also comes from the lack of correlations between SPS scores and violent media engagement.

Future recommendations

Future research should test the basis of violence avoidance amongst Highly Sensitive Persons, potentially using brain-imaging and eye-tracking technology. Eye-tracking can be used to test for visual avoidance, for instance, to investigate the focal points of violent scenes. It may be expected that highly sensitives focus on more peripheral aspects of violent scenes rather than the central aspects, to avoid the violence. Perhaps they experience increased eye movements, so as to not focus on one aspect of the scene for too long, or because of attentional biases. For instance, Dolcos et al. (2022) revealed that individuals use their attention to down-regulate negative emotions by focusing on the background of negative images, and Scrivner et al. (2019) found that there is less focus on faces during violent interactions but more on the points of

contact between individuals involved. Alternatively, highly sensitives may be more inclined to focus on the violence due to perceptions of threat (Nelson et al., 2022).

Furthermore, brain-imaging can be adopted to test the brain basis of reactions to violence avoidance. Greven et al. (2019) suggest that further research is required to investigate the large-scale brain networks involved in high SPS, and the processing of novel and emotionally salient stimuli. One region of interest in violence avoidance could include the default mode network, responsible for internal processing and self-reflection, as well as mind-wandering (Konjedi & Maleeh, 2017). Research has found that negative affect induces more episodes of mind-wandering (Stawarcyzk, Majerus, & D'Argembeau, 2013), and attentional biases (Smallwood, Fitzgerald, Miles, & Phillips, 2009). Thus, Highly Sensitive Persons may have a more active default mode network while viewing violence, providing a neural mechanism for the avoidance of negativity, or alternatively to a higher level or response to negativity. Additionally, the Inferior Frontal Gyrus (IFG) may be implicated in the processing of violent acts, as this region is suggested to have a role in empathy as well as in the mirror neuron system (Zhao et al., 2021). SPS may hold greater associations with the IFG during the viewing of violence due to empathetic responses to victims, which again could provide further insight into the reasons that highly sensitives are averse to scenes of violence.

Finally, no measure of felt aggression was included due to the length of the experiment. Therefore, the associations between SPS and potentially reduced or increased aggression could not be tested. Future research should aim to test the effect of negative reactivity to and avoidance of violence on aggression amongst Highly Sensitive Persons. Personality has been shown to affect aggression (Bettencourt, Talley, Benjamin, & Valentine, 2006).

SPS and the Big Five

Associations between SPS and the Big Five traits were tested to remain consistent with other Chapters. The only traits that correlated (positively) with SPS were neuroticism (HSPS score and NSR) and agreeableness (PSR). No associations emerged with extraversion and openness to experience, suggesting weak evidence for the claim (Hellwig & Roth, 2021) of SPS being a positive re-definition of neuroticism, introversion, and openness to experience. The amount of variance explained by the Big Five traits in HSPS score and NSR was comparable to that found in Chapter 4 (20.6% vs 32.4%; 27.2% vs 36.1%; respectively), however, the variance explained in PSR was lower (only 10.7%). A potential explanation for the lack of correlations with the

traits and discrepancies with previous research (e.g., Grimen & Diseth. 2016; Hellwig & Roth, 2021; Smolewska et al. 2006; Yano, Kase, & Oishi. 2019) could be the use of the 10-item Big Five inventory, as discussed in Chapter 4. As mentioned previously, this is a very short questionnaire which takes approximately one minute to complete (Rammstedt & John, 2007), which minimised the time taken to complete this study, as the tasks were extensive, possibly introducing fatigue and effects of tiredness.

Conclusions and implications

Findings here of greater response to videos of violence amongst Highly Sensitive Persons revealed support for item 18 of the HSPS. Particularly, high SPS seems to result in negative emotional reactions and responses to the viewing of violence, regardless of whether this is fictional (movies) or real. Videos were rated as more violent by highly sensitives when compared with low and medium sensitives, as well as more negative and uncomfortable in specific conditions. This has implications on the everyday life of individuals high in SPS and means of reducing such stimulation caused by negative affect should be put in place to promote positive environments. For example, being aware of the reasons for reacting to stimuli can help individuals minimise adverse responses. Also, adequate coping mechanisms can be adapted, such as mindfulness to reduce overstimulation. A blog written by Elaine Aron (Aron, 2019) provides methods of meditation, designed, and tailored specifically for Highly Sensitive Persons. This research also provides insight into the positive aspects of being highly sensitive, such that these individuals experience increased empathy, which has many benefits in the personal, professional, and social aspects of their lives. Although the argument can be made that increased empathy contributes to negative feelings, encouraging highly sensitives to, once again, focus on their positive characteristics can help them to flourish and thrive in their everyday lives. Future research should continue to investigate such negative reactions to and avoidance of violence, especially in terms of whether high SPS is protective against feelings of aggression, as well as the brain and visual attention basis of such reactions and such avoidance.

Chapter 8. Summary of Findings

Since its initial conceptualisation in 1997, the biophysiological trait of Sensory Processing Sensitivity (SPS) with its operationalisation through the Highly Sensitive Person Scale (HSPS) has been the subject of much research and debate. The main gaps in the literature have concerned whether the HSPS has subdimensions, whether SPS refers solely to reactivity or also to perceptual accuracy, and whether SPS as measured by the HSPS is correlated with dream content and also responses to violent images. This thesis aimed to address these gaps in the literature, while also addressing the claim that relationships with HSPS could be explained more parsimoniously as due to the more established Big Five measures. For more extensive discussions, see the individual Chapters.

Sensory Processing Sensitivity and perception

Revealed in Chapter 2, support for the use of the two-subscale approach was provided (Tabak et al., 2022). SPS was positively related to the experience of paranormal phenomena. Furthermore, Positive Sensory Responsivity (PSR; the positive subscale of the HSPS, as in Tabak et al. (2022)) was correlated with increased perceptual accuracy in detecting truly degraded stimuli, which was supported by Signal Detection Theory analyses. The lack of association of the subscale Aesthetic Sensitivity (AES) (as in the three-subscale approach; Smolewska et al., 2006) with identification of degraded words implies the removal of a single item to create PSR is better reflective of the positive facet of being highly sensitive. Negative Sensory Responsivity (NSR) was confirmed to be associated with introversion and neuroticism, and PSR with openness to experience. Despite shared variance between the traits, the enhanced perceptual ability of high PSR individuals was demonstrated, particularly that of detection and identification of visually degraded stimuli. Importantly, this supports SPS as an independent construct (Hellwig & Roth, 2021). These findings are fully demonstrated in Chapter 3.

Sensory processing sensitivity and dream experiences

Chapter 4 aimed to cross-sectionally investigate SPS and dreaming experiences as well as explore the relationships between thin boundaries, SPS, and dream variables. This was important because Hartmann's (Hartmann, 1991) thin boundariness construct has overlaps with SPS and has been the main measure of such sensitivity in studies of dreaming. Findings

suggested similarities between the two traits of thin boundaries and SPS. In addition, SPS was found to be related to dream recall, the emotional intensity of dreams, as well as dream complexity. As limitations, however, these studies of dreams could not test the changes in dreaming across time and sleep quality was not considered, which is an important factor in dream and emotion research.

The continuity hypothesis was supported in Chapter 5, suggesting that personal concerns and daily emotions appear within dreams, while addressing concerns of the previous literature (such as using an established measure of daily stress; Samson-Daoust et al., 2019). Incorporating measures of sleep quality, results suggested this to be important in impacting upon dream emotions. Furthermore, contradicting Differential Susceptibility, PSR predicted increased negative dream emotions and interacted only with daily positive mood in reducing positive dream affect, which could imply a functional, emotional regulation role of positive sensitivity. The Differential Susceptibility model has not yet included the possibility of sensitivity having a functional role other than for behavioural strategies.

The previous chapters all involved non-clinical samples and so Chapter 6 addressed the relationships of HSPS score to nightmare experience in a clinical sample of individuals with serious mental health diagnoses who wished to have treatment for their distressing and frequent nightmares. A relationship between NSR and nightmare experience was found in this sample, indicating a predisposition of Highly Sensitive Persons to experiencing distressing dreams, and of a relationship between SPS and nightmare frequency. However, the preliminary sample size was too small for full testing, thus, future research should aim to test associations between SPS and mental health symptomology, as well as how this relates to nightmares and adherence to treatment over time.

Sensory processing sensitivity and violence

A further under-researched aspect of SPS relates to the response of Highly Sensitive Persons to violence. Chapter 7 revealed support for Item 18 of the HSPS, in that highly sensitives display negative emotional reactions and responses to viewing violence, regardless of whether that violence is fictional and non-fictional. On the other hand, and positively for highly sensitives, these individuals also displayed increased empathy, which can benefit these individuals in most aspects of their everyday lives.

Important findings

The current thesis includes important findings from three under-researched topics, that of perception, dreaming, and violence avoidance. Firstly, the perceptual advantage of high SPS was supported, corroborating previous theories (e.g., Williams et al., 2021), and these relationships were beyond that of the Big Five traits. It is evidenced that SPS is an ability trait, distinguishable from pre-established constructs. Highly sensitives show unique perceptual abilities, suggesting these individuals are more aware of environmental subtleties and process the world differently. This poses implications on behavioural reactivity, in the sense that enhanced perception can lead to overstimulation in certain conditions, although it can also lead to, for instance, creativity (Kiou, 2018).

Furthermore, dream experiences were explored using extensive dream questionnaires, allowing for the capture of dream complexity, as well as including the use of longitudinal methods to test for changes to emotional dreaming as a function of high SPS. The evidence of relationships between SPS and dream experiences reveal the importance of promoting positivity in everyday life, particularly considering the impact of dreams on waking emotions. However, a real-world consequence of being highly sensitive is the experience of nightmares and pre-disposition to mental health conditions. Once again, a shift to positivity, such as focusing on the Highly Sensitive Person's propensity to benefit from treatment interventions, can improve mental health and nightmare outcomes. Finally, preliminary findings revealed support for Item 18 of the HSPS, an item that has received no validation until now (to the author's knowledge). It was demonstrated that highly sensitives are disproportionately affected by the viewing of violence, however, the increased empathy account of high SPS was supported, with empirical evidence to demonstrate that Highly Sensitive Persons are more empathetic.

Overall, these findings highlight the advantages and consequences of being highly sensitive, although a focus on the positive aspects can lead to better outcomes. Enhancing the understanding of what it means to be, as well as the core characteristics of, high sensitivity can aid in improving the functioning of Highly Sensitive Persons. In addition, the results demonstrate the evolutionary advantage of SPS, in that different levels of sensitivity display different evolutionary strategies in response to the environment. The factors driving sensitivity may be exaggerated in highly sensitives, leading to the development of an interesting

personality profile of someone who is highly reactive, processes more deeply, and is inherently appreciative of aesthetics.

Challenges and Future Research

Regardless of such positive findings, further investigation is required. Firstly, in Chapter 5, results indicated that PSR interacts with the experience of positive daily emotions in predicting reduced positive emotions during dreaming, a potential emotional regulation account of dreaming in highly sensitives. Moreover, there were no significant effects of SPS on negative dreaming, with these findings overall contradicting the theory of Differential Susceptibility. However, nightmares may be distinct from negative dreaming (dreams which are not nightmares). Therefore, future research should intend on testing how SPS (specifically the negative facet of SPS) is related to daily fluctuations in mood, emotional wellbeing (e.g., trait anxiety, Carr et al., 2020), and the experience of and response to nightmares.

Secondly, Chapter 6 details the future aim to explore whether the relationships between mental wellbeing and nightmares exist for Highly Sensitive Persons in specific clinical populations, such as those with a diagnoses of a mental health disorder (e.g., post-traumatic stress disorder, clinical depression), as well as whether highly sensitives in these populations are more responsive to interventions with the intent to improve symptomology.

Furthermore, although the associations between SPS and reactions to violence were tested in the current thesis, it cannot be concluded that highly sensitive individuals are likely to avoid violent television shows and movies. Also, effects of SPS on the avoidance of different types of violence, that of real-life violence, are also unclear. An in-depth investigation of avoidance of violence amongst Highly Sensitive Persons should be explicitly conducted, for instance, with use of brain imaging and eye-tracking technology (Chapter 7). The brain structures involved in the default mode network as well as the inferior frontal gyrus are suggested to be related to the viewing of violence in Highly Sensitive Persons; structures involved in internal processing, emotion, and empathy.

Finally, SPS was measured throughout the thesis using the 27-item HSPS (Aron & Aron, 1997). Argument could be made that this scale is now insufficient in measuring SPS in terms of environmental sensitivity (Greven et al., 2019; Hellwig & Roth, 2021; Konrad & Herzberg,

2019). This idea derives from overlap with the Big Five personality traits (Attary & Ghazizadeh, 2021; Hellwig & Roth, 2021; Roth et al., 2023), and the lack of items referring to "cardinal characteristics" of being a Highly Sensitive Person, such as an enhanced depth of processing (Greven et al., 2019). With an attempt to overcome such definitional and measurement issues, alternative measures of environmental sensitivity have been developed in recent times. For example, the Introduction describes the work of DeGucht et al. (2022) in developing the Sensory Processing Sensitivity Questionnaire (SPSQ), which combines a series of items, referring to environmental, emotional, sensory, and aesthetic sensitivities, from a variety of pre-established and validated questionnaires. The SPSQ is advantageous over the HSPS in that it considers six dimensions of sensitivity, even describing cardinal characteristics (Greven et al., 2019) which are not captured by the HSPS. Replication of the current research on SPS, measured using the HSPS, would be interesting but instead using alternative measures of environmental sensitivity, such as the SPSQ.

Limitations of Thesis

Firstly, although an attempt was made to address the Big Five traits, a measure of these were not included in Chapters 2, 5 and 6. One aim was to distinguish SPS from the Big Five traits, and thus not including these creates inconsistencies, and does not allow these additional traits to be controlled for during the analyses. For instance, when testing the changes in emotional dreaming as a function of SPS in Chapter 5, neuroticism would be an important factor to consider due to its overlap with SPS in terms of aversion of negativity and enhanced (negative) emotional reactivity. Furthermore, different measures of the Big Five traits were used when these were considered due to attempts to save time for individuals during participation. In Chapter 3, the 44-item Big Five Inventory (John et al., 1991; John & Srivastava, 1999) was used, this questionnaire includes 8-10 items per individual trait. Although not as extensive as the larger Big Five questionnaires (e.g., the 240-item NEO PI-R; Costa & McCrae, 1992), it still includes more items per trait than the Big Five Inventory-10 (Rammstedt & John, 2007), which has only two items representing each individual trait. As discussed in Chapter 4, shorter scales capturing the Big Five traits can underestimate behavioural associations, as well as inflate the chance of Type I errors (Crede et al., 2012).

Secondly, the generalisability of findings throughout the thesis is questionable due to the demographics of participants. In particular, across all complete studies (excluding Chapter 6),

75% of the participants were female and 91% were of White ethnicity. Therefore, the findings from these three topics of perception, dreaming, and violence avoidance may not generalise further than White, female individuals. Differences in SPS between cultures (Greven et al., 2019), and particularly cultural differences in experiences such as attitude towards dreams and violence are all important to consider moving forward.

Moving on, all studies were conducted online, including the experimental methods in Chapters 3 and 7. Discussed in Chapter 3, online testing may pose consequences to psychological research as the experimenter has little to no control of participants' environments, which could be detrimental to results. For example, each participant would have completed the experiments on a different computer, each differing in brand, model, and size, viewing their screens in different room lightings, at a different brightness, and differing screen angles. Furthermore, participating in experiments from home (or other locations) increases the possibility of distractions, and again, the experimenter had no knowledge of what distractions were present. As an attempt to counteract these factors, participants were provided with instructions before the experiments, although it is uncertain whether these were followed.

Conclusion

To conclude, this thesis contributes to the growing body of research on SPS by addressing key gaps and offering insights into the HSPS' dimensions, and relationships with perception, dreaming, and responses to violence. By employing different approaches and diverse methodologies, the findings underline SPS as an independent construct with unique behavioural and emotional implications. Importantly, the adaptive and challenging aspects of SPS are emphasised. Future research is essential to expand these findings, continuing the important work on the Highly Sensitive Person; crucial for refining our understanding of this trait and to better support the needs of highly sensitives in a variety of contexts. Moreover, researchers and practitioners, using these insights, can move towards supporting individuals in harnessing their sensitivity as a strength, rather than a limitation.

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Appendices

Appendix A.

Table from Attary and Ghazizadeh (2021) demonstrating the difference in items from the original HSPS and the HSPS-16.
Original Caption: The original back-translated 27-question HSPS (1st left column) along with the designation of the three subdomains AES, EOE, and LST (25 questions) with 2 questions being uncategorized (2nd column). Short version of the HSPS is shown in the 3rd column and our modified 16 questions version in the 4th column.

All HSPS	Three dimentions	Short version	Our proposed 16-item SPS
1. Intense sensory stimuli make me overwhelmed	uncategorized	Not included	Included
2.In my opinion, I notice the existing elegance and beauty of my circumference	AES	Included	Not included
3.Other people's mood and behavior affects me	EOE	Not included	Included
4. I am hypersensitive about pain	EOE	Not included	Included
5.On busy days, I find myself in need of sheltering in a dark room or any other comfortable place	AES	Not included	Not included
6. I am sensitive about the effects of caffeine in tea and coffee	LST	Not included	Included
7.I'm easily influenced by stuff like bright light, pungent odors, and rough fabrics with rough texture, and the closed siren sound	LST	Included	Included
8. I have a full and complicated inner life	AES	Included	Not included
9. I get annoyed by loud noises	LST	Not included	Included
10.I am deeply inspired by art and music	AES	Included	Not included
11.Often I feel that my nervous system is so irritated that I need to be left alone	uncategorized	Not included	Not included
12. I am a conspicuous person	AES	Not included	Not included
13. I get scared and panicked easily	EOE	Not included	Included
14. I feel stressed when I have a lot of work to do in a short period of time	EOE	Included	Included
15. When I see other people are uncomfortable, I know what makes that person comfortable (like changing the lights or changing the seat)	AES	Not included	Not included
16.I get annoyed when others try to force me to do a lot of things	EOE	Included	Included
17. I try hard not to forget the things and make a mistake	EOE	Not included	Not included
18. In my opinion, we should avoid watching violent movies	LST	Included	Included
19. I get irritated when a lot happens around me	LST	Not included	Included
20. Hunger triggers a powerful reaction in me and perturbs my mood and concentration	EOE	Not included	Included
21. The changes in life make me feel stressed	EOE	Included	Included
22. I pay attention to the scenes, the smells, the tastes and the sounds in the environments and I enjoy them	AES	Included	Not included
23. I find it unpleasant to do all the things once	EOE	Included	Included
24. my priority is to avoid difficult and uncomfortable situations, to put my life in order.	EOE	Not included	Included
25.Intense motives such as loud noises or deranged scenes disturb me	LST	Included	Included
26.When I compete with others in doing something or I get doing a task when I am being observed, I get very upset and unstable and act worse than what expected	EOE	Included	Not included
27. When I was a kid, it seemed like my parents and teachers considered me a sensitive and shy person	EOE	Not included	Not included

Appendix B.
Method information for Chapter 2, as in Williams & Blagrove (2022).

Participants

62 participants were recruited through social media and the university psychology credit system. Participants were awarded either university credits or a raffle ticket to win a prize. One participant did not complete the computer task due to program failure, and their data were excluded. There was a total sample size of N = 61, with 20 men and 41 women, ages 18 to 54 years (Mean = 26.95 years, SD = 9.86), and 90.2% were White. 13.1% of participants were educated to high school level (or below), 46.5% had completed college or sixth form (A-Level), 31.3% achieved Bachelor's Level (undergraduate), and 8.2% achieved Master's Level qualifications. Full written consent was provided by participants. The study was granted ethical approval from Swansea University's College of Human and Health Sciences Research Ethics Committee.

Materials

Stimuli

The stimuli were those used in Nees and Phillips [14]. There was a total of 136 stimuli arranged in four conditions (34 stimuli per condition). Each stimulus lasted approximately 600 milliseconds, including a 5-millisecond onset given by the original researchers. The four conditions were EVP, human speech, degraded speech, and artificially produced white noise. The EVP recordings were examples of purported ghost voices captured during real paranormal investigations and can be defined as pareidolia [4]. Human speech recordings included clearly spoken words or phrases, such as "Anything", "Is there anybody", and "Talk to us". The degraded speech stimuli were the same recordings used in the speech condition, degraded within white noise, with the signal to noise ratio creating challenges for speech perception. The speech and white noise stimuli acted as control conditions for the EVP and degraded speech conditions. All audio files (except for the artificial white noise condition, created using Audacity) were extracted from a series of videos titled Ghost Adventures - Guess that EVP on the Travel Channel Website (see Nees & Phillips [14] for details of stimulus production).

Questionnaires

The Survey of Anomalous Experiences (SAE) [42] was used to measure the extent to which participants report having previous paranormal experiences (Cronbach's alpha = .83). This questionnaire provides 20 anomalous experiences and participants respond according to whether they have had the experience and would attribute it as paranormal, if they have had the experience but believe there was an alternative explanation, or that they have never had the experience. Questions 14 and 19 were reworded to create a broader anomalous experience which could apply to more individuals, and the first response option for all items was reworded to "I think it was…" instead of "It must have…". For instance, "I have become aware of a scent in a room, yet there was nothing there that could have that smell", gives the following response options: "Yes, and I think it was an instance of an apparition or ESP." (Paranormal Response), "Yes, but it was probably just an illusion or physiological anomaly." (Anomalous Response), or "No" (No Response). The total number of responses per option per participant was calculated, resulting in three variables of SAE No Responses, Paranormal Responses, and Anomalous Responses.

To measure SPS, the Highly Sensitive Person Scale [18] (HSPS; Cronbach's alpha = .85) was used, which asks about the sensory experiences of the individual. Participants responded to 27 questions with reference to a 7-point Likert scale (1 = Not at all; 7 = Extremely). Questions include, "Are you easily overwhelmed by strong sensory input?" and "Do you

startle easily?". The responses to each question were added together to give a total score, and a mean score was calculated, with a higher score representing higher SPS. The mean scores for each of the subscales were also calculated according to Smolewska et al.'s three subscales of AES (7 items; a = .68), EOE (12 items; a = .75), and LST (6 items; a = .68) [29].

Procedure

The current design was a replication of the procedure used by Nees and Phillips [14], with the addition of the SAE and HSPS. Firstly, participants were asked to read an information sheet that contained all the relevant information regarding the study. The title given to all was "Voice Detection in Sounds", so that participants in the unprimed group remained naïve to the paranormal aspect of the investigation. All provided informed written consent. Participants sat in front of a MacBook Air (2017) and placed a pair of Sony MDR-ZX310APB headphones over their ears.

Priming Manipulation and Computer Task

The computer program randomly assigned participants to one of two groups, either the paranormal primed group (n = 30) or the unprimed group (n = 31). The only difference between these two groups was the first line of the instructions. The primed group read the following, "This is an experimental study on the identification of electronic voice phenomenon – purported voices of ghosts in recordings from paranormal research.", whereas the unprimed group were told, "This is an experimental study of the identification of voices in noisy environments." The remainder of the instructions were the same for both groups, that they would hear a variety of sounds in the headphones, and after hearing each sound they should respond 'Yes' or 'No', depending on whether they heard a voice in the recording. To move on from the instructions, participants pressed the spacebar, and a proceed screen was displayed, asking participants to, "Please press the spacebar to begin a trial.". This appeared before each of the 136 trials (stimuli) to ensure participants were prepared for and not surprised by the sounds. After pressing, a blank screen appeared, and the stimulus played after a 1000ms onset. Once the recording had finished, the program moved to the question screen automatically, asking the participant if they heard a voice in the sound. If they responded yes, they were immediately directed to an additional question screen, which asked participants to type in a box a guess as to what they thought the voice had said, and to not give responses such as "I don't know" or "unsure". If they responded no to hearing a voice, they immediately moved to the next trial proceed screen. An unlimited amount of time was given to answer, and the stimuli were presented in a different random order for each participant. The percentage of yes responses per condition was calculated by dividing the total number of yes responses in that condition by the number of trials (34 trials), as a measure of the propensity to perceive human voices within the recordings. In addition, participants' guesses as to the spoken content of the recordings were extracted and used to test for spoken content agreement.

Questionnaires

Once the computer task was completed, participants were asked to fill in electronic versions of the SAE and HSPS on Qualtrics (Qualtrics, Provo, UT) using an Apple iPad Air (2018). Data were also collected regarding participants' age, gender, education level, and ethnicity. Participants were fully debriefed at the end of the study, the purpose of the investigation was explained, and their group assignment was revealed. The final question on the questionnaire asked participants if they had guessed the true nature of the experiment, i.e., that there was a paranormal nature and/or that they had been randomly assigned to one of two groups. This was specifically important to ensure the unprimed group remained naïve to this throughout, so the priming manipulation was not diminished, and they remained unaware of the paranormal aspect of the investigation. One example of how they could have been aware of

this during the experiment is if the participant had recognised the voices of the paranormal investigators from the television show "Ghost Adventures". Another reason was to control for diffusion of the instructional manipulation that occurred, e.g., amongst class peers, a previous limitation of the original study [14]. One participant did not give a response as there was an error with the questionnaire software.

Statistical Analyses

The analyses of Nees & Phillips [14] were replicated. A 2 (priming group) x 4 (stimulus condition) mixed analysis of variance (ANOVA) was conducted, with the proportion of yes responses as the dependent variable. A 2 (priming group) x 2 (stimulus condition) ANOVA was also conducted using only the detection of voices within the EVP and degraded speech stimulus conditions, due to the non-normality of the speech and noise conditions (Nees & Phillips [14]; footnote 2, p29). Paranormal Responses and SAE No Responses were included as covariates to control for participants' existing susceptibility to experience paranormal phenomenon as well as suggestibility. The current study involves priming, stimulus detection, and paranormal experiences, and thus all variables are present within the ANOVAs.

Qualitative data (participants' guesses) were collected and analysed for any agreement amongst participants and a one-way ANOVA was conducted to test the difference between the maximum agreement in each stimulus condition (34 trials each), with each trial as a case. Participants' agreement with the original interpretations of the EVP stimuli (according to the subtitled videos in which the EVP originated) were also compared to test for spoken content agreement; the number of times in which participants agreed with these interpretations was calculated.

Appendix C.
The Results information from Chapter 2, as in Williams & Blagrove (2022).

Nees and Phillips Replication

Replicating the analysis of Nees and Phillips [14], a 2 (instructional priming group) x 4 (stimulus condition) mixed ANOVA was conducted with percentage of yes responses as the dependent variable: due to the design of the current study, Paranormal Responses and SAE No Responses were added as covariates. The assumption of sphericity was violated, and thus Greenhouse-Geisser correction was used. A significant main effect of stimulus condition on yes responses was revealed, $F(1.78, 101.52) = 29.42$, $p < .001$, $\eta p2 = 0.34$. Pairwise comparisons, with an adjusted significance threshold using Bonferroni correction ($a = .008$), were used to test the differences between the four speech conditions. There were significant differences between all four conditions of stimulus ($p < .001$), except between the degraded speech and EVP conditions ($p > .05$) (Fig 3, for 95% Confidence Intervals see S3 Table). On the other hand, there was a non-significant main effect of priming group, $F(1, 57) = 0.04$, $p = .84$, $\eta p2 = .001$. There were non-significant differences between the groups for the detection of voices in degraded speech ($t(59) = -.72$, $p = .47$, 95% CI [-14.686, 6.691]), EVP ($t(59) = 1.13$, $p = .26$, CI [-4.116, 14.799]), speech ($t(46.64) = -1.05$, $p = .30$, 95% CI [-0.580, 0.182]), and noise ($t(33.28) = -1.10$, $p = .14$, 95% CI [-1.873, 0.557]). There was also a non-significant interaction between group and stimulus type, $F(1.78, 101.52) = 1.43$, $p = .24$, $\eta p2 = .025$. The same results held without inclusion of the covariates (as conducted in Nees and Phillips [14]).

Nees and Phillips [14] noted the violations of the assumption of normality for both the noise and speech conditions (see footnote 2, p.29), which is seen to be the case in the current study. With these conditions omitted, there was no change to the original authors' findings of two significant main effects and a significant interaction. However, removing these and conducting a 2 (group) x 2 (stimulus condition) ANOVA with the current data (with Paranormal Responses and SAE No Responses as covariates) reveals a significant interaction between group and stimulus condition, $F(1,57) = 4.08$, $p = .048$, $\eta p2 = 0.07$), although the main effects were non-significant: stimulus condition, $F(1,57) = 0.16$, $p = .69$; group, $F(1,57) = 0.09$, $p = .77$. For the primed group, a paired samples t-test revealed a significant difference between these two stimulus conditions, $t(29) = -2.47$, $p = .02$, 95% CI [-15.057, -1.414]. The primed participants reported hearing a higher percentage of voices in the EVP stimuli compared with the degraded speech stimuli. However, for the unprimed group, there was a non-significant difference between these conditions, $t(30) = 0.38$, $p = .71$, 95% CI [-5.080, 7.972]. This suggests that participants informed of the paranormal aspect of the study reported hearing more voices in the EVP than the degraded speech condition.
Qualitative data (participants' word guesses) were collected and analysed for the agreement amongst participants as to the spoken content of the stimuli within the four conditions. A total of 3,954 responses included scoreable guesses as to what the voices within the recordings had said. Scoreable guesses did not include words such as 'I don't know', 'Not sure', 'Man's voice', or 'Interference', and following the previous researchers, partial matches or rhyming words were not counted as in agreement, but homophones (e.g., 'here', 'hear') and spelling mistakes were. There was no trial in the noise condition in which more than one participant agreed upon the spoken content, thus, with the three remaining stimulus conditions, each trial (stimulus) with more than one response was analysed and the maximum percentage agreement across participants was calculated. This was done by identifying the word with which the most agreed and dividing the number of participants who agreed with the word by the total number of guesses for that trial.

Analysing differences between the percentage agreements in each stimulus condition (EVP, speech, and degraded speech), a one-way ANOVA was conducted. Stimulus condition was the independent variable, with each trial as a case (102 cases in total), and the mean percentage agreement as the dependent variable. The ANOVA revealed a significant difference between the stimulus conditions, $F(2, 99) = 391.16$, $p < .001$, $\eta p2 = .89$. Bonferroni post-hoc comparisons were used to explore the differences between these, with an adjusted alpha value of $a = .017$. There were differences between the degraded speech and speech conditions ($p < .001$), and between speech and EVP ($p < .001$). However, there were no significant differences between the EVP and degraded speech conditions, the two types of ambiguous stimuli ($p > .05$). Descriptive statistics are displayed in Table 2.

Table 2. Descriptive statistics for the maximum agreement of the spoken word content per condition. The means, standard deviations (SD), minimum, and maximum values for the maximum spoken content agreement in each stimulus condition. Noise was not included as there was no trial on which more than one participant guessed the same word.

	Mean	SD	Minimum	Maximum
Human Speech	89.03	17.78	31.15	100.00
Degraded Speech	10.69	10.31	0	40.00
EVP	11.80	10.17	0	43.33

Lastly, participants' guesses of the spoken content of the EVP stimuli were compared with the interpretations of the original paranormal researchers (Ghost Adventures). The original videos in which the EVP were extracted were subtitled with interpretations of the spoken content. As above, homophones and spelling mistakes were scored as being in agreement, but partial matches were not. 34 trials of EVP were included, with 984 scorable guesses: only 9 responses (0.91%) agreed with the paranormal researchers' interpretations.

Correlations with SPS

HSPS score was positively associated with the number of Paranormal Responses, $rs(61) = .298$, $p = .02$, as well as negatively related to the number of SAE No Responses, $r(61) = -.301$, $p = .02$. This suggests that higher SPS is associated with an increased reporting of paranormal experiences. The subscale AES also had significant associations with SAE No Responses ($r(61) = -.44$, $p < .001$) and Paranormal Responses ($rs(61) = .28$, $p = .03$). Furthermore, the only significant correlation found for SPS and perception was that between AES and the percentage of degraded words detected, $r(61) = .30$, $p = .02$, a higher AES score was related to higher perception of words within this stimulus condition.

To test the paradox between SPS, paranormal experiences, and perception, a multiple regression was calculated to predict Paranormal Responses based on two perceptual measures (yes responses in the EVP (pareidolia) condition and degraded human speech condition) as well as HSPS score and its three subscales. A significant regression equation was found, $F(6,54) = 4.594$, $p < .001$. The model explained 33.8% of the variance, and all variables significantly contributed to the model ($p < .01$), except for the percentage of yes responses in the EVP and degraded speech conditions ($p > .05$).

To further explore the relationship with AES and perception, SDT measures were calculated to test sensitivity (d') to perceiving voices where voices were present (hits, detection of degraded human speech) versus when they were not (false alarms, detection of voices in the

noise condition), as well as response bias (β) (i.e., the inclination for participants to respond with more "Yes" responses or "No" responses). AES was significantly associated with perceptual sensitivity (d'), $r(61) = .263$, $p = .04$, but not to response bias (β), $r(61) = -.026$, $p = .842$ (Fig 2). Correlations between SDT measures and the remaining subscales and SAE Responses were non-significant ($p > .05$) (Table 1), and there were no significant differences between primed and unprimed participants for perceptual sensitivity ($t(61) = 0.23$, $p = .82$) or response bias ($t(61) = -0.36$, $p = .72$)

Finally, participants' guesses were extracted for each trial (34 trials) within the degraded speech condition, and the number of correct guesses per participant was calculated. Overall, the number of correct guesses was low across the sample, ranging from 0 to 6, with a mean of 1.43 (SD = 1.50). This suggests that accurate speech recognition was difficult for participants. Due to the non-normality of the number of correctly identified degraded words, a Spearman's rho was conducted and revealed a non-significant correlation between AES and the number of correctly identified degraded words ($rs(61) = .07$, $p = .61$), as well as with HSPS score ($rs(61) = .11$, $p = .39$).

Table 1. Correlations between the perception, paranormal experiences, and sensory-processing sensitivity.

	SAE No Responses	Anomalous Responses	Paranormal Responses	HSPS Score	EOE	LST	AES
Percentage of Words Detected:							
Degraded Human Speech	-.214	.055	.117[a]	.116	-.122[a]	.118	.300[b]
Human Speech	-.009[a]	.140[a]	-.021[a]	.062[a]	.236[a]	.131[a]	-.137[a]
EVP	-.123	.093	-.001[a]	-.031	-.109[a]	.045	.135
Noise	-.061[a]	.012[a]	.107[a]	.000[a]	-.030[a]	-.001[a]	.072[a]
SDT Measures:							
Perceptual Sensitivity (d')	-.216	.052	.109[a]	.095	-.138[a]	.121	.263[b]
Response Bias (β)	.045	.087	-.087[a]	-.073	-.144[a]	-.007	-.026
Paranormal Experiences:							
SAE No Responses	-	-.349[c]	-.583[ad]	-	-	-	-
Anomalous Responses	-	-	-.427[ad]	-	-	-	-
Sensory-Processing Sensitivity:							
HSPS Score	-.301[b]	.058	.298[ab]	-	-	-	-
EOE	-.107[a]	.048[a]	.108[a]	.824[ad]	-	-	-
LST	-.169	.114	.158[a]	.837[d]	.603[ad]	-	-
AES	-.439[c]	.114	.279[ab]	.733[d]	.445[ad]	.452[d]	-

All DFs = 61.
[a]Spearman's Rho correlations conducted due to non-normality.
[b]$p < .05$
[c]$p < .01$
[d]$p < .001$

Appendix D.

Spearman's rho correlations and confidence intervals demonstrating the relationship between the personality measures and perception.

Spearman's rho correlations were conducted due to the non-normality of the perceptual and confidence variables, all correlations and significance values are displayed. It is important to highlight that although significant, all correlation coefficients were small ($r_s < .22$). Correlations between the personality variables and detection and confidence in the white noise condition were negligible (detection and confidence r_s range = -.07 to .03, $p > .05$) and thus not reported.

Spearman's rho correlations (coefficient, p-value) between the personality measures, including Big Five, social desirability (SDS), and SPS, with the perceptual measures.

	Detection				**Identification**				**Confidence**					
	Level 1	Level 2	Level 3	Overall	Level 1	Level 2	Level 3	Overall	Level 1	Level 2	Level 3	Overall	Correct	Incorrect
HSPS Score	-.010, *p* = .879	-.026, *p* = .703	.052, *p* = .442	.028, *p* = .680	.063, *p* = .347	.047, *p* = .487	-.006, *p* = .930	.053, *p* = .428	-.070, *p* = .302	-.080, *p* = .233	.019, *p* = .782	-.060, *p* = .377	**-.133, *p* = .049**	-.025, *p* = .716
NSR	-.025, *p* = .707	-.052, *p* = .444	.007, *p* = .915	-.017, *p* = .801	.043, *p* = .521	.010, *p* = .883	-.043, *p* = .520	.012, *p* = .856	-.088, *p* = .190	-.110, *p* = .101	-.031, *p* = .647	-.100, *p* = .136	**-.148, *p* = .027**	-.026, *p* = .699
PSR	.030, *p* = .652	.113, *p* = .094	**.201, *p* = .003**	**.196, *p* = .003**	.082, *p* = .222	**.175, *p* = .009**	**.150, *p* = .025**	**.191, *p* = .004**	.068, *p* = .310	**.155, *p* = .021**	**.222, *p* < .001**	**.187, *p* = .005**	.054, *p* = .422	.005, *p* = .941
SDS	**-.145, *p* = .030**	-.075, *p* = .264	**-.152, *p* = .024**	**-.151, *p* = .024**	.037, *p* = .587	-.013, *p* = .842	-.044, *p* = .499	-.022, *p* = .740	.058, *p* = .393	.063, *p* = .349	.014, *p* = .840	.054, *p* = .420	**.155, *p* = .021**	**.207, *p* = .002**
Extraversion	-.008, *p* = .906	-.069, *p* = .304	-.034, *p* = .613	-.029, *p* = .668	-.077, *p* = .250	-.093, *p* = .169	-.006, *p* = .926	-.076, *p* = .258	-.014, *p* = .832	.052, *p* = .442	.130, *p* = .054	.082, *p* = .226	**.139, *p* = .039**	**.257, *p* < .001**

Conscientiousness	.042, *p* = .532	.124, *p* = .065	.014, *p* = .835	.038, *p* = .573	.047, *p* = .490	.045, *p* = .504	.072, *p* = .286	.062, *p* = .358	.110, *p* = .101	**.160, *p* = .017**	.086, *p* = .201	**.146, *p* = .030**	**.170, *p* = .011**	.036, *p* = .592
Agreeableness	.129, *p* = .055	.093, *p* = .169	**.143, *p* = .034**	**.147, *p* = .029**	.130, *p* = .052	.062, *p* = .359	**.169, *p* = .012**	**.142, *p* = .035**	**.152, *p* = .023**	.112, *p* = .095	**.204, *p* = .002**	**.177, *p* = .008**	.074, *p* = .272	.023, *p* = .729
Neuroticism	-.021, *p* = .754	.024, *p* = .727	.008, *p* = .901	.001, *p* = .993	-.003, *p* = .968	-.072, *p* = .287	-.061, *p* = .368	-.059, *p* = .378	-.071, *p* = .295	**-.140, *p* = .037**	-.044, *p* = .511	-.114, *p* = .089	-.105, *p* = .119	-.082, *p* = .223
Openness	.020, *p* = 768	**.149, *p* = .027**	**.214, *p* < .001**	**.221, *p* < .001**	.095, *p* = .158	**.164, *p* = .014**	.123, *p* = .068	**.162, *p* = .016**	**.139, *p* = .039**	**.186, *p* = .005**	**.211, *p* = .002**	**.220, *p* < .001**	.113, *p* = .092	.042, *p* = .529

Spearman's Confidence Intervals for Chapter 3.

Spearman's rho confidence intervals (lower, upper for the correlation coefficients between the personality variables and perceptual variables.

	Detection				**Identification**				**Confidence**					
	Level 1	Level 2	Level 3	Overall	Level 1	Level 2	Level 3	Overall	Level 1	Level 2	Level 3	Overall	Correct	Incorrect
HSPS Score	-.146, .125	-.161, .110	-.084, .186	-.108, .163	-.073, .197	-.089, .181	-.141, .130	-.083, .188	-.203, .067	-.214, .056	-.117, .154	-.194, .077	-.263, .003	-.160, .111
NSR	-.160, .111	-.186, .084	-.128, .143	-.152, .119	-.093, .178	-.126, .041	-.178, .093	-.123, .148	-.221, .048	-.242, .026	-.166, .105	-.233, .036	-.278, -.013	-.161, .110
PSR	-.105, .165	-.023, .244	.068, .328	.063, .323	-.054, .215	.041, .304	.015, .280	.057, .318	-.068, .202	.020, .284	.089, .347	.053, .314	-.082, .188	-.131, .140
SDS	-.276, -.010	-.209, .061	-.281, -.016	-.281, -.016	-.099, .171	-.149, .122	-.180, .090	-.157, .113	-.079, .192	-.073, .197	-.122, .149	-.082, .188	.020, .285	.073, .333
Extraversion	-.143, .128	-.203, .067	-.169, .102	-.164, .107	-.211, .059	-.225, .044	-.142, .129	-.210, .060	-.150, .121	-.084, .186	-.006, .260	-.054, .215	.003, .269	.126, .380

Conscientiousness	-.094, .177	-.011, .255	-.122, .149	-.098, .173	-.090, .181	-.091, .180	-.064, .205	-.074, .196	-.025, .242	.025, .289	-.050, .219	.011, .276	.025, .299	-.100, .171
Agreeableness	-.006, .260	-.043, .225	.007, .273	.012, .277	-.005, .261	-.074, .196	.034, .298	.006, .272	.017, .282	-.024, .244	.071, .331	.042, .305	-.062, .207	-.113, .158
Neuroticism	-.156, .115	-.112, .159	-.127, .144	-.135, .136	-.138, .133	-.205, .064	-.195, .075	-.193, .077	-.204, .066	-.271, -.005	-.179, .092	-.246, .021	-.237, .031	-.215, .054
Openness	-.116, .155	.013, .278	.081, .340	.088, .346	-.041, .228	.029, .293	-.013, .254	.027, .291	.003, .269	.052, .314	.078, .337	.087, .345	-.022, .245	-.094, .177

Appendix E.

Relationships between SPS and perception, controlling for social desirability (SDS).

Spearman's rho partial correlations (coefficient, p-value) between SPS and the perceptual variables, controlling for SDS score. Significance is highlighted in bold. All dfs = 219.

	Detection				**Identification**				**Confidence**					
	Level 1	Level 2	Level 3	Overall	Level 1	Level 2	Level 3	Overall	Level 1	Level 2	Level 3	Overall	Correct	Incorrect
HSPS	-.019 p = .780	-.030 p = .655	.044 p = .519	.019 p = .775	.066 p = .331	.046 p = .494	-.009 p = .899	.052 p = .440	-.066 p = .326	-.077 p = .254	.019 p = .774	-.057 p = .402	-.125, p = .063	-.013, p = .850
NSR	-.083, p = .576	-.058, p = .389	-.005, p = .937	-.030, p = .658	.046, p = .492	.009, p = .896	-.047, p = .484	.010, p = .877	-.084, p = .213	-.106, p = .117	-.030, p = .659	-.096, p = .153	**-.138, p = .041**	-.009, p = .890
PSR	.043, p = .521	.120, p = .076	**.217, p < .001**	.212, p = .001	.079, p = .239	**.177, p = .008**	**.155 p = .021**	**.193, p = .004**	.064, p = .344	**.150, p = .025**	**.222, p < .001**	**.183, p = .006**	.042, p = .538	-.013, p = .850

Appendix F.

Tables to support the findings of Chapter 4.

The descriptive statistics summarising the dream experience variables measured by MADRE, including the percentage and frequency of responses per option, as well as means and medians of each variable. The total number of responses are also provided per dream variable as the questions were optional, resulting in missing data.

	Percentage of Responses	Frequency
Dream Recall Frequency		
Never	7.8	18
Less than once a month	12.9	30
About once a month	11.6	27
About 2-3 times a month	12.5	29
About once a week	23.3	54
Several times a week	22.4	52
Almost every day	9.5	22
Total Number of Responses	232	
Mean (SD)	3.36 (1.79)	
Median	4.00	
Dream Emotional Intensity		
Not at all intense	12.3	29
Not that intense	24.7	58
Somewhat intense	36.2	85
Quite intense	15.7	37
Very intense	11.1	26
Total Number of Responses	235	
Mean (SD)	1.89 (1.16)	
Median	2.00	
Dream Emotional Valence		
Very Negative	3.8	9
Somewhat Negative	29.8	70

Neutral	56.2	132
Somewhat Positive	9.8	23
Very Positive	0.4	1
Total Number of Responses	235	
Mean (SD)	-0.27 (0.70)	
Median	0.00	

The descriptive statistics summarising the nightmare experience variables measured by MADRE, including the percentage and frequency of responses per option, as well as means and medians of each variable. The total number of responses are also provided per dream variable as the questions were optional, resulting in missing data.

	Percentage of Responses	Frequency
Recurring Nightmares Relating to Real Life		
Yes	37	87
No	63	148
Total Number of Responses	235	
Childhood Nightmare Frequency		
Never	13.6	32
Less than once a year	8.5	20
About once a year	3.8	9
About 2 - 4 times a year	16.1	38
About once a month	15.3	36
About 2 - 3 times a month	14.4	34
About once a week	15.3	36
Several times a week	13.1	31
Total Number of Responses	236	
Mean (SD)	3.81 (2.27)	
Median	4.00	

The descriptive statistics (mean, standard deviation (SD), minimums, maximums) for the continuous variables measured by MADRE. These included the percentage of nightmares that are recurring nightmares, the age of which lucid dreaming first occurred, and the mean attitude towards dreams score, calculated by adding and averaging the scores for each dream attitude item (those with missing data were excluded from this calculation).

	Mean	SD	Minimum	Maximum	Total Number of Responses
Percentage of Nightmares that are Recurring	19.56	26.42	0.00	100.00	166
Age Lucid Dreaming First Occurred	12.17	7.82	0.00	41.00	131
Dream Attitude	2.19	0.98	0.00	3.88	228

The percentage of responses for how often participants experience each dream-related activity. The total number of responses are also provided per dream variable as the questions were optional, resulting in missing data.

	Never	Less than once a year	About once a year	About 2-4 times a year	About once a month	About 2-3 times a month	About once a week	Several times a week	Total Number of Responses
Telling Others About Dreams	16.6	10.6	5.1	12.8	19.6	11.1	14.5	9.8	235
Recording Dreams	79.7	3.8	1.3	2.5	6.8	2.1	2.5	1.3	236
Dreams Affect Mood	44.1	9.3	6.8	11.0	8.9	7.2	7.6	5.1	236
Dreams Help Solve Problems	61.9	8.9	5.1	11.4	5.9	4.2	1.3	1.3	236
Déjà vu Experience	4.7	11.9	8.5	30.1	12.7	14.4	8.9	8.9	236

Spearman's rho correlations (coefficient, p value, degrees of freedom (df)) between the SPS variables (total HSPS score, NSR, and PSR), trait anxiety (STAI), and thin boundaries with the dream variables. Significance is highlighted in bold.

	HSPS Score	NSR	PSR	STAI	Thin Boundaries
Lucid Dream Frequency	**.235, *p* < .001, df = 232**	**.224, *p* < .001, df = 232**	**.168, *p* = .010, df = 232**	.121, *p* = .066, df = 232	**.158, *p* = .015, df = 232**
Age Lucid Dreams First Occurred	-.003, *p* = .735, df = 129	.014, *p* = .876, df = 129	-.153, *p* = .082, df = 129	**-.184, *p* = .036, df = 129**	-.043, *p* = .629, df = 129
Dream Attitude	**.378, *p* < .001, df = 234**	**.339, *p* < .001, df = 234**	**.264, *p* < .001, df = 234**	**.171, *p* = .010, df = 234**	**.286, *p* < .001, df = 234**

Appendix G.
Spearman's rho correlations for Chapter 4.

Spearman's rho correlations (coefficient, p-value, degrees of freedom) between the Big Five traits and dream variables.

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
Dream Recall Frequency (DRF)	.088, p = .179, df = 232	-.020, p = .763, df = 232	.009, p = .890, df = 232	.045, p = .495, df = 232	.163, p = .013, df = 232
Dream Emotional Intensity	.026, p = .690, df = 235	-.032, p = .624, df = 235	.013, p = .843, df = 235	.145, p = .026, df = 235	.125, p = .055, df = 235
Dream Emotional Valence	.021, p = .751, df = 235	.150, p = .022, df = 235	-.006, p = .927, df = 235	-.153, p = .019, df = 235	.003, p = .960, df = 235
Nightmare Frequency	-.052, p = .422, df = 236	-.086, p = .190, df = 236	-.057, p = .380, df = 236	.196, p = .003, df = 236	.020, p = .758, df = 236
Nightmare Distress	.007, p = .932, df = 163	-.117, p = .137, df = 163	-.025, p = .754, df = 163	.203, p = .009, df = 163	.045, p = .569, df = 163
Lucid Dream Frequency	.109, p = .095, df = 234	.048, p = .465, df = 234	.097, p = .140, df = 234	-.049, p = .456, df = 234	.117, p = .074, df = 234
Age Lucid Dreams First Occurred	.080, p = .362, df = 131	.088, p = .318, df = 131	.044, p = .618, df = 131	-.065, p = .459, df = 131	.016, p = .855, df = 131

Appendix H.

Information regarding Future Research for Chapter 6.

A Research Assistant (RA) randomly allocates the participant to one of two groups/arms via simple randomisation: either the Treatment as Usual (TAU) group, or the Dream Completion Technique (DCT) and TAU group (DCT+TAU). The participant remains blind to their group assignment, as well as do all other members of the research team, only the RA is informed of the group assignment.

The TAU group simply receives their therapy as normal; this is the control group, and these individuals receive 12-16 sessions of therapy. The DCT+TAU group is the experimental group. This group receives a 40-minute DCT session at the beginning of their therapy, and then 12-16 sessions of TAU. They also receive one or two 10-minute DCT follow-up sessions in their TAU sessions. The participants then begin their treatment after their waiting period. The 40-minute DCT session involves a discussion about the longevity, frequency, severity, and type of nightmares the person has, as well as a YouTube video about DCT, a discussion about this with the therapist, and about how to approach their own dreams with DCT, and provision of a DCT information sheet. In each 10-minute follow-up session, they have a progress check, including the dream change ideas they have, and any further coaching required.

As mentioned previously, participants complete the IAPT measures, the unique problem descriptor questionnaires, and NAS before treatment, at each session of treatment (12-16 sessions), and at a 3-month follow-up. The data collected at sessions T0, T1, T2, T3, Final and Follow-up will be used in the subsequent analyses.

Design and statistical analysis
Data are processed using Python Programming Language (version 3.8.8). Statistical analyses are conducted using IBM SPSS Statistics for Macintosh, Version 28.0 (IBM Corp, Armonk, N.Y, USA).

There are four groups/arms in the investigation. Firstly, two control groups: TAU for PTSD and TAU for other IAPT descriptors. Secondly, two treatment groups: TAU+DCT for PTSD and TAU+DCT for other IAPT descriptors. There are six different time points of interest: T0 (pre-treatment), T1, T2, T3 (during treatment), Final treatment session, and 3-month follow-up (post-treatment). All questionnaires (IAPT measures, problem descriptor questionnaire, NAS) is collected at each time point, except for the HSPS, which is only measured once.

In order to test the effectiveness of DCT, a 2 (treatment vs control) x 2 (problem descriptor) x 5 (time point) mixed-factor ANOVA will be conducted. Treatment (DCT+TAU vs TAU) and problem descriptor (PTSD vs other descriptor) are between-subjects variables, whereas time (T0, T1, T2, T3, Final, and Follow-up) is within-subjects. The dependent variables will be NAS score. Post-hoc tests will be conducted to explore any significant main effects or interactions. Also, if there is a significant reduction of nightmares in those receiving DCT+TAU for PTSD, a 2 (DCT+TAU vs TAU) x 2 (T0 vs Final) mixed-factor ANOVA will be conducted with PCL-5 score as the dependent variable. As well as this, the 2x2 ANOVA will be conducted for all other outcome variables (IAPT measures and other descriptor problem questionnaire). This is to test

whether DCT is effective in reducing nightmares, which, in turn, reduces the severity of the problem descriptor.

Investigating SPS, correlations are conducted with NAS, the IAPT measures, and each problem descriptor questionnaire to assess the associations between SPS and nightmares and SPS and mental health vulnerabilities. Scores on these questionnaires are expected to be higher than, for example, the general population as a specific sample of participants with problem descriptors has been aimed for. For all four separate groups (two treatment and two control groups), correlations are conducted between NAS severity and frequency and SPS, as well as with the problem descriptor questionnaires and IAPT measures. Change scores are calculated from T0 to T1, T0 to Final, and T0 to Follow-up, and these scores are correlated with SPS for each group.

Appendix I.

Gender t-tests for Chapter 7.
T-test results (t, p-value) for the differences between males and females on the rating variables in each condition. All dfs = 81.

	t	p-value
Emotion (1 = Extremely negative; 10 = Extremely positive)		
Violent Movie	4.362	< .001
Non-Violent Movie	3.310	< .001
Violent Real Life	3.036	.002
Non-Violent Control	-0.512	.305
Empathy (1 = No empathy at all; 10 = A lot of empathy)		
Violent Movie	-1.629	.054
Non-Violent Movie	-0.273	.393
Violent Real Life	-0.979	.165
Enjoyability (1 = Not at all enjoyable; 10 = Extremely enjoyable)		
Violent Movie	4.826	< .001
Non-Violent Movie	3.166	.001
Violent Real Life	4.667	< .001
Non-Violent Control	0.232	.409
Discomfort (1 = Not at all uncomfortable; 10 = Extremely uncomfortable)		
Violent Movie	-0.804	.212
Non-Violent Movie	-0.516	.303
Violent Real Life	-0.401	.345
Non-Violent Control	0.824	.206
Violence (1 = Not at all violent, 10 = Extremely violent)		
Violent Movie	-1.914	.030
Non-Violent Movie	0.692	.246
Violent Real Life	-0.200	.421
Non-Violent Control	0.085	.466

Appendix K.
Spearman's rho correlations for Chapter 7.
Spearman's rho correlations (coefficient, p-value) between the Big Five traits and the rating variables in each video condition, as well as with violent media engagement. All dfs = 89. Significance is highlighted in bold.

	Extraversion	Agreeableness	Conscientiousness	Neuroticism	Openness
Emotion					
Violent Movie	-.121, p = .254	-.126, p = .235	**-.269, p = .010**	**-.256, p = .014**	-.007, p = .946
Non-Violent Movie	.010, p = .927	.060, p = .574	-.074, p = .484	**-.361, p < .001**	-.021, p = .841
Real Life Violence	-.179, p = .089	-.146, p = .169	**-.283, p = .007**	**-.357, p < .001**	-.113, p = .287
Non-Violent Control	-.018, p = .862	.093, p = .382	.045, p = .673	-.016, p = .882	-.008, p = .939
Empathy					
Violent Movie	**.312, p = .003**	**.225, p = .032**	**.288, p = .006**	.009, p = .934	.091, p = .389
Non-Violent Movie	.070, p = .511	.200, p = .058	**.216, p = .040**	-.013, p = .902	.086, p = .416
Real Life Violence	.101, p = .339	.128, p = .225	.190, p = .071	.175, p = .097	**.220, p = .037**
Enjoyability					
Violent Movie	-.018, p = .866	-.133, p = .209	-.200, p = .058	**-.294, p = .005**	.037, p = .725
Non-Violent Movie	-.013, p = .903	.043, p = .687	-.049, p = .644	**-.367, p < .001**	.028, p = .791

Real Life Violence	-.115, p = .277	-.172, p = .102	**-.261, p = .012**	**-.269, p = .010**	.013, p = .903
Non-Violent Control	-.062, p = .558	.057, p = .589	.038, p = .721	.029, p = .784	.126, p = .236
Discomfort					
Violent Movie	.148, p = .162	.068, p = .525	**.274, p = .008**	-.002, p = .985	-.008, p = .938
Non-Violent Movie	.016, p = .879	-.006, p = .957	.082, p = .439	-.006, p = .958	.041, p = .702
Real Life Violence	.142, p = .179	.041, p = .701	**.243, p = .021**	**.224, p = .033**	.132, p = .213
Non-Violent Control	.094, p = .376	-.198, p = .060	.005, p = .962	-.138, p = .193	.059, p = .577
Violence					
Violent Movie	**.228, p = .029**	.125, p = .239	**.340, p < .001**	.045, p = .672	.002, p = .983
Non-Violent Movie	.047, p = .658	-.132, p = .212	-.157, p = .138	-.030, p = .779	.107, p = .312
Real Life Violence	**.248, p = .018**	.143, p = .175	**.228, p = .030**	.114, p = .282	.076, p = .473
Non-Violent Control	-.018, p = .866	**-.223, p = .034**	.006, p = .951	-.148, p = .160	-.133, p = .209
Violent Media Engagement	.183, p = -.062	-.062, p = .559	.559, p = -.032	-.032, p = .761	.761, p = -.064

Appendix L.

Scatterplots for Chapter 7.

Figure. Scatterplot demonstrating the association between average violence and empathy scores in each video condition, with scores plotted separately for each SPS group. Violent movie clips are displayed in the top-left, non-violent movies in top-right, violent real-life in bottom-left, and the non-violent control condition in bottom-right. Graphs are to scale (same axis values), except for non-violent control scores as these were very low.