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SENSORY PROCESSING SENSITIVITY (SPS) AND THE RELATIONSHIP WITH HIGH IQ, ADAPTIVE PERFECTIONISM, DWRI INTELLIGENCE AND GREATER CREATIVITY AND EMPATHY

Fabiano de Abreu Agrela Rodrigues
Post-PhD in Neurosciences, esp. Genomics
Heráclito Research and Analysis Center (CPAH), Department of Neuroscience and Genomics, Brazil & Portugal
https://orcid.org/0000-0002-5487-5852

Flávio Henrique dos Santos Nascimento
Psychiatrist specializing in Neurosciences
Heráclito Research and Analysis Center (CPAH), Department of Neuroscience and Genomics, Brazil
https://orcid.org/0009-0007-3760-2936

Abstract: The study explores the relationship between Sensory Processing Sensitivity (SPS) and high IQ, identifying that individuals with high SPS tend to have high scores on IQ tests and a greater propensity for creativity. The brain regions involved in SPS include the orbitofrontal cortex, precuneus, middle temporal gyrus, cingulate and insula, mediated by the neurotransmitter dopamine. Genetic variants in dopamine-related genes are associated with SPS, suggesting high cognitive potential and variability in performance on intelligence tests.
Keywords: Sensory Processing Sensitivity, high IQ, dopamine, creativity, cognitive variability, dopamine-related genes

INTRODUCTION

Sensory Processing Sensitivity (SPS) is a personality trait characterized by heightened sensory processing, resulting in greater emotional responsiveness and detailed perception of the environment. Although the relationship between SPS and traits such as introversion and burnout has been explored, the influence of age on this trait remains poorly understood. Preliminary research indicates that SPS may intensify with age, especially after the age of 40, due to neurobiological changes, such as alterations in inhibitory function and neurotransmitter levels. These changes can lead to manifestations such as hyperesthesia and misophonia. Furthermore, although the direct relationship between SPS and high intellectual ability (IQ) has not been widely investigated, there are indications of a possible overlap between the two traits. Individuals with high IQs often report intense sensory experiences and heightened emotional reactions, characteristics that resemble those observed in people with SPS. The theory of hyperexcitability, proposed by Kazimierz Dabrowski, suggests that individuals with high cognitive ability show heightened reactions in various domains, including the sensory domain. This hyperexcitability, although beneficial for personality development, can be associated with symptoms of anxiety and depression. It is therefore important to consider that sensitivity in gifted people manifests itself differently in each individual, varying in intensity and in the domains most affected.

REVIEW

NUANCES OF SENSORY PROCESSING SENSITIVITY (SPS)

Sensory processing sensitivity (SPS) is a personality trait distinguished by heightened sensory processing, resulting in greater emotional responsiveness and acute perception of details in the environment.Although previous research has explored the relationship between SPS and traits such as introversion, burnout and physical symptoms, the influence of age on this trait remains poorly understood. Preliminary studies indicate that SPS may intensify with advancing age, particularly after the age of 40. This intensification may be associated with neurobiological changes, such as alterations in inhibitory function and neurotransmitter levels, which could lead to manifestations such as hyperesthesia, synesthesia and misophonia. Although the relationship between SPS and high intellectual ability (IQ) has not been directly investigated in previous studies, such as that by Borges (2018), there are indications of a possible overlap between the two traits. Individuals with high IQ often report intense sensory experiences and heightened emotional reactions, characteristics that are similar to those observed in people with SPS. In addition, the literature on high intellectual ability often mentions sensory hyperexcitability as a common trait, which may be related to SPS.

The theory of hyperexcitability, proposed by Kazimierz Dabrowski in the 1960s, suggests that individuals with high cognitive ability (CA) show intensified reactions in five

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domains: psychomotor, sensory, intellectual, imaginative and emotional. Dabrowski postulated that this hyperexcitability, while potentially beneficial for personality development, could also be associated with symptoms of depression, anxiety and tics (Karpinski et al., 2018). However, it is important to note that not all gifted people are Highly Sensitive Individuals (HSP) or have Sensory Processing Sensitivity (SPS). The hyperexcitability described by Dabrowski does not necessarily imply SPS. While some gifted people may demonstrate characteristics of HSP, this is not a universal relationship. Hyperexcitability is more related to heightened responses in the domains mentioned, but does not require the individual to have the extreme sensitivity associated with SPS. Studies indicate that individuals with CA tend to engage in mental rumination more frequently, a process of revisiting and re-evaluating past events, particularly negative ones (Penney et al., 2015). Gifted children show more intense emotional and behavioral reactions (Gere et al., 2009), which can predispose them to symptoms of anxiety and depression, as pointed out by Nolen-Hoeksema (2000). Hyperexcitability has been associated with greater psychological vulnerability and emotional and social fragility in individuals with CA. This vulnerability can manifest itself in a variety of mental disorders, including bipolar disorder, attention deficit hyperactivity disorder (ADHD), autism spectrum disorder (ASD), as well as medical conditions such as allergies, asthma and autoimmune diseases (Karpinski et al., 2018).

A large-scale cross-sectional study of Japanese adults (N = 1,983) investigated the relationship between Sensory Processing Sensitivity (SPS) and age, but did not specify IQ, so it serves as a general analysis. The participants, aged between 20 and 69, completed the Japanese version of the Highly Sensitive Person Scale (HSPS-J19), which assesses three dimensions of SPS: low sensory threshold, ease of arousal and aesthetic sensitivity. The results of the hierarchical multiple regression analysis indicated that low sensory threshold and ease of arousal decrease linearly with age, while aesthetic sensitivity increases linearly. Age-related changes in SPS did not differ between the sexes. Ueno et al. (2019) conclude that the status of age-related changes differs slightly based on sensory processing sensitivity factors

Sensory Processing Sensitivity (SPS) refers to a greater responsiveness to sensory and emotional stimuli, both internal and external. Individuals with SPS can be more sensitive to sounds, lights, textures, emotions and social environments, and can be easily overwhelmed by these stimuli. The relationship between SPS and high intellectual capacity (IQ) is still little explored in the literature, but there are indications that individuals with high intellectual capacity may have greater sensory sensitivity. Rinn et al. (2018) mention that several researchers and scholars in the field of gifted education have noted the tendency for gifted individuals to be more sensitive and easily affected by environmental stimuli than others. This sensitivity can manifest itself as greater emotional intensity, behavioral reactivity and even sensory overexcitabilities.

Dąbrowski (1964) proposed the theory of overexcitabilities, which describes an innate tendency to respond to internal and external stimuli in an intensified way. Sensory overexcitability (S-OE) is one of the five forms of overexcitability and is related to an increased sensitivity to sensory stimuli. Studies suggest that gifted children may develop sensory skills earlier than expected and that physiological and intellectual development may occur asynchronously, which could lead to difficulties in interpreting or processing sensory information. In the study by Rinn et al. (2018) they found a moderate correlation between the Sensory Discomfort subscale of the HSPS and the S-OE subscale of the Overexcitability Questionnaire 2 (OEQ-II). This suggests that, although rela-

ted, these two dimensions of sensory sensitivity may be distinct. The strong correlation between the Orientation Sensitivity subscale of the HSPS and the S-OE subscale of the OEQ-II indicates that they may be assessing the same construct. In summary, the research by Rinn et al. (2018) contributes to the validation of the HSPS in individuals with high intellectual ability and reveals a relationship between SPS and high intellectual ability.

Sensory Processing Sensitivity (SPS) is a personality trait that involves an increased depth of processing and heightened sensitivity to external and internal stimuli. Although often associated with anxiety and depression, recent studies also highlight its link with creativity and feelings of wonder. Lionetti (2020) explores the relationship between SPS, neuroticism and affect in adults, finding a positive correlation with neuroticism and negative affect, but also a connection with openness to new experiences and emotional reactivity to positive stimuli. The author suggests that SPS can act as a risk or protective factor depending on the environmental context. Research in various age groups and cultural groups has developed scales to assess sensitivity in children, adolescents and adults, which is crucial to understanding its influence on psychological well-being and behavior throughout life. Studies indicate a correlation between high IQ and certain personality traits, such as neuroticism and openness. High IQ individuals, especially gifted adolescents, exhibit higher levels of openness to experience (Bartels et al., 2012). Neuroticism has been identified as a significant predictor of eye conditions in adulthood (Chamorro-Premuzic et al., 2006). In addition, a study of older adults found that openness to experience is associated with cognitive engagement, suggesting that promoting behaviors related to openness may increase cognitive engagement in this population (Schretlen et al., 2010).

Schretlen et al. (2010) did not directly investigate personality in people with high IQ, but rather the relationship between openness to experience (a personality trait), intelligence and other cognitive functions. However, their results may be relevant to understanding personality in people with high IQs, since openness to experience is often associated with a high IQ. The study found that openness to experience correlates more strongly with verbal/crystallized intelligence (acquired knowledge and skills) than with fluid/spatial intelligence (ability to solve new problems) or executive functions (skills such as planning and cognitive flexibility). This suggests that people with high IQs, who are often characterized by high openness to experience, may perform particularly well on tasks that require verbal knowledge and skills acquired throughout life

The relationship between Sensory Processing Sensitivity (SPS) and IQ scores presents a substantial complexity that requires detailed and rigorous analysis in order to be fully understood. In an investigation conducted by Yano et al. (2021), it was found that SPS is characterized by deeper sensory processing, which can potentially correlate with higher cognitive functions such as IQ measures, although the study did not directly address the measurement of IQ scores. According to Mary-Krause et al. (2022), SPS was assessed in relation to the use of psychoactive substances, suggesting that individuals with high SPS may exhibit unique cognitive and behavioral responses to environmental stimuli, but without an explicit link to IQ scores.

Onuma (2022) explored brain structural features associated with SPS, identifying correlations between SPS and the microarchitecture of the white matter in regions of the frontal cortex, areas implicated in emotions, motivation and cognition. These findings suggest a possible connection between SPS and cognitive functions, including IQ. In the stu-

dy by De Gucht et al. (2022), a comprehensive tool for measuring SPS was developed, revealing significant associations with traits of neuroticism and openness, which in some cases are related to higher cognitive abilities, although without directly measuring IQ. Acevedo et al. (2023) investigated the relationship between SPS and sensation-seeking, demonstrating that although SPS and sensation-seeking traits are largely separate, SPS can involve different modes of cognitive engagement, hinting at variations in cognitive abilities with no direct link to IQ scores. These studies therefore suggest that SPS may be associated with different aspects of cognitive function and brain structure, although more research is needed to elucidate these relationships precisely.

Posar and Visconti (2018) do not examine the relationship between sensory ability and IQ directly, but rather sensory abnormalities in children with autism spectrum disorder (ASD). The authors note that sensory integration deficits may be related to impaired brain connectivity, which can contribute to the main symptoms of autism, such as impaired social communication. Although the article does not mention IQ explicitly, it suggests that sensory difficulties may be related to communication and social interaction difficulties, which in turn may be associated with lower IQ in some individuals with ASD. However, it is important to note that this is only one possible interpretation of the study's results and that more research is needed to fully understand the relationship between sensory ability and IQ in individuals with ASD. Based on this study, it is possible that people with high IQ who do not have SPS are autistic or neurodivergent, but this will depend on the individual characteristics of each person and their neuropsychological profile.

De Gucht et al. (2023) did not directly investigate the relationship between Sensory Processing Sensitivity (SPS) and IQ. However, the authors did find an association between SPS and verbal/crystallized intelligence, which is one of the components of IQ. Specifically, openness to experience, a personality trait that correlates positively with verbal/crystallized intelligence, is also associated with SPS, especially its positive dimension (aesthetic sensitivity, for example). This suggests that individuals with high verbal/crystallized intelligence and high openness to experience may be more likely to have high SPS. However, more research is needed to directly investigate the relationship between SPS and total IQ.

RELATIONSHIP WITH DWRI INTELLIGENCE

Rodrigues (2022) proposes the concept of DWRI (Development of Wide Regions of Intellectual Interference) as a construct that goes beyond traditional IQ, encompassing the ability to integrate different types of intelligence and modulate the emotional influence on logical thinking. The author highlights the importance of the prefrontal cortex in the development of DWRI, which would include abilities such as creativity, attentional focus and emotional control. Although the article does not directly address Sensory Processing Sensitivity (SPS), the discussion of the integration of different brain areas and the modulation of emotion by the prefrontal cortex suggests that SPS may be a relevant component in DWRI intelligence, since SPS involves the ability to process and respond to sensory stimuli in an adaptive way. However, the article does not explore this relationship in detail, and more research would be needed to investigate how SPS relates to DWRI intelligence.

ADAPTIVE PERFECTIONISM

Stenmark and Redfearn (2021) examine Sensory Processing Sensitivity (SPS) and analytical mindset in ethical decision-making. People with high SPS are more sensitive to stimuli and can reflect more deeply on decisions, which may be indicative of an adaptive perfectionist behavior, where attention to detail and the pursuit of accuracy are important. Mary-Krause et al. (2022) focused on the relationship between SPS and psychoactive substance use, the study suggests that individuals with high SPS have unique responses to environmental stimuli, which may include detail-oriented and meticulous behavior characteristic of adaptive perfectionism. Montoya-Pérez et al. (2019) analyzes the psychometric properties of the Highly Sensitive Person Scale in the Mexican population, highlighting that people with high SPS are more empathetic and sensitive to stimuli, which may correlate with characteristics of adaptive perfectionism. Bas et al. (2021), a qualitative study explores the experiences of adults with high SPS. The interviews revealed that these people tend to have deep emotional responses and process information in a detailed way, which can be seen as a form of adaptive perfectionism. The Mental Health and SPS Study (2023) investigates the associations of SPS with mental and somatic health in different settings, suggesting that SPS may be a differential susceptibility factor. Individuals with high SPS may benefit from positive environments, potentially reflecting an adaptive perfectionist behavior that seeks to optimize outcomes in favorable environments.

SENSITIVITY

Research by McGarrigle and Mattys (2023) examines the relationship between Sensory Processing Sensitivity (SPS) and auditory fatigue in young and elderly adults. The study revealed that SPS is a significant predictor of listening fatigue, but is not associated with perceived effort during listening tasks. In other words, individuals with high SPS tend to experience more fatigue when listening, regardless of whether or not they perceive greater effort during the listening activity. This finding suggests that older adults with high SPS may be particularly susceptible to listening fatigue, possibly due to greater sensitivity to auditory stimuli. The results highlight the importance of SPS as a determining factor for auditory fatigue, regardless of the individual's auditory or cognitive abilities

SPS NEUROSCIENCES

Walter et al. (2023) investigated Sensory Processing Sensitivity (SPS), a psychological trait that reflects perceptual sensitivity and cognitive and emotional responses to environmental stimuli. The study aimed to determine whether the level of SPS correlates with neural complexity and whether there are differences in the electroencephalogram (EEG) between individuals with high and low levels of SPS. A total of 115 individuals participated and had their EEG data collected during a task-free resting state. The results revealed a positive correlation between SPS scores and measures of neural complexity, such as sample entropy and Higuchi fractal dimension. In addition, the highly sensitive group had higher sample entropy compared to the low sensitivity group, particularly in the central, temporal and parietal regions of the brain. These findings suggest that SPS is associated with increased neural complexity, which may reflect deeper information processing in highly sensitive individuals

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Sensory Processing Sensitivity (SPS) may be correlated with spatial intelligence in IQ tests, mainly due to the intrinsic characteristic of individuals with high SPS to be more reactive and attentive to details in the environment, which includes the perception of symmetry and spatial organization. Acevedo et al. (2021) explored the individual differences in resting-state functional connectivity associated with SPS. Individuals with high SPS showed increased connectivity within the ventral and dorsal attention networks and the limbic system, which implies deeper and more detailed processing of environmental stimuli. This capacity for attention to detail may be associated with superior abilities in tasks involving perception and spatial organization. Yano et al. (2021) examined the relationship between SPS and the Big Five personality traits, suggesting that greater sensitivity to stimuli may be correlated with characteristics such as openness to experiences, which includes a greater appreciation for patterns and symmetry, fundamental aspects of spatial intelligence. Stenmark and Redfearn (2021) highlight the ability of individuals with high SPS to process information in an analytical and detailed manner. This ability can translate into superior performance in tests that assess spatial intelligence, where attention to detail and the perception of patterns and symmetries are crucial

Mathew-Richards (2023) highlights how SPS, especially in children, is associated with greater emotional reactivity and a deeper awareness of environmental subtleties, also referred to by some experts as nature intelligence. This ability to process and respond to emotional stimuli can be directly related to emotional intelligence, a form of intelligence that involves the perception, use, understanding and management of emotions. Sutter and Sülzenbrück (2023) investigate how SPS influences organizational behavior and organizational citizenship. The ability of individuals with high SPS to understand and respond to the needs and emotions of others may be related to interpersonal intelligence, which involves the ability to interact effectively with others. Schmitt (2022) examines how SPS can predict proactive behavior at work and the relationship between job complexity and proactivity. Greater sensitivity to stimuli can lead to greater reflection and personal initiative, characteristics of a reflective and proactive intelligence. Acevedo et al. (2023) explore the relationship between SPS and sensation seeking, suggesting that SPS is associated with greater responsiveness to environmental stimuli and creative behavior. Increased sensitivity may allow for a richer and more detailed perception of the environment, promoting creativity

Sensory Processing Sensitivity (SPS) involves various regions and sub-regions of the brain, neurotransmitters and genes. The main brain regions associated with SPS include the orbitofrontal cortex, precuneus, middle temporal gyrus, cingulate and insula. These areas are involved in processing emotions, empathy, self-reflection and sensory integration. Dopamine is a crucial neurotransmitter in SPS, mediating increased sensitivity. Studies have identified that variations in dopamine-related genes, such as TH, DβH, SLC6A3, DRD2, NLN, NTSR1 and NTSR2, are associated with SPS, influencing sensitivity. In addition, these same brain regions and neurotransmitters have been associated with high IQ levels. The orbitofrontal cortex and the cingulate cortex, for example, are involved in advanced cognitive functions such as decision-making and working memory, which are essential for high performance on IQ tests. Dopamine also plays a significant role in executive functions and behavior regulation, both of which are important for intelligence. Therefore, the resting-state activity of these brain regions may mediate the impact of dopamine-related genes on both SPS and cognitive abilities, highlighting the complex interaction between genetics and brain function in determining these traits

According to the Genetic Intelligence Project (GIP), a genetic relationship has been found that reveals that people with Sensory Processing Sensitivity (SPS) have high genetic scores for intelligence, as well as high scores on IQ tests.

DISCUSSION

Sensory Processing Sensitivity (SPS) is a personality trait characterized by increased reactivity to environmental and emotional stimuli. Studies indicate that individuals with high SPS can present cognitive and emotional characteristics that overlap with those found in people with high IQs. In particular, the ability to process information in depth and detail is a factor that can contribute to superior performance in intelligence tests. This greater sensitivity can also be associated with greater creativity and empathy, characteristics often observed in individuals with high intelligence and profound giftedness (Bas et al., 2021). The relationship between SPS and adaptive perfectionism is equally relevant. Individuals with high SPS tend to exhibit deep and reflective sensory processing, which can foster adaptive perfectionist behavior. This type of perfectionism is characterized by a continuous search for excellence and meticulous attention to detail, which can be an advantageous adaptive mechanism in various contexts, including academic and professional ones. Stenmark and Redfearn's (2021) research suggests that high sensitivity to moral and ethical stimuli is associated with more detailed and reflective processing, strengthening the idea that SPS can facilitate effective adaptive perfectionism (Stenmark & Redfearn, 2021). In addition, SPS may be correlated with DWRI (Development of Wide Regions of Intellectual Interference) intelligence, a form of intelligence that integrates divergent and introspective thinking. Studies such as that by Acevedo et al. (2023) highlight that high SPS is associated with greater responsiveness to environmental stimuli, which can promote innate creativity and increased empathy. These capacities are crucial for DWRI intelligence, which values both the ability to generate original ideas and depth of understanding and reflection. Therefore, SPS can be seen as a facilitator of various forms of intelligence, including emotional and interpersonal intelligence, contributing to superior performance in creative and empathetic contexts (Acevedo et al., 2023).

CONSIDERATIONS

Sensory Processing Sensitivity (SPS) involves various regions and sub-regions of the brain, neurotransmitters and genes. The main brain regions associated with SPS include the orbitofrontal cortex, precuneus, middle temporal gyrus, cingulate and insula. These areas are involved in processing emotions, empathy, self-reflection and sensory integration. Dopamine is a crucial neurotransmitter in SPS, mediating increased sensitivity. Studies have identified that variations in dopamine-related genes, such as TH, DβH, SLC6A3, DRD2, NLN, NTSR1 and NTSR2, are associated with SPS, influencing sensitivity.

Based on the GIP project (Genetic Intelligence Project), there is a strong correlation between SPS and high IQ, with SPS being one of the indicators of high intellectual capacity. It is not possible to quantify SPS with the size of IQ, as there is a lack of specific studies on this relationship. However, it is possible to find a connection between SPS and more creative people. Taking into account that IQ does not define creativity, and that there are different types of creativity, with «out of the box" ideas being rarer among high-IQ individuals, there may be a relationship between SPS, high IQ and creativity. These characteristics may be interconnected.

The concept of DWRI intelligence, which involves personality traits such as adaptive perfectionism and well-developed global intelligence, may also be related to SPS. A strong relationship has been observed between SPS and spatial intelligence in IQ tests. The emotional intelligence associated with SPS may be linked to nature intelligence, and the findings identify SPS with interpersonal intelligence and creativity. These results corroborate with global DWRI intelligence, where all intelligences are well developed, but with a determining IQ.

Not all gifted people are Highly Sensitive Individuals (HSP) or have SPS. Hyperexcitability, a common characteristic in gifted people, does not necessarily imply SPS. All gifted people show greater sensitivity in some domains. It is important to note that sensitivity in gifted people manifests itself differently in each individual, varying in intensity and in the domains most affected. In other words, all gifted people are sensitive, but not all are SPS.

It is possible that people with high IQs who do not have SPS are autistic or neurodivergent, but this will depend on the individual characteristics of each person and their neuropsychological profile. This explains why autistic people don't have the same emotional and social intelligence, and why their creativity is based on what they have learned and not innate. In other words, SPS people may not be neurodivergent or, if they are, the relationship is more akin to anxiety and depression disorders. SPS people may also have innate creativity, possibly due to their ability to perceive the world in a more detailed and profound way. Regardless of IQ score, SPS is associated with profound giftedness and greater variability in IQ scores. This indicates that SPS may be associated with high cognitive potential, but also with greater variability in performance on intelligence tests.

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