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# Enhancing medical education: The crucial role of sensory processing – Insights from occupational therapy

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## Abstract:

The processing of sensory information is crucial for academic success, socialization, and emotional well-being. Students who struggle with sensory processing (SP) may have difficulty concentrating, forming relationships with peers, and getting adequate sleep. These challenges are especially prevalent among college students with neurodevelopmental conditions like autism spectrum disorder and attention deficit hyperactivity disorder. To provide a comprehensive analysis of SP findings in medical education, this review examines prior research in the field of occupational therapy. To gather relevant studies, we conducted a literature search using various databases including PubMed, ISI Web of Science, and SCOPUS. Our search utilized keywords such as “sensory processing,” “university students,” and “college students”. We have classified the outcomes into eight distinct subheadings, which we elaborated in detail. “Managing educational settings with senses into account,” “managing relationships with senses into account,” “SP affects medical education in various ways,” “challenges that learners with SP difficulties may face in medical education,” “misconceptions that medical educators have about learners with SP difficulties,” “learning more about SP difficulties in medical learners,” “techniques that can support medical learners with SP difficulties,” and “challenges related to incorporate sensory experiences into medical education” are explained in the result section. Understanding different personality types and their preferences according to the Dunn model of SP can help create a more productive and satisfying university setting for everyone. Therefore, it is essential for universities to recognize the impact of SP difficulties and provide appropriate support and accommodations to help students succeed both academically and socially.

## Keywords:

Education, learning, occupational therapy, sensation, university

## Introduction

Sensory processing (SP) is the process by which our nervous system receives, comprehends, and reacts to sensory information from our surroundings. This information can come from any of our senses, including tactile, taste, smell, visual, auditory, vestibular, proprioception, and interoception. SP is a crucial aspect of our daily lives,<sup>[1]</sup> and it plays an especially important role in the university setting.<sup>[2]</sup>

Therefore, it is the interface between the neurological function of the individual and the environment.<sup>[3]</sup> SP can affect people's quality of life, adaptive strategies, and individual choices.<sup>[2]</sup>

Dunn, an occupational therapist and neuroscientist, has proposed a conceptual model that explains how individuals respond differently to sensory stimuli. The model consists of four main patterns that are created by the interplay between neurological thresholds and self-regulatory strategies. The neurological threshold axis is

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based on the concepts of sensitization and habituation, where a low threshold requires a small amount of sensory information for activation, while a high threshold requires a large amount of stimulation. Self-regulation techniques can range from passive reactions to active responses, where individuals make efforts to manage and modify the quantity and nature of sensory input received. The combination of these two axes results in four distinct SP patterns. Dunn's model provides a framework for understanding how individuals process sensory information and how they can use self-regulation techniques to manage their sensory experiences.<sup>[4]</sup>

The first pattern is referred to as low registration, which is distinguished by a high sensory threshold and a passive approach to responding to environmental stimuli. People with this pattern may encounter challenges in recognizing and expressing their own emotions as well as perceiving the emotions of others. The second pattern is known as sensory seeking, which is characterized by a high sensory threshold and an active approach to responding to environmental stimuli. Individuals with this pattern may seek out intense sensory experiences and engage in risky behaviors. The third pattern is sensory sensitivity, which is identified by a decreased sensory threshold and a passive response strategy to environmental stimuli. Individuals with this pattern may be uncomfortable with sensory experiences and perceive them as intense and disturbing. The fourth pattern is sensory avoidance, which is characterized by a low sensory threshold and an active response strategy to environmental stimuli. Individuals with this pattern may limit their exposure to sensory stimuli and may be socially isolated. Understanding these patterns can help individuals and professionals identify and manage SP difficulties.<sup>[3]</sup>

Dunn's SP model proposes that sensory registration problems can interfere with an individual's ability to give meaning to an activity or situation, leading to a lack of motivation to participate. Individuals in the extreme sensory seeking section of the model have a high stimulation threshold and actively seek out sensory stimulation. They may appear restless, active, and thrill-seeking in their daily lives, and their behavior may be seen as inappropriate or destructive in social situations. Those in the sensory sensitivity section have a low stimulation threshold and are highly aware of sensory stimuli, which can lead to confusion and discomfort. In contrast, individuals in the sensory avoidance section also have a low stimulation threshold but actively try to avoid sensory stimuli that are annoying to them. For example, they may leave a place with many voices to avoid feeling overwhelmed. Recognizing these patterns can aid individuals and experts in identifying and addressing SP challenges and creating effective approaches to assist individuals in their daily routines.<sup>[5,6]</sup>

The increasing significance of SP research is highlighted by the consistent rise in the number of publications related to this topic over the past decade. While there is a significant amount of literature on the impact of SP on childhood development, there has been limited exploration of its effects on college and university students.<sup>[2,7-9]</sup> In the university setting, students are constantly bombarded with sensory input from the noise of the lecture hall to the feel of the chair they are sitting on. For some students, this sensory input can be overwhelming and can interfere with their ability to learn and succeed in their academic pursuits.<sup>[7]</sup> Furthermore, studies have demonstrated that SP challenges are prevalent among college students who have neurodevelopmental conditions (neurodiversity), such as autism spectrum disorder (ASD) and attention deficit hyperactivity disorder (ADHD).<sup>[10]</sup>

Previous studies have emphasized on the importance of SP in cognitive and emotional processing, socio-emotional development, and academic achievement. Some researchers suggest that an impaired SP system can negatively affect an individual's ability to learn and engage with the educational environment.<sup>[2,11,12]</sup> In addition, it can be associated with discomfort or distress, mood disorders, and challenging behaviors.<sup>[13-18]</sup> There is a significant connection between sensory sensitivity and avoidance and anxiety, a positive correlation between poor sensory registration and anxiety and impulsivity, and an association between poor sensory registration and feelings of inferiority, while a sensory sensitivity processing style has been associated with deficits in response inhibition.<sup>[18-22]</sup> Research has shown that individuals with SP difficulties may have difficulty interpreting social cues and may struggle with social interactions.<sup>[23]</sup> University students who experience SP difficulties may feel isolated and may struggle to form meaningful relationships with their peers.<sup>[24]</sup> SP difficulties can also impact sleep patterns in university students. Research has shown that poor sleep quality is associated with SP difficulties.<sup>[25]</sup> University students who have difficulty falling asleep or staying asleep may be experiencing SP difficulties, which can affect their academic performance and overall well-being.<sup>[26]</sup>

Understanding the importance of SP in a university setting is essential for creating an inclusive and supportive learning environment for all students.<sup>[2,7,27,28]</sup> Research reveals that managing educational environments requires a similar approach to managing different settings. Just like in families at home, there will be individuals with different sensory patterns in the university setting, and everyone needs to find ways to accomplish tasks and meet their sensory needs. Without an understanding of sensory patterns, a person may become annoyed by the idiosyncrasies of his/her colleagues; however, with sensory

knowledge, he/she can be pro-active and even amused by his/her own and others' behaviors. In a university setting, seekers enjoy busy university settings and can work on multiple projects simultaneously. Avoiders require a specific routine for work, prefer a contained university setting, and need reminders before face-to-face meetings. Bystander learners are comfortable with things that may bother others, occasionally miss meetings or deadlines, and work better with project partners and updates. Sensory sensitive learners require precise instructions for work, prefer structured work projects with handled details, and need their own work materials.<sup>[1,5,29]</sup>

As many of us spend a considerable amount of time and effort in university as either faculty or students, this environment is also a suitable place to examine sensory behaviors. Sensory patterns are by all accounts, not the only clarification for what occurs; sensory knowledge gives one more supportive instrument to ensuring education is almost as useful and fulfilling as could really be expected. Considering sensory behaviors allows us to explore possibilities for modifying the work environment to be more beneficial for everyone.<sup>[5]</sup>

Given the significance of this matter, we have endeavored to provide a comprehensive analysis of the SP findings in medical education through a review of prior research in the field of occupational therapy.

## Materials and Methods

### Search strategy

In this literature review study, to obtain relevant study, a modified (no comparison intervention) Patient Intervention Comparison Outcome (PICO) method was used by the author for the following research question: "What impact does a Sensory Processing have on Medical Education?" The following databases were searched from January 1, 2000 until August 2023 to capture the most contemporary research information: Web of Science, PubMed, and SCOPUS.

The terms searched were ("sensory processing" OR "sensory integration") AND ("university students" OR "college students"). When possible, a search limit was implemented, limiting articles to peer-reviewed journals in the English language, conducted on college and university students and focused on SP. A further search strategy was used to supplement the database search. A hand search was completed to find articles not identified in the databases but referenced in a journal article. Key authors were noted, and an electronic search of their peer-reviewed and published papers was conducted. In the subsequent section, we have classified the outcomes into eight distinct sub-headings, which we elaborate on in detail.

### Study selection criteria

Inclusion and exclusion criteria were applied for article selection to focus the literature further to answer the research question. Articles excluded if the intervention provided were not via a 'Sensory Processing lens.' Qualitative studies were included to capture the lived experience of the client's perspective. Table 1 shows the study inclusion and exclusion criteria.

### Search outcome

Figure 1 illustrates the steps taken in the search process for this review. Using the search strategy, 97 articles were identified. Following the assessment of article titles and abstracts, 43 articles were selected. Once duplicates were removed, 29 articles remained, of which the full-text articles were all read. The electronic citations of these articles and the reference sections were manually reviewed, producing no further articles. In total, 23 full-text articles were read by the author, and 11 were removed according to the inclusion and exclusion criteria. Eleven articles were consequently included for the review and are summarized in Table 2.

## Results

### Managing educational settings with senses into account

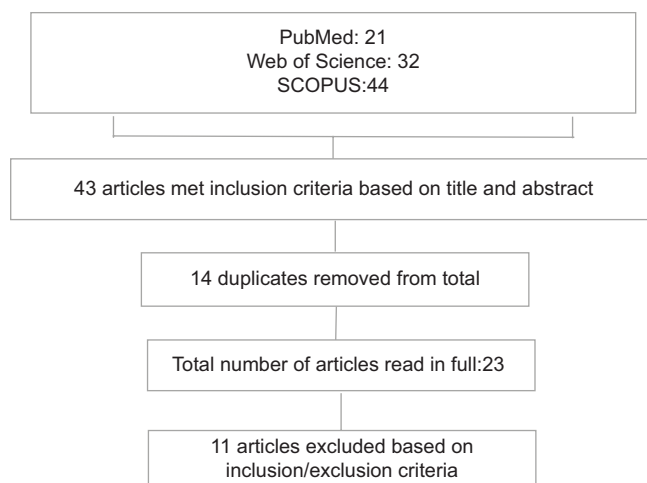
The university setting plays a crucial role in an individual's productivity and satisfaction. Different personality types have different preferences regarding their work environment. Seekers prefer adaptable settings and may enjoy keeping their work activities visible to stay focused. They also tend to work better with other seekers or bystanders. Bystanders, on the other hand, prefer relaxed settings with interruptions to keep them alert and focused. They may not notice changes in the environment as easily as others. Sensory-sensitive learners require some control over their immediate settings and tend to have a logical organization for their materials. Avoiders require isolated settings and may be resistant to changes in their environment. Seekers and bystanders tend to be flexible with their schedules and can handle crises effectively because of their adaptability.

**Table 1: Inclusion and exclusion criteria for study selection**

Inclusion criteria	Exclusion criteria
<ul style="list-style-type: none"> <li>Studies published in English</li> <li>Studies published between 2000 and 2023</li> <li>Studies with participants college and university students</li> <li>Studies investigating use of SP methods</li> <li>Both individual intervention and group intervention were included</li> <li>All quantitative and qualitative papers were included (i.e., no limits on study design)</li> </ul>	<ul style="list-style-type: none"> <li>Studies of SP interventions on populations other than college and university students.</li> </ul>

**Table 2: Summary of studies included in the review**

Author/Year	Study	Findings
Gearhart CC, Bodie GD (2012) <sup>[21]</sup>	Sensory-Processing Sensitivity and Communication Apprehension: Dual Influences on Self-Reported Stress in a College Student Sample	First, as self-report SP sensitivity increased, so did self-reported communication apprehension. Second, as SP sensitivity increased, so did perceived college stress, most noticeably academic stress. Third, SP sensitivity accounted for a greater amount of variance in self-reported stress than communication apprehension.
Khodabakhsh S (2016) <sup>[29]</sup>	The relationship between sensory processing patterns and depression in adults	SP patterns might be related to individuals' depression. Having insight into their sensory patterns can help them to reduce their depressive symptoms.
Yano K and <i>et al.</i> (2019) <sup>[22]</sup>	The effects of sensory-processing sensitivity and sense of coherence on depressive symptoms in university students	The results showed that a strong sense of coherence moderated the relationship between SP sensitivity and depressive symptoms in university students. Results showed that students were moderately stressed. Those who had higher scores in over-responsiveness to auditory, visual, and touch perceived significantly higher stress levels and experienced poor sleep quality. OT educators and practitioners can address SP strategies for reducing perceived stress and improving sleep quality to enhance learning.
Chang M and <i>et al.</i> (2019) <sup>[25]</sup>	The Effects of Sensory Processing Patterns on Perceived Stress and Sleep Quality Among College Students	Low registration and sensory avoidance were positively correlated with interpersonal problems. Study clarifies the relationships between SP styles and interpersonal problems and the mediating effects of attachment styles. Sensory training can be an effective method for EMS providers to increase comfort levels in taking care of patients with sensory difficulties.
Lee ON, Park G-A (2020) <sup>[23]</sup>	The Mediating Effects of Attachment Styles on the Relationship between Sensory Processing Styles and Interpersonal Problems in Healthy University Students	Decision-making skills were negatively correlated with depressive tendencies only in low-SPS students. Emotional coping skills were negatively correlated with depressive tendencies in high-SPS students. These results may help universities incorporate SPS levels when creating life-skills-based interventions for students.
Shah N and <i>et al.</i> (2020) <sup>[39]</sup>	Increasing Comfort with Sensory Processing Difficulties in the Prehospital Setting: Pre-Post Study of Education and Sensory Tools in EMS Providers	The results of this study showed that if the resilience and quality of life of college students are improved through appropriate interventions according to their individual SP profiles, it will be possible to provide a foothold for their high-quality social participation as they transition to adulthood and full integration in society.
Yano K and <i>et al.</i> (2020) <sup>[43]</sup>	Sensory Processing Sensitivity Moderates the Relationships Between Life Skills and Depressive Tendencies in University Students	Four common themes emerged from the lived experiences that further expressed the differences in sensory preferences: (1) Environment, which included both physical and social environments, (2) transition from high school to college (experiences of the transition and adjustment), (3) COVID-19 (the effect the pandemic had on an already difficult transition period), and (4) sensory preferences.
Hyun Hwang J (2021) <sup>[45]</sup>	Correlations between the Sensory Processing Profiles, Resilience, and Quality of Life of College Students	Medical education institutions should recognize the population of people with disabilities as a vital component of their commitment to diversity, equity, and inclusion and strive to provide inclusive education for learners with disabilities.
Nelson K (2022) <sup>[44]</sup>	Impact of Sensory Processing Preferences on First-Year College Students' Success	Medical schools are required to develop technical standards for admission, retention, and graduation of their students to practice medicine safely and effectively with reasonable accommodation
Golden RN, Petty EM (2022) <sup>[37]</sup>	Learners With Disabilities: An Important Component of Diversity, Equity, and Inclusion in Medical Education	
Sonn T and <i>et al.</i> (2023) <sup>[36]</sup>	Encouraging workforce diversity- supporting medical students with mobility and sensory disabilities	

**Figure 1:** Flowchart of search strategy and study selection

deadlines. However, the schedule can become a burden for sensors and avoiders to the point where they struggle to handle interruptions to their planned activities when emergencies arise.

It is important to provide adaptable spaces, allow for interruptions, and give individuals some control over their immediate environment. By doing so, individuals can work more efficiently and effectively, leading to better outcomes for themselves and their teams.<sup>[15,30]</sup>

Tips for bystanders include finding external methods to remember meeting times and deadlines, identifying a colleague in their workgroup to help remind them of important tasks, using an alarm on their computer or phone, keeping work visible (in brightly colored holders) to stay on top of tasks, wearing an iPod to stay stimulated while working, seeking out sensors and avoiders to help with task organization, seeking out seekers to stay



motivated during work, finding alternative routes to get to places at work, and accepting assignments on highly charged work teams to provide a calming influence while staying stimulated.

Tips for avoiders include choosing work and projects that require a high degree of structure and organization, identifying tasks that can be completed independently, volunteering for remote work locations, working from home when possible, using email to reduce interruptions in their university setting, allowing seekers to generate ideas to enhance projects and taking over for implementation, serving on safety and procedure committees, and scheduling specific blocks of time for people to meet with them to avoid constant interruptions.

Special points for sensors include establishing a designated university setting for yourself, even if it is small, and focusing on having control over this area. Put up a sign to indicate when you are available for drop-in or scheduled appointments. Volunteer to final checks or edits of work for your team. Be mindful of how much you schedule each day and leave some flexible time for unexpected events. Offer to take notes at meetings to ensure everything is recorded accurately. Develop some safety valve strategies, such as running errands, getting a drink, or taking a walk, to help you cope when things become overwhelming.

According to the abovementioned issues, it is necessary for professors to be aware of SP patterns and to pay special attention to this issue in the analysis of students' classroom performance. Since there is individual variation in SP patterns, different teaching approaches to teach the same information with the help of different SPs can promote the learning process and improve information storage.<sup>[31]</sup>

### Managing relationships with senses into account

When multiple individuals share a common interest or goal, it is important to have discussions to address everyone's needs, including their sensory needs. It is easy to become frustrated with colleagues who have sensory patterns different from our own in the university setting. Seekers may come across as flashy (which they see as a positive trait), but this behavior can be irritating for sensors who are trying to manage their sensory input. Avoiders, who tend to be more structured, may be seen as stifling the creativity of seekers who prefer to brainstorm and free-associate. Bystanders may appear uninterested in a project to a sensor who has everything planned out meticulously.<sup>[1,5,30]</sup>

### SP affects medical education in various ways

Educators worldwide continue to hold onto the "neuromyth" of learning styles, which suggests that identifying a personal sensory preference for processing

information can enhance academic performance. However, this promise lacks evidence and contradicts our current knowledge of the neuroscience of learning.<sup>[32]</sup> Various types of medical students use different sensory modalities to absorb knowledge and information. The prevalence of electronic tools for teaching is widespread, which can impact learning styles.<sup>[33]</sup> Sensory experiments can be used to stimulate the five senses of undergraduate medical students. This can help students break paradigms and significantly influence their way of thinking.<sup>[34]</sup> Medical education can incorporate virtual reality technology, which includes virtual observation, experiments, anatomy, and operation instruction. Virtual reality technology is distinguished by immersion, interaction, and imagination. It combines computer graphics, simulation, multimedia, artificial intelligence, computer networking, parallel processing, and sensor technologies to simulate visual, auditory, tactile, and other sensory functions.<sup>[35]</sup>

### Challenges that learners with SP difficulties may face in medical education

Medical educators may not be fully aware of the difficulties that learners with SP difficulties encounter in medical education. As more students with these problems enroll in medical schools, educators have a responsibility to ensure that their needs are met.<sup>[36]</sup> Misunderstandings about the capabilities of individuals with SP difficulties can result in a lack of inclusion of these learners in medical education. This exclusion represents a missed opportunity to improve the health of a significant and expanding population. While medical schools are required to establish technical standards for admission, retention, and graduation to ensure safe and effective medical practice with reasonable accommodations, accommodating learners with SP difficulties can involve extra resources and expenses.<sup>[37]</sup>

### Misconceptions that medical educators have about learners with SP difficulties

There are misunderstandings about the capabilities of individuals with sensory difficulties. Including people with sensory difficulties in medical education can significantly enhance the education of all learners and the professional development of faculty and staff. This inclusion provides valuable perspectives on the significant abilities of individuals with diverse sensory disabilities.<sup>[37]</sup> In India, there is a lack of awareness among medical professionals about SP difficulties. This lack of awareness creates challenges in distinguishing between typical behavior and SP difficulties.<sup>[38]</sup>

### Learning more about SP difficulties in medical learners

Healthcare providers, including medical students, may encounter challenges when treating patients

with SP difficulties. Sensory training can be a helpful non-pharmacological approach to address this patient population. A pilot project was conducted to assess whether providing sensory education and tools could increase the comfort level of emergency medical service (EMS) providers. The educational session included a video presentation covering various topics related to SP difficulties and education on sensory tools.<sup>[39]</sup> Additionally, a research study conducted in Japan found that individuals with high sensitivity were more likely to experience various gastrointestinal symptoms, indicating a link between high SP sensitivity and physical health.<sup>[40]</sup>

Undergraduate medical students were invited by teachers of the Communication, Leadership, and Management Skills discipline to engage in sensory stimulation of the five senses. The classroom was equipped with six stations for conducting sensory experiments. Such activities prompt students to challenge their existing paradigms, leading to a significant impact on their way of thinking.<sup>[34]</sup>

### Techniques that can support medical learners with SP difficulties

Sensory accommodation tools, such as noise-canceling headphones and fidget toys, can help learners with SP difficulties manage their sensory sensitivities. To promote the inclusion of students with SP difficulties, medical schools can offer reasonable accommodations. A practical list of accommodation strategies and administrative steps has been developed through a review of the literature and expert opinion to aid educators and students. These strategies include providing note-taking services, extended time for exams, and alternative testing formats. Using electronic tools for teaching can impact learning styles and be advantageous for medical students with SP difficulties. A study conducted in India revealed that first-year medical students preferred auditory and kinesthetic learning styles. Noticing this issue using multi-modal styles with a focus on auditory and kinesthetic modes can enhance learning outcomes.<sup>[33]</sup>

Adopting a structured approach can be helpful when working with learners who are struggling with SP difficulties to enhance faculty success and satisfaction with the remediation process. The Subjective, Objective, Assessment and Plan (SOAP) diagnostic framework can be used to ensure that faculty conduct a comprehensive differential diagnosis and focus their interventions on addressing underlying issues that impact learner success. To illustrate, a workshop was created to teach medical education faculty the necessary skills for assisting learners who are struggling. The workshop spanned three 2-hour sessions, during which participants learned how to evaluate a learner in difficulty, create an initial

remediation plan, and assess their learning system to improve support for learners in difficulty.<sup>[41]</sup>

### Challenges related to incorporate sensory experiences into medical education

Sensory experiments may require additional resources, such as equipment and materials, and may be time-consuming to set up and conduct. For example, an integrated Gestalt Therapy-based perception workshop was created, which included six stations to stimulate the five senses. However, this training is currently part of continuing education, and it is uncertain how practical it would be to integrate such sensory experiments into the standard medical curriculum.<sup>[34]</sup>

Healthcare providers face difficulties in interacting with patients who have SP difficulties, which is even more challenging for EMS personnel in acute care settings. Sensory training can be a useful non-pharmacological approach to manage these patient populations. However, it is unclear how generalizable the results of a pilot project that assessed whether sensory accommodation education and tools increased the comfort level in EMS providers are to other healthcare providers and settings.<sup>[39]</sup>

To integrate sensory experiences into medical education, modifications to the curriculum and teaching methods may be necessary. For instance, medical schools are increasingly providing student-as-teacher electives, and participants in these courses have shown higher levels of education-related knowledge and skills. Both course participants and non-participating peers recognized the importance of teaching skills and suggested opportunities to incorporate medical education training into the medical school curriculum. However, it is uncertain how widely these courses are available and how successful they are in achieving their learning objectives.<sup>[42]</sup>

## Discussion

SP is critical for our daily functioning as it enables us to respond appropriately to sensory stimuli. It is interesting to learn about the different patterns of SP and how they can impact an individual's ability to learn and engage with their environment. Understanding these patterns can be beneficial in creating an inclusive and supportive learning environment for all people.

The body of literature regarding the importance of SP for university students highlights the crucial role it plays in academic success, socialization, and emotional well-being. The literature emphasizes the need to consider SP difficulties in university students, which can manifest in various ways, such as difficulties in attention, concentration, and social interaction.<sup>[43,44]</sup>

Educators can provide accommodations, such as quiet study spaces and reduced distractions, to support students with SP difficulties. Additionally, mindfulness and sensory-based interventions, such as sensory diets and sensory integration therapy, have shown promising results in improving SP abilities and reducing related challenges.<sup>[4]</sup>

There is a need for educators and healthcare professionals to be more aware of the impact of SP difficulties on university students. Second, further research is necessary to determine the prevalence of SP issues among university students and whether there are any gender or demographic differences. Last, more studies are needed to identify the most effective interventions for university students with SP difficulties and to evaluate the long-term effects of such interventions.<sup>[29]</sup>

Overall, this field of research has substantial potential to enhance the educational outcomes and quality of life of university students.<sup>[45]</sup>

## Conclusion

SP difficulties are common in university students, and they can affect academic performance and social interactions. This article explored the various aspects of SP in university students and how they impact their academic and social lives. One of the primary SP difficulties experienced by university students is sensory overload. Sensory overload occurs when an individual is exposed to too much sensory input, which overwhelms their nervous system. University students are often exposed to high levels of sensory input, such as noise, bright lights, and crowded spaces, which can lead to sensory overload. Sensory overload can cause anxiety, stress, and fatigue, which can impact academic performance and social interactions. Another aspect of SP that affects university students is sensory-seeking behavior. Sensory-seeking behavior refers to the need for intense sensory input to feel calm or focused. Research has shown that some university students engage in sensory-seeking behavior, such as fidgeting or tapping their feet, to help them concentrate on class. However, this behavior can distract others and negatively impact social interactions. In conclusion, universities need to recognize the impact of SP difficulties and to provide support and accommodations to help students succeed academically and socially.

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## Author contribution

S Gh, A R and S k contributed to the study's conceptualization, design, and data collection. The first draft of the manuscript was written by S Gh, and all authors reviewed the manuscript.

## Ethical approval

This study was approved by the Research and Ethical Committee of SUMS with registration code: IR.SUMS.REC.1397.531.

## Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used perplexity (academic) in order to upgrade English language. After using this tool/service, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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## Conflicts of interest

There are no conflicts of interest.

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