

# Relationship Between Sensory Profile and Academic Achievement in University Students: A Cross-Sectional Study

## Üniversite Öğrencilerinde Duyu Profili ve Akademik Başarı Arasındaki İlişki: Bir Kesit Çalışması

Muserrefe Nur Keles<sup>1\*</sup> 

<sup>1</sup>Department of Physiotherapy and Rehabilitation, Gazi University Faculty of Health Sciences, Ankara, Türkiye

**Abstract:** This study aimed to examine the relationship between sensory profile and academic achievement in university students. This cross-sectional study was conducted with 252 university students (80 female and 172 male). The Adolescent/Adult Sensory Profile Questionnaire was used to assess the sensory processing characteristics of students. The grade point average used as a measure of academic achievement of students. The Pearson correlation coefficient was used to determine the relationship between sensory profile and grade point average of students. A significant negative correlation was found between the grade point average and low registration ( $r=-0.358$ ), sensory sensitivity ( $r=-0.244$ ), and sensory avoiding ( $r=-0.246$ ) quadrants of the Adolescent/Adult Sensory Profile Questionnaire of university students. Students classified in the 'low registration,' 'sensory sensitivity,' and 'sensation avoidance' quadrants of Dunn's sensory processing model exhibit significantly lower academic performance compared to their peers. Considering the impact of students' academic success in university on their future careers, the importance of identifying sensory processing issues becomes apparent. Further research is needed to explore the long-term effects of sensory processing on academic success and to develop interventions that can help students overcome these challenges.

**Keywords:** Sensation Disorder, Students, Academic Success

**Özet:** Bu çalışma, üniversite öğrencilerinde duyuşal profil ile akademik başarı arasındaki ilişkiyi incelemeyi amaçlamıştır. Bu kesitsel çalışma, 252 üniversite öğrencisi (80 kadın ve 172 erkek) ile gerçekleştirilmiştir. Öğrencilerin duyuşal işlem özelliklerini değerlendirmek için Adolesan/Yetişkin Duyu Profili Anketi kullanılmıştır. Öğrencilerin akademik başarı ölçütü olarak ise not ortalaması kullanılmıştır. Duyuşal profil ile öğrencilerin not ortalaması arasındaki ilişkiyi belirlemek için Pearson korelasyon katsayısı kullanılmıştır. Üniversite öğrencilerinin Adolesan/Yetişkin Duyu Profili Anketi'nde "düşük kayıt" ( $r=-0.358$ ), "duyuşal hassasiyet" ( $r=-0.244$ ) ve "duyuşal kaçınma" ( $r=-0.246$ ) kadrantları ile not ortalaması arasında anlamlı bir negatif korelasyon bulunmuştur. Dunn'ın duyuşal işleme modelinde "düşük kayıt," "duyuşal hassasiyet" ve "duyuşal kaçınma" kadrantlarına sınıflandırılan öğrenciler, akranlarına göre anlamlı ölçüde daha düşük akademik performans sergilemektedir. Üniversitede öğrencilerin akademik başarısının gelecekteki kariyerlerine etkisi göz önüne alındığında, duyuşal işleme sorunlarının belirlenmesinin önemi ortaya çıkmaktadır. Duyuşal işleme akademik başarı üzerindeki uzun vadeli etkilerini keşfetmek ve öğrencilerin bu zorlukları aşmalarına yardımcı olacak müdahaleler geliştirmek için daha fazla araştırmaya ihtiyaç vardır.

**Anahtar Kelimeler:** Duyu Bozuklukları, Öğrenciler, Akademik Başarı

## 1. Introduction

Senses are crucial components of the neurological system that form the foundation of human life and enable individuals to become aware of their bodies and interact with their environment. According to the recent literature, humans possess eight senses (Faure and Richardson, 2012). The most well-known of which are vision,

smell, hearing, taste, and touch. In addition to these five senses, there are three additional senses often referred to as "hidden" senses: the vestibular sense related to movement and gravity, proprioception related to body position, and interoception, which perceives information from internal organs (Faure and Richardson, 2012).

In daily life, people are constantly exposed to all the

\* İletişim Yazarı / Corresponding author.  
✉ muserrefkeles19@gmail.com

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eight senses. Often, multiple senses are simultaneously activated. An individual selects the most relevant sense at that moment and generates an appropriate motor response. Although the process of receiving, transmitting to the relevant brain center, evaluating sensory input, and producing a motor response is quite complex, it occurs within seconds. Dr. Jean Ayres defined this process of receiving, processing, and generating an appropriate motor response as ‘Sensory Integration’ (Ayres, 1979). Each stage of this process is of great importance, because it affects individuals’ learning capacities, behaviors, responses, and personality traits (Ahadi and Bashapoor, 2010; Liss et al., 2008; Engel-Yeger and Dunn, 2011; Lee et al., 2022; Serafini et al., 2017; Ben-Avi et al., 2012; Khodabakhsh et al., 2020; Meredith et al., 2016; Yano et al., 2021, Lee et al., 2017; Salehi Sadati et al., 2022; Bagus, 2012).

Dr. Winnie Dunn, who has conducted significant research on sensory processing, emphasizes that senses provide a map of our bodies and our environment (Dunn, 2007). Dr. Dunn is also a prominent theorist in the field with her ‘Dunn’s Four Quadrant Model of Sensory Processing’ to better understand how individuals respond to sensory input in everyday situations (Dunn, 2007; Brown et al., 2001; Dunn, 2001). This model is built around two core components: neurological thresholds and behavioral responses. It categorizes sensory processing into four distinct quadrants (Dunn, 2007; Brown et al., 2001; Dunn, 2001).

The first quadrant, termed ‘low registration,’ indicates that an individual has a high neurological threshold. This implies that a high level of stimulus is required for an individual to become aware. The second quadrant, known as ‘sensation seeking,’ refers to an individual in search of more sensory input. The third quadrant, ‘sensory sensitivity,’ describes an individual who is more sensitive and alert to sensory stimuli owing to a low neurological threshold. Finally, the fourth quadrant is the ‘sensation avoiding’ strategy, where the individual, due to having a low neurological threshold, exhibits avoidance behavior towards sensory stimuli (Dunn, 2007; Brown et al., 2001; Dunn, 2001).

Academic achievement is a comprehensive concept that indicates the extent to which individuals achieve educational goals. Various studies have revealed the presence of internal and external factors affecting academic success (Najimi et al., 2013; Mishra, 2020). In recent years, sensory processing issues have been added to these factors, drawing researchers’ attention (Salehi Sadati et al., 2022; Bagus, 2012, Jones et al., 2020; Butera et al., 2020; Howe and Stagg, 2016).

Based on Dunn’s model, students with different sensory processing profiles may exhibit various behaviors in the learning environment: a ‘low registration’ student may struggle to focus during class when not exposed to adequate stimulation and may prefer taking notes over following the lesson. A student ‘sensation seeking’ may require continuous stimuli to stay focused in class and might satisfy this need by biting a pen or fidgeting. A student showing ‘sensory sensitivity’ might be disturbed by complex presentations in the classroom and have difficulty concentrating. A ‘sensation avoiding’ student, on the other hand, may be bothered by classroom noises and the presence of other students, and may choose to sit at the front of the class to concentrate better. These behaviors demonstrate how sensory processing affects academic success. Despite its significance, research exploring the connection between sensory processing and academic performance in young adults remains limited (Salehi Sadati et al., 2022; Bagus, 2012). However, university education is a period in which individuals learn the professions they will pursue in the future and graduate as qualified professionals. During this process, it is necessary to thoroughly examine every factor that may affect students’ academic achievement. Therefore, this study aimed to fill a gap in the literature by evaluating the relationship between sensory processing profiles and academic achievement among university students.

## 2. Material and Methods

This cross-sectional study was conducted at Gazi University, Faculty of Health Sciences, Department of Physiotherapy and Rehabilitation. All data were collected between April and July 2024. The inclusion criterion for the study was being enrolled in an undergraduate program in physiotherapy and rehabilitation, while the exclusion criteria did not want to participate in the study and incomplete form submission.

### 2.1. Sampling

The study population consisted of all students (n=461) enrolled in the Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Gazi University. This study aimed to include the entire population without selecting a sample. Students who declined to participate (n=178) and those with incomplete survey forms (n=54) were excluded from the study. Consequently, the final sample comprised 252 students, representing 54.66% of the population. With a power of 0.95 and a margin of error set at 5%, an a priori sample size of n=218 was determined based on existing literature (Salehi Sadati et al., 2022). Therefore, a sufficient sample size was achieved within this scope.

## 2.2. Study Design

Initially, the content of the study was explained face-to-face to all students enrolled in the study. Written consent was then obtained from students who agreed to participate in the study. These students then completed a questionnaire survey using pencil and paper. Additionally, students' Grade Point Averages (GPA) was collected at the end of the semester.

## 2.3. Ethics

Ethical approval (protocol number: 2024/927) was granted by the Gazi University Ethics Committee and institutional permission was secured from the Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Gazi University. Informed consent forms were obtained from all students participating in the study. All study procedures conducted in accordance with the principles set forth in the Declaration of Helsinki. This study also registered at the ClinicalTrials.gov (Registration number: NCT06659432).

## 2.4. Assessments

### Demographic Information Form:

The sociodemographic data (age, gender, academic year) recorded in this form.

### Academic achievement

Academic achievement was represented by the students' grade point average (GPA) on a scale of 0.00 to 4.00 at the end of the 2023-2024 academic year. The GPA data was obtained with permission from the faculty's student affairs office to ensure objectivity.

### Adolescent/Adult Sensory Profile Questionnaire (AASP):

The AASP, a 60-item self-report questionnaire, was used to evaluate participants' sensory processing by assessing their responses to various sensory stimuli, including taste/smell, movement, visual, touch, auditory processing, and activity level (Brown et al., 2001). Evaluation was conducted using a five-point Likert scale. Higher scores reflect a greater manifestation of specific sensory processing traits. The items in each section were combined into four quadrants to characterize experience and behavior. These quadrants are grouped as "low registration," "sensation seeking," "sensory sensitivity," and "sensation avoidance" (Brown et al., 2001). We used the Turkish version of the AASP in present study (Üçgül et al. 2017).

## 3. Statistical Analysis

All statistical analyses were carried out using the SPSS version 22.0 (Statistical Package for the Social Sciences (IBM Corporation, Armonk, NY, USA). Descriptive

data are presented as numbers (n) and percentages (%) for qualitative data, and as mean (M) and standard deviation (SD) for quantitative data. The normality of the data was assessed using the Kolmogorov-Smirnov test, alongside skewness and kurtosis values, and histograms, confirming that the data followed a normal distribution. The relationship between sensory profile and grade point averages was assessed using the Pearson correlation coefficient, with the following interpretations: 0.90-1.00 indicating a very strong correlation, 0.70-0.89 a strong correlation, 0.40-0.69 a moderate correlation, 0.10-0.39 a weak correlation and 0-0.9 negligible correlation (Schober et al., 2018). A p value of less than 0.05 was deemed statistically significant.

## 4. Results

This study included 80 female and 172 male students with mean age  $21.02 \pm 1.59$  years. The demographic characteristics outlined in ► **Table 1**.

**Table 1.** Demographic Characteristics of Students (n=252)

	n	(%)
Gender		
Female	80	31.74
Male	172	68.25
Age (years)		
18	17	6.74
19	23	9.12
20	46	18.25
21	60	23.80
22	67	26.58
23	25	9.92
24	14	5.55
Academic Year (1-4)		
First	45	17.85
Second	66	26.19
Third	73	28.96
Fourth	68	26.98
Grade Point Average (0-4)		
1.50-1.99	11	4.36
2.00-2.49	78	30.95
2.50-2.99	93	36.90
3.00-3.49	68	26.98
3.50-4.00	2	0.79

The results of the sensory processing assessment of the students are presented in ► **Table 2**. The students scored the lowest on the low registration section of the AASP ( $30.86 \pm 5.56$ ) and the highest on the sensation seeking section ( $47.89 \pm 6.66$ ).

**Table 3.** Relationship between Sensory Processing Profile and Grade Point Average (n=252)

Variables	Low registration		Sensation seeking		Sensory sensitivity		Sensation avoiding	
	r	p	r	p	r	p	r	p
Grade Point Average (0-4)	-0.358	<0.001**	-0.912	0.158	-0.244	0.025*	-0.246	0.023*

\*p&lt;0.05, \*\*p&lt;0.001

**Table 2.** Levels of the Sensory Processing Profiles of Students (n=252)

Variables	Categories	Mean±SD	Min-Max
AASP	Low registration	30.86±5.56	17-46
	Sensation seeking	47.89±6.66	31-68
	Sensory sensitivity	40.17±6.53	24-53
	Sensation avoiding	39.46±7.79	26-86

AASP: Adolescent/Adult Sensory Profile Questionnaire

The relationship between the students' grade point averages and sensory processing profiles is outlined in ► **Table 3**. A negative weak significant correlation was found between the GPA level and the AASP low registration quadrant ( $r=-0.358$ ,  $p<0.001$ ), sensory sensitivity quadrant ( $r=-0.244$ ,  $p=0.025^*$ ), and sensory avoiding quadrant ( $r=-0.246$ ,  $p=0.023^*$ ).

## 5. Discussion

The study revealed a significant relationship between low registration, sensory sensitivity, and sensation avoiding quadrants of the sensory profile and academic achievement in university students.

Although there has been an increase in studies examining the relationship between sensory processing, behavioral problems in learning environments, learning difficulties and academic achievement over the past decade, research remains limited (Jones et al., 2020; Butera et al., 2020; Howe and Stagg, 2016). Most existing studies have primarily focused on specific populations (autism spectrum disorder, attention deficit hyperactivity disorder, etc.) with participants generally being children under the age of 18, particularly in preschool and elementary education (Dunn and Bennett, 2002; Ghanizadeh, 2011; van der Linde et al., 2013). These studies suggest that behavioral problems common in children with ADHD and ASD (e.g., distractibility, difficulty concentrating) are often linked to sensory processing challenges (Dunn and Bennett, 2002; Ghanizadeh, 2011; van der Wurff et al., 2021). However, studies examining sensory processing in typically developing children are quite limited (Little et al., 2017, van der Wurff et al., 2021). Little et al. (2017) found that even typically developing children can experience sensory processing difficulties, which may coincide with attention problems. Similarly,

van der Wurff et al. (2021) reported that typically developing children with sensory processing difficulties exhibit distractibility, negatively impacting their performance on arithmetic tests.

As research on sensory processing and its related factors in children has expanded, the interest in sensory processing difficulties in adults has also increased. These studies indicate that similar to children, sensory processing issues in adults can lead to difficulties in daily living activities and behavioral problems. Research has shown that sensory processing difficulties in adults can lead to anxiety, sleep disorders, depression, decreased coping capacities, and attention difficulties (Ahadi and Bashapoor, 2010; Liss et al., 2008; Engel-Yeger and Dunn, 2011; Lee et al., 2022; Serafini et al., 2017; Ben-Avi et al., 2012; Khodabakhsh et al., 2020; Meredith et al., 2016; Yano et al., 2021, Lee et al., 2017; Salehi Sadati et al., 2022; Bagus, 2012). While these studies may not directly link to academic performance, numerous studies indicate that insomnia, anxiety, depression, and attention deficits significantly impact students' academic success (Najimi et al., 2013; Mishra, 2020).

To date, only two studies have specifically explored the relationship between sensory processing and academic achievement in university students (Salehi Sadati et al., 2022; Bagus, 2012). One study examined the direct relationship between students' sensory profiles and their success in a specific course, while the other investigated the connection between sensory profiles, critical thinking skills, and academic achievement.

Bagus (2012) investigated the sensory profiles of first-year students in a university's health sciences faculty using the AASP and assessed their academic performance based on grades from shared courses taken during the fall and spring semesters. This study found no signifi-

cant relationship between any quadrant of Dunn's sensory processing profile and academic achievement. By contrast, our study identified a significant relationship between low registration, sensory sensitivity, and sensation-avoiding quadrants of the sensory profile and academic achievement. Several factors may account for this discrepancy. First, the difference in student demographics could play a role; Bagus (2012) study focused solely on first-year students, a time marked by the challenges of adapting to a new school and life. This transitional period is often accompanied by psychosocial factors such as loneliness, adaptation challenges, and anxiety, which are known to affect academic performance. The inclusion of only first-year students may have influenced the findings. In our study, we included students from all academic years to provide a more comprehensive and objective understanding of the relationship.

Another potential reason for the differing results lies in the method of assessing academic achievement. In Bagus (2012) study, academic success was assessed based on the end-of-semester grades of first-year health sciences students in shared courses. This method focuses on performance in specific courses, which may not fully reflect students' overall academic performance. Particularly, first-year students often face psychosocial and environmental challenges during their transition to university life (e.g., loneliness, anxiety, and adaptation difficulties), which could influence their performance in these courses. In contrast, our study evaluated academic success using the GPA of students from all academic years. GPA provides a more comprehensive measure that reflects the overall academic performance of students across all courses. This methodological difference might explain the variation in findings between the two studies.

The study by Salehi Sadati et al. (2022) examined the relationship between sensory processing profiles and critical thinking skills. It found that sensory sensitivity had a positive correlation with critical thinking ( $r=0.229$ ), while low registration and sensory seeking quadrants showed negative correlations ( $r=-0.223$  and  $r=-0.249$ , respectively). Additionally, critical thinking was strongly and positively correlated with academic success ( $r=0.875$ ). These findings suggest that sensory processing characteristics may indirectly influence academic achievement. Our study, in contrast, directly explored the relationship between sensory processing profiles and academic success, revealing that low registration, sensory sensitivity, and sensory avoidance quadrants had significant impacts on GPA. While Salehi Sadati et al. (2022) findings focused on the cognitive effects of sensory processing profiles, our study highlighted their direct impact on academic performance.

For instance, the low registration quadrant demonstrated consistent results across both studies. Salehi Sadati et al. (2022) linked it to reduced critical thinking skills, whereas our findings indicated that low registration negatively influenced academic success might due to delayed responses to environmental stimuli and inadequate classroom engagement. Sensory sensitivity, however, showed differing effects in the two studies. While Salehi Sadati et al. (2022) emphasized its positive role in enhancing critical thinking, our study suggested that heightened sensory sensitivity might lead to distractions and overstimulation in complex learning environments, thereby adversely affecting academic performance. On the other hand, sensory seeking had a negative impact on critical thinking in Salehi Sadati et al. (2022) study but did not show a significant relationship with academic success in our findings.

These results reflect the methodological differences and variations in focus between the two studies (e.g., cognitive skills vs. academic performance). Nevertheless, both studies underscore the critical role of sensory processing profiles in shaping individual performance. This highlights the need for further research to comprehensively examine the effects of sensory processing characteristics on both cognitive and academic outcomes.

Our findings emphasize the significant impact of sensory processing profiles on academic performance in university students. By situating our results within the context of previous studies, such as those by Salehi Sadati et al. (2022) and Bagus (2012), we demonstrate the multifaceted influence of sensory characteristics on both cognitive and academic outcomes. This reinforces the importance of addressing sensory needs within educational settings to support diverse learning experiences and optimize student success.

## 5.1. Limitations

This study has certain limitations. First, it was limited to students enrolled in the same undergraduate program at a single university, which may affect the extent to which the findings apply to the broader university student population. Additionally, as a cross-sectional study, data were gathered at one specific point in time, which limits the ability to establish causality. To obtain more reliable insights into the relationship between sensory processing and academic achievement, future research should consider conducting longitudinal studies.

## 6. Conclusion

Our findings reveal that students classified in the 'low registration,' 'sensory sensitivity,' and 'sensation avoid-

ance' quadrants of Dunn's sensory processing model demonstrate significantly lower academic performance compared to their peers. This finding is significant because university education is a crucial period for individuals specializing in their chosen professions and undergoing extensive training. Given the importance of academic success in shaping future careers, it is essential to recognize and address the sensory processing challenges faced by some students. By identifying these differences early, educators can implement tailored strategies and accommodations to enhance learning environments and to support academic achievement. This study is one of the pioneering efforts to examine the relationship between sensory processing and academic achievement among university students. Further research is required to investigate the long-term impact of sensory processing on academic achievement and to design interventions that can support students in addressing these challenges effectively.

## Research Ethics

Ethical approval (protocol number: 2024/927) was

granted by the Gazi University Ethics Committee and institutional permission was secured from the Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Gazi University.

## Author Contributions

The author solely conducted all stages of this research.

## Competing Interests

The authors have no conflicts of interest to declare.

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## Data Availability

The raw data can be obtained on request from the author.

## Peer-review

Externally peer-reviewed.

## Orcid

Muserrefe Nur Keles <https://orcid.org/0000-0001-8274-8212>

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