

Musical Sophistication and Anxiety: A Study on University Students

Sofisticação musical e ansiedade: Um estudo com estudantes universitários



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Abstract: This study investigated the relationship between musical sophistication and anxiety levels among university students, recognizing anxiety's prevalence and its adverse effects on student well-being. Using a survey design, data were collected from 229 students at Yıldız Technical University via the Personal Information Form, Beck Anxiety Inventory (BAI), and Goldsmiths Musical Sophistication Index (Gold-MSI TR). Findings revealed a substantial prevalence of anxiety symptoms: 19.7% reported none, 28.4% mild, 29.7% moderate, and 22.3% severe. Anxiety levels were significantly higher in female students ($p < .001$) and undergraduate students compared to graduate students ($p = .018$), with no significant differences by age or academic discipline. In terms of musical sophistication, male students scored significantly higher on the Perceptual Abilities and Musical Training subscales of the Gold-MSI TR. Crucially, preliminary correlation analyses indicated a statistically significant negative relationship between total BAI scores and General Musical Sophistication total scores, as well as its subscales: Musical Training, Singing Abilities, and Perceptual Abilities. These exploratory findings suggest a potential association, rather than a causal link, between anxiety symptoms and musical sophistication, particularly in the domains of Perceptual Abilities, Musical Training, and Singing Abilities.

Keywords: musical sophistication. anxiety. university students. music psychology. Gold-MSI.

Resumo: Este estudo investigou a relação entre sofisticação musical e níveis de ansiedade entre estudantes universitários, reconhecendo a prevalência da ansiedade e seus efeitos adversos sobre o bem-estar dos estudantes. Usando um desenho de pesquisa do tipo levantamento, foram coletados dados de 229 alunos da Universidade Técnica de Yıldız por meio do Formulário de Informações Pessoais, do Inventário de Ansiedade Beck (BAI) e do Índice de Sofisticação Musical Goldsmiths (Gold-MSI TR). Os resultados revelaram uma prevalência substancial de sintomas de ansiedade: 19,7% relataram nenhum, 28,4% leve, 29,7% moderado e 22,3% grave. Os níveis de ansiedade foram significativamente mais altos em estudantes do sexo feminino ($p < 0,001$) e em estudantes de graduação em comparação com estudantes de pós-graduação ($p = 0,018$), sem diferenças significativas por idade ou disciplina acadêmica. Em termos de sofisticação musical, os alunos do sexo masculino obtiveram uma pontuação significativamente maior nas subescalas Habilidades Perceptivas e Treino Musical do Gold-MSI TR. Crucialmente, as análises de correlação preliminares indicaram uma relação negativa estatisticamente significativa entre as pontuações totais do BAI e as pontuações totais da Sofisticação Musical Geral, bem como suas subescalas: Educação Musical, Habilidade de Canto e Habilidades Perceptivas. Esses achados exploratórios destacam uma correlação negativa entre os sintomas de ansiedade e a sofisticação musical, sem implicar causalidade, particularmente nos domínios da percepção musical, treino musical e habilidade vocal.

Palavras-chave: sofisticação musical. ansiedade. estudantes universitários. Psicologia da Música. Gold-MSI.

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1. Introduction

In psychology, anxiety is often defined as a condition involving both cognitive symptoms, such as distraction and difficulty making decisions, and physiological symptoms, including sweating and palpitations (APA, 2022; Barlow, 2002). Barlow (2002) defined anxiety as a mood state that includes both cognitive and physiological components, highlighting its multidimensional nature. It is particularly common among university students, who face challenges like academic pressures, social expectations, and uncertainty about the future (Bayram & Bilgel, 2008; Dyrbye et al., 2006). Research has shown that anxiety can significantly affect academic performance, social relationships, and overall well-being. These impacts are often mediated by anxiety's effects on cognitive functions such as attention and decision-making, and can also involve difficulties with memory (Eysenck et al., 2007; Stein & Stein, 2008).

Given its widespread impact, it is important to explore factors that may help reduce or manage anxiety. Music is often cited as a powerful tool for emotional regulation, with a long history of use in both personal and social contexts. Currently, music is also utilized as a complementary treatment for conditions such as cancer, posttraumatic stress disorder, and depression (Bradt et al., 2016; Landis-Shack et al., 2017). Studies have shown that music can support emotional regulation (Koelsch, 2014; Saarikallio, 2010), reduce stress (Linnemann et al., 2015), promote relaxation (Labbé et al., 2007), and improve psychological well-being (de Witte et al., 2020; Erkkilä et al., 2011). However, the effect of music varies for everyone. The extent to which a person engages with music may influence its effectiveness in managing anxiety.

In this context, the concept of musical sophistication becomes particularly relevant. The idea that musical ability is not a single, innate trait, but a multifaceted construct, has been highlighted by several researchers. Hallam and Prince (2003), for instance, demonstrated that musical ability is conceptualized in a complex

manner, encompassing not only performance but also aural skills, receptive responses (such as listening and understanding), and personal qualities like motivation and commitment. Building on this broader understanding, early efforts to operationalize musical sophistication include the work of Ollen (2006), who developed an index based on factors like formal training, performance experience, and self-assessed competence. Subsequently, Müllensiefen et al. (2014) proposed the Goldsmiths Musical Sophistication Index (Gold-MSI), a comprehensive model designed to assess these varied forms of musical engagement in the general population. Their model distinguishes between formal and informal aspects of musicality, covering psychological, cognitive, and emotional elements.

The Goldsmiths Musical Sophistication Index (Gold-MSI) identifies five sub-dimensions: active musical engagement, perceptual abilities, musical training, singing ability, and emotional responses to music. This multidimensional structure makes the Gold-MSI particularly suitable for investigating how different facets of musical engagement (e.g., active participation vs. emotional response) may relate to anxiety in distinct ways. These dimensions reflect how deeply and in how many ways individuals connect with music.

Musical sophistication helps us understand whether a person is not just a passive listener but someone who actively interacts with music in meaningful ways. This connection might be linked to mental health outcomes, including anxiety. For instance, being musically engaged or having musical skills has been associated with better emotional regulation (Miranda & Claes, 2009; Saarikallio, 2010). Music education and performance experiences can also support a sense of self-efficacy, which in turn may reduce anxiety, as demonstrated in a study conducted with music undergraduates (McPherson & McCormick, 2006). On a cognitive level, focusing on music may serve as a distraction from anxious thoughts or help build stronger cognitive control (Eysenck et al., 2007).

While there is growing interest in this area, the number of studies directly linking musical sophistication to anxiety is still limited. Some research suggests that musical sophistication is associated with improved emotional regulation and overall well-being (Cara et al., 2022). For example, Ulor et al. (2022) found that emotional responses to music and musical imagery before sleep were linked to anxiety. Rakei et al. (2022) showed that experiencing flow while making music was associated with lower anxiety in musicians. Other studies found that listening to classical music can reduce anxiety in students (Erginsoy Osmanoglu & Yilmaz, 2019). Yet, few studies have explicitly focused on the different dimensions of musical sophistication and their relationship with anxiety.

This study aims to investigate the relationship between musical sophistication and anxiety levels in university students, particularly by examining each sub-dimension separately. The main research question is: "Is there a significant relationship between the sub-dimensions of musical sophistication and anxiety levels in university students?"

Given the multidimensional nature of both anxiety and musical engagement, a facet-level analysis may provide a more nuanced understanding of their relationship.

By focusing on this question, the study aims to provide insights into the relationship between individual musical experiences and mental health. The findings may also support the development of music-based strategies for managing anxiety and improving well-being.

2. Method

This study employed a quantitative, correlational survey design to investigate the relationship between the sub-dimensions of musical sophistication and anxiety levels in university students. This research design is particularly suitable for quantitatively describing the tendencies and characteristics of a population by studying a sample, as well as for examining the associations

between variables without experimental manipulation (Creswell & Creswell, 2023; Creswell & Guetterman, 2019). However, the use of a university student sample may limit the generalizability of the findings to broader populations.

2.1 Participants

The data were collected using an online survey form created via Google Forms. The form link was distributed to university students through institutional email lists, and the data collection period lasted from April 8 to May 8, 2025. Participation in the study was entirely voluntary, and responses were anonymous.

The study was approved by the Ethics Committee of Yıldız Technical University (Approval No. 2025.02, Date: 19 February 2025). Participants were recruited using a convenience sampling strategy, a method commonly employed in the social sciences when random selection is not feasible (Babbie, 2016; Bryman & Bell, 2019). Although efforts were made to include respondents from various faculties and institutes, no stratified sampling technique was applied. As such, the generalizability of the results may be limited due to the non-random nature of the sampling process. A total of 229 university students participated in the study, and their demographic characteristics are presented in detail in Table 1.

Table 1 - Demographic characteristics of participants (N=229)

Variable	Group	<i>n</i>	%	Variable	Group	<i>n</i>	%
Gender	Female	113	49.3	Education Level	Undergraduate	179	78.2
	Male	116	50.7		Graduate	50	21.8
Age	18-19	42	18.3	Faculty/Institute	Electrical And Electronics	39	17.0
	20-21	64	27.9		Education	11	4.8
	22-23	58	25.3		Graduate School of Science and Engineering	31	13.5
	24+	65	28.4		Arts and Sciences	19	8.3
					Naval Architecture and Marine Engineering	4	1.7
					Chemistry and Metallurgy	30	13.1
					Mechanical Engineering	21	9.2
					Architecture	22	9.6
					Art and Design	9	3.9
					Graduate School of Social Sciences	19	8.3
					Economics and Administrative Sciences	11	4.8
					Civil Engineering	13	5.7

The participants' ages ranged from 18 to 55, with an average age of 23.3 years. A subsequent analysis of the gender distribution revealed that 50.7% of the participants were male ($n = 116$) and 49.3% were female ($n = 113$). Regarding educational attainment, the majority of the participants were undergraduate students (78.2%, $n = 179$), while 21.8% ($n = 50$) were graduate students.

A subsequent analysis of the distribution of participants according to age groups revealed the following percentages: 18.3% ($n = 42$) in the 18-19 age group, 27.9% ($n = 64$) in the 20-21 age group, 25.3% ($n = 58$) in the 22-23 age group, and 28.4% ($n = 65$) in the 24 and over age group.

Among the faculties and institutes participating in the study, the Faculty of Electrical and Electronics demonstrated the highest rate of participation, with 17.0% of the faculty members surveyed ($n = 39$). The subsequent rankings were as follows: Graduate School of Science and Engineering (13.5%; $n = 31$), the Faculty of Chemistry and Metallurgy (13.1%; $n = 30$), the Faculty of Architecture (9.6%; $n = 22$), and the Faculty of Mechanical Engineering (9.2%; $n = 21$). The remaining participants were selected to ensure a balanced representation from various faculties and institutes.

2.2 Instrumentation

During the research, three complementary data collection instruments were employed. The first was the "Personal Information Form," which the researchers developed to ascertain the demographic characteristics of the participants. The second was the "Beck Anxiety Inventory," which Ulusoy et al. (1998) adapted into Turkish to determine the anxiety levels of the participants. The third was the "Goldsmiths Musical Sophistication Index Self-Report Inventory," which Dursun (2024) adapted into Turkish to determine the musical sophistication levels of the participants.

Table 2. Cronbach's alpha reliability coefficients of the scales

Scale	n	Items	Cronbach's α		
			Present Study	tr	en
BAI	21	1-21	.912	.93	.92
F1	9	1, 3, 8, 15, 21, 24, 28, 34, 38	.796	.92	.87
F2	9	5, 6, 11, 12, 13, 18, 22, 23, 26	.851	.90	.87
F3	7	14, 27, 32, 33, 35, 36, 37	.832	.96	.90
F4	7	4, 7, 10, 17, 25, 29, 30	.759	.90	.87
F5	6	2, 9, 16, 19, 20, 31	.742	.82	.79
FG	18	1, 3, 4, 7, 10, 12, 14, 15, 17, 19, 23, 24, 25, 27, 29, 32, 33, 37	.888	.96	.93

Note. BAI = Beck Anxiety Inventory; F1 = Active Engagement; F2 = Perceptual Abilities; F3 = Musical Training; F4 = Singing Abilities; F5 = Emotions; FG = General Musical Sophistication

As illustrated in Table 2, the internal consistency reliability of the Beck Anxiety Inventory (BAI) and the Gold-MSI TR subscales was examined. Cronbach's alpha values were calculated for each scale. The reliability coefficient for the Beck Anxiety Inventory was found to be high ($\alpha = .912$), indicating excellent internal consistency.

For the subscales of the Gold-MSI TR, Cronbach's alpha values ranged between .742 and .888. These values can be viewed in the context of ranges reported in the original English validation study ($\alpha = .79$ to .93) and the Turkish adaptation study ($\alpha = .82$ to .96). Crucially, the coefficients obtained in the present study represent acceptable to high levels of reliability (DeVellis, 2017; Field, 2024).

No formal statistical test was conducted to compare reliability coefficients across studies. Therefore, the observed values in the present sample are considered to reflect a reliable and consistent psychometric profile, supporting the conclusion that the instruments provided sound measurements for this study.

2.2.1. Personal Information Form

The researchers developed this form to collect the demographic characteristics of the participants within the scope of the study. The participants were asked to provide information regarding their demographic characteristics, including their age, gender, level of education (undergraduate or graduate), and field of study.

2.2.2. Goldsmiths Musical Sophistication Index Self-Report Inventory (Gold-MSI)

The Goldsmiths Musical Sophistication Index Self-Report Inventory (Gold-MSI TR), developed by Müllensiefen et al. (2014) and adapted into Turkish by Dursun (2024), was used to determine the participants' musical sophistication levels. The Gold-MSI is a 38-item multidimensional self-report instrument that measures general musical sophistication and various music-related behaviors. The inventory is composed of five distinct subscales: The first factor, F1, is defined as "Active Engagement," and comprises nine items. The second factor, F2, is defined as "Perceptual Abilities," and contains nine items. The third factor, F3, is defined as "Musical Training," and comprises seven items. The fourth factor, F4, is defined as "Singing Abilities," and contains seven items. The fifth factor, F5, is defined as "Emotions," and comprises six items. A total score of "General Musical Sophistication" is also obtained based on the 18 items in the inventory.

The Turkish adaptation of the inventory was conducted by Dursun (2024), and a validity and reliability study was conducted on 118 participants. According to the analyses performed, it was ascertained that the Gold-MSI TR manifests a substantial degree of internal consistency. The Cronbach Alpha coefficients ranged

between 0.751 and 0.942, the Gutmann λ_6 reliability coefficients ranged between 0.759 and 0.961, and the test-retest correlation coefficients ranged between 0.825 and 0.965. A substantial and powerful positive correlation was identified between all subscales of the inventory and overall musical sophistication. Confirmatory factor analysis (CFA) demonstrated that the 5+1 factor structure delineated in the original study (5 subscales + General Musical Sophistication) exhibited an optimal fit (e.g., χ^2/df : 1.10, RMSEA: 0.034, CFI: 0.927). This finding was substantiated in the Turkish form. These findings confirm that the Turkish version of the inventory is a reliable and valid measurement instrument.

2.2.3. Beck Anxiety Inventory

The Beck Anxiety Inventory, developed by Beck, Epstein, Brown, and Steer (1988), was utilized to assess the anxiety levels of the participants. The BAI is a 21-item self-report inventory that measures the severity of anxiety symptoms experienced during the past week. Because it focuses on this recent temporal frame, it is interpreted as a measure of state anxiety, reflecting transient emotional and physiological responses rather than stable personality traits. This interpretation is supported by the Turkish adaptation study by Ulusoy, Şahin, and Erkmen (1998), which found that the BAI correlated more highly with a dedicated state anxiety measure than a trait anxiety measure. The aforementioned adaptation study was conducted on 177 psychiatric patients and demonstrated a high degree of internal consistency (Cronbach's $\alpha = 0.93$).

For each item in the BAI, participants are instructed to rate the degree to which they have experienced the specified symptom during the previous week on a 4-point Likert-type scale. The scale ranges from 0 (none) to 3 (severe), and the total score that can be obtained from the inventory ranges from 0 to 63. The total score is classified as follows: mild anxiety (8-15 points), moderate anxiety (16-25 points), and severe anxiety (26-63 points).

2.3 Data Analysis

The statistical software program Jamovi, Version 2.6 (The Jamovi Project, 2024), was utilized to conduct the statistical analysis of the quantitative data obtained in this study. Jamovi conducts its analyses using the R language and environment, along with packages such as 'psych', which are also cited (R Core Team, 2024; Revelle, 2023). A comprehensive data analysis was conducted, encompassing the calculation of descriptive statistics (e.g., frequency, percentage, mean, standard deviation, median, etc.). To examine the differences and relationships between variables, non-parametric tests (Mann-Whitney U test and Kruskal-Wallis H test) and correlation analysis (Spearman's rho) were employed, considering the data distribution.

3. Results

In this section, the statistical findings related to the study's primary variables are presented. The present study reports findings related to the Beck Anxiety Inventory (BAI) and Goldsmith Musical Sophistication Index Self-Report Inventory (Gold-MSI TR) scores, distributions according to anxiety level, relationships between variables, and analysis results for differences between groups.

Descriptive statistics for the Beck Anxiety Inventory (BAI) and the Goldsmiths Musical Sophistication Index (Gold-MSI TR) are presented in Appendix A. The mean BAI score for the sample ($M = 17.66$) falls within the range indicating mild to moderate anxiety. For the Gold-MSI TR, the highest mean score was observed in the 'Perceptual Abilities' subscale ($M = 46.53$), while the 'Musical Training' subscale had the lowest mean ($M = 17.27$), which may reflect the generalist nature of the university student sample rather than a population of music specialists.

The assumption of normality was assessed by examining skewness and kurtosis values, as well as conducting the Shapiro-Wilk test for each variable (see Appendix A for all values). While the skewness and kurtosis values were essentially within acceptable

limits, suggesting a relatively normal distribution (Hair et al., 2017), the Shapiro–Wilk test, which is often more sensitive to deviations from normality (Razali & Wah, 2011), indicated a statistically significant departure from normality for the majority of the variables. Specifically, the test was significant ($p < .05$) for the BAI score and four of the six musical sophistication scores (Perceptual Abilities, Musical Training, Emotions, and FG).

Given that the assumption of normality was violated for most of the key variables, non-parametric statistical methods (e.g., Spearman’s correlation, Mann-Whitney U test, and Kruskal-Wallis test) were deemed the most appropriate choice for all subsequent hypothesis testing to ensure the robustness of the findings.

Following the complementary analyses of the scale scores, a comparison was made between the Beck Anxiety Inventory results and the scale scores, categorized by gender, age, education level, and the faculties of the students. The results of the analysis are presented in tabular form and accompanied by their respective interpretations.

Table 3. Beck Anxiety Inventory results of university students

Scale	Anxiety Level	<i>n</i>	%
BAI	None	45	19.7
	Mild	65	28.4
	Moderate	68	29.7
	Severe	51	22.3

Note. BAI = Beck Anxiety Inventory

Table 3 presents the distribution of anxiety levels among university students in the sample, based on their total BAI scores. The data show that 19.7% ($n = 45$) reported no anxiety symptoms, while 28.4% ($n = 65$) reported mild symptoms, 29.7% ($n = 68$) moderate symptoms, and 22.3% ($n = 51$) severe symptoms. In total, 80.3% of participants reported experiencing some level of anxiety symptoms. These findings suggest that a substantial proportion of students in this sample experienced elevated anxiety, with

approximately one-third reporting moderate symptoms and more than one-fifth reporting severe symptoms. While these results cannot be used to infer prevalence at the population level, they do highlight the prominence of anxiety symptoms within the study sample.

Table 4. Comparison of university students' Beck Anxiety Inventory scores by gender

Scale	Group	<i>n</i>	Mean	Median	SD	SE	Mann-Whitney U		Effect Size
							Statistic	<i>p</i>	
BAI	Female	113	22.1	21.0	12.7	1.20	3871	<.001	.409
	Male	116	13.4	12.5	9.10	0.845			

Note. BAI = Beck Anxiety Inventory

Table 4 presents the BAI scores of university students by gender, along with the results of the Mann-Whitney U test. The analysis revealed a statistically significant difference in score distributions between female and male students ($U = 3871$, $p < .001$, $r = .409$), indicating a moderate effect size. Descriptively, female students had higher mean (22.1) and median (21.0) anxiety scores than male students (mean = 13.4, median = 12.5). Standard deviations were 12.7 for female and 9.10 for male students. These findings suggest that female students generally report higher levels of anxiety symptoms compared to their male counterparts.

Table 5. Comparison of university students' Beck Anxiety Inventory scores according to education level

Scale	Group	n	Mean	Median	SD	SE	Mann-Whitney U		Effect Size
							Statistic	p	
BAI	Undergraduate	179	18.6	17.0	12.0	.915	3496	.018	-0.219
	Graduate	50	14.4	13.0	10.9	1.55			

Note. BAI = Beck Anxiety Inventory

Table 5 presents the descriptive statistics and Mann-Whitney U test results comparing BAI total scores between undergraduate and graduate students. The test revealed a statistically significant difference in score distributions between the two groups ($U = 3496$, $p = .018$, $r = -.219$). Undergraduate students had higher mean ranks than graduate students, suggesting that anxiety symptoms were generally more pronounced in this group. Although descriptive statistics indicate that undergraduates had a higher mean (18.6) and median (17.0) compared to graduates (mean = 14.4, median = 13.0), it is worth noting that the Mann-Whitney U test assesses differences in distributions rather than directly testing mean or median differences. The standard deviation of the anxiety scores was 12.0 for undergraduate students and 10.9 for graduate students. The effect size of this difference was found to be low ($r = -.219$). These findings suggest a tendency toward higher anxiety symptom scores among undergraduate students in the current sample.

Table 6. Comparison of university students' scores on the Gold-MSI TR inventory by gender

Scale	Group	n	SD	SE	Mann-Whitney U		Effect Size
					Statistic	p	
F1	Male	116	10.48	0.973	5864	0.169	-0.1053
	Female	113	9.24	0.870			
F2	Male	116	10.15	0.943	5188	0.006	-0.2084
	Female	113	9.88	0.930			
F3	Male	116	8.71	0.809	5434	0.025	-0.1710
	Female	113	8.12	0.764			
F4	Male	116	8.39	0.779	6252	0.547	-0.0462
	Female	113	7.90	0.743			
F5	Male	116	6.15	0.571	5842	0.155	-0.1087
	Female	113	6.45	0.607			
FG	Male	116	18.88	1.753	5571	0.050	-0.1501

Note. F1 = Active Engagement; F2 = Perceptual Abilities; F3 = Musical Training; F4 = Singing Abilities; F5 = Emotions; FG = General Musical Sophistication

Table 6 presents the Mann-Whitney U test and descriptive results for the Gold-MSI TR subscales and FG scores across gender groups.

The analysis revealed statistically significant differences in two subscales. Male students scored significantly higher than female students in F2 ($U = 5188$, $p = .006$, $r = -.2084$); descriptively, the male mean was 48.3 (Md = 49.0) compared to the female mean of 44.7 (Md = 44.0). Similarly, males scored significantly higher in F3 ($U = 5434$, $p = .025$, $r = -.1710$), with a mean of 18.5 (Md = 17.0) versus the female mean of 16.0 (Md = 14.0).

For the total FG score, the difference approached statistical significance ($U = 5571$, $p = .050$, $r = -.1501$), with males ($M = 108.8$, $Md = 107.5$) again showing a tendency for higher scores than females ($M = 103.7$, $Md = 103.0$). No statistically significant differences were found for F1, F4, or F5 (all $ps > .15$).

In summary, male students in this sample demonstrated significantly higher levels of perceptual abilities and musical training. The overall musical sophistication score also showed a marginally significant tendency in the same direction, while other dimensions of musical engagement did not differ by gender.

Table 7. The Relationship between musical sophistication and anxiety in university students

	BAI	F1	F2	F3	F4	F5	FG
F1	0.029	—					
F2	-0.218***	0.536***	—				
F3	-0.156*	0.478***	0.537***	—			
F4	-0.162*	0.555***	0.745***	0.560***	—		
F5	-0.014	0.688***	0.602***	0.352***	0.529***	—	
FG	-0.155*	0.743***	0.809***	0.769***	0.868***	0.629***	—

Note. * $p < .05$, ** $p < .01$, *** $p < .001$

Table 7 displays the results of Spearman's rho correlation analysis examining the relationships between musical sophistication dimensions (Gold-MSI TR subscales and FG total score) and anxiety levels (BAI scores) among university students. The findings revealed the following:

- F2, F3, F4, and FG total scores were all negatively and significantly correlated with anxiety (BAI), with weak effect sizes ($r = -0.218$, -0.156 , -0.162 , and -0.155 , respectively). This suggests that higher musical sophistication in these domains is associated with lower levels of general anxiety.

- F1 and F5 subscales did not show significant correlations with anxiety ($r = 0.029$, $p = .663$ and $r = -0.014$, $p = .836$, respectively), indicating no meaningful relationship between these musical dimensions and anxiety levels.

Additional analyses examining BAI scores across age and faculty groups, as well as Gold-MSI TR scores across age, education level, and faculty groups, did not yield statistically significant differences (all $ps > .05$). Detailed descriptive statistics and complete test results for these analyses are presented in Appendices B–F.

Overall, the results suggest that certain facets of musical sophistication—particularly perceptual, educational, and singing-related skills—may be modestly associated with lower anxiety levels. In contrast, active and emotional engagement with music do not appear to influence anxiety in this sample.

4. Discussion

The objective of this study is to examine the relationship between university students' anxiety levels and various dimensions of musical sophistication. The findings provide data on the prevalence of anxiety among this population. In addition, the results indicate that certain demographic variables significantly influenced both anxiety and musical sophistication. The analysis also revealed associations between specific sub-dimensions of musical sophistication and anxiety levels. The following discussion contextualizes these findings within the existing body of literature.

The findings of the study indicated that a considerable proportion of the university students in the sample exhibited anxiety symptoms at various levels. Specifically, 80.3% of the students reported experiencing mild, moderate, or severe anxiety, highlighting the widespread nature of this issue in the university population. This aligns with previous research emphasizing high anxiety prevalence among university students. For example, studies during the pandemic reported heightened anxiety levels (Hernandez-Ruiz, 2022). In Turkey, Bayram and Bilgel (2008) found

that 47.1% of students experienced moderate or higher anxiety levels. Similarly, Eisenberg et al. (2007) reported that 15.6% of undergraduates and 13.0% of graduate students in the United States were diagnosed with depressive or anxiety disorders.

A review of 25 systematic reviews by Tan et al. (2023) revealed that the median global prevalence of anxiety among university students was 32%, ranging from 7.40% to 55%, underscoring both the ubiquity and variation of the issue across different contexts. These findings suggest that anxiety is a pervasive mental health concern that transcends cultural boundaries. In the Turkish context, research has pointed to academic, social, and personal stressors in the university setting as key contributors to students' psychological distress (Demir & Razlık, 2025). In another pandemic-era study, Baş (2024) found that 68.7% of students experienced some level of anxiety (40.7% mild, 18.3% moderate, 9.7% severe), which was negatively associated with developmental factors such as learning and vitality

A subsequent analysis of anxiety levels concerning demographic variables revealed that female students exhibited significantly higher levels of anxiety compared to their male counterparts. This finding is consistent with prior research examining gender-based differences in anxiety among university students. For example, Verger et al. (2009) reported that female first-year university students experienced higher levels of psychological distress. Similarly, Hernandez-Ruiz (2022) found that female students showed increased anxiety symptoms during the COVID-19 pandemic. These results suggest a recurring trend in university populations, where female students appear more vulnerable to anxiety-related challenges.

A notable finding of the study is the observation that anxiety levels among undergraduate students are significantly higher compared to those of graduate students. This result aligns with previous research indicating that early-stage university students experience more pronounced anxiety. For example, Bayram and Bilgel (2008) found that students in their first and second years had

elevated anxiety levels relative to upper-year students. Similarly, Eisenberg et al. (2007) reported higher anxiety prevalence among undergraduate students than among graduate students.

This discrepancy may reflect the unique challenges faced during the undergraduate period, such as the transition to university life, increased academic demands, uncertainty about the future, and intense personal and social development (Brenes, 2006). In contrast, graduate students may have greater academic clarity and emotional coping strategies, which could contribute to lower anxiety levels.

The absence of a statistically significant discrepancy between age groups and faculties in terms of anxiety levels suggests that anxiety remained relatively stable across these demographic categories within the sample. This finding is consistent with Eisenberg et al. (2007), who emphasized the general prevalence of anxiety and its associated factors, rather than highlighting specific differences based on age or faculty.

However, Verger et al. (2009) reported that among female students, those enrolled in medical faculties experienced higher levels of psychological distress, indicating that faculty affiliation may sometimes be linked to anxiety levels.

These findings suggest that the relationship between demographic variables and anxiety can vary depending on the context and sample, sometimes producing inconsistent or contradictory results (Müllensiefen et al., 2014; Santangelo et al., 2024).

A subsequent examination of the distribution of musical sophistication levels according to demographic characteristics revealed that male students scored significantly higher than female students on the Perceptual Abilities and Music subscales of the Gold-MSI TR.

Müllensiefen et al. (2014), the developers of the Gold-MSI, posited that socio-demographic factors, including age and gender, are associated with musical sophistication. Research conducted

on general population samples (Dursun, 2024; Santangelo et al., 2024) has demonstrated that musical sophistication varies by gender, with males scoring higher in specific musical dimensions. However, a Portuguese adaptation of the Gold-MSI found that gender differences were less pronounced, with females scoring higher in some areas (Lima et al., 2020).

The reasons for these gender differences are likely multifactorial and may include sociocultural factors such as access to music-related activities, instrument preferences, and practicing habits. The gender-based disparities observed in this study are broadly consistent with findings from the literature, including a larger Turkish sample (Dursun, 2024).

Conversely, the study found no significant differences in musical sophistication scores across age groups, educational levels, or faculties. While previous research has shown associations between musical sophistication and demographic variables such as age and education (Müllensiefen et al., 2014; Santangelo et al., 2024), the present study's lack of significant findings in this regard may be due to the homogeneity of the university student sample.

This relatively narrow age and education range, combined with a shared academic environment, may reduce the variability needed to detect such differences.

Regarding the primary problem statement of the study, weak but statistically significant negative relationships were found between the Beck Anxiety Inventory total score and the Gold-MSI TR subscales of Perceptual Skills, Musical Training, Singing Abilities, as well as the General Musical Sophistication total score. These findings suggest that as musical sophistication increases, anxiety levels may decrease.

This supports the commonly held view that music may benefit psychological well-being (Linnemann et al., 2015; Thoma et al., 2013). Music performance anxiety (MPA), a common issue among music students, has been addressed in several studies (Kurtaslan et al., 2022; Wang & Yang, 2024; Zarza-Alzugaray et al., 2020).

For example, Cara et al. (2022) found that individuals with lower musical backgrounds were more affected by anxiety, and that musical sophistication was negatively associated with anxiety and anger.

Musical self-efficacy has also emerged as a key factor in this relationship. Higher self-efficacy levels have been shown to correlate with lower MPA and may act as a protective factor. While music education and experience may reduce anxiety by enhancing self-efficacy, other variables such as social support and emotional experience are also influential (Muthuswamy & Ragavendran, 2024; Wang & Yang, 2024; Zarza-Alzugaray et al., 2020).

Taken together, these findings suggest that musical competence, experience, and self-efficacy can serve as critical personal resources—not only for artistic performance, but also for emotional regulation and psychological resilience. Although causality cannot be established due to the correlational nature of the study, the observed associations point to a possible buffering effect of musical sophistication against anxiety.

To better understand these associations, it is helpful to consider the content of the subscales in the Gold-MSI TR Inventory. For example, the Perceptual Abilities subscale includes items that assess an individual's ability to perceive and differentiate musical elements (Items 5, 6, 11, 18, 22, 26). The negative correlation between these abilities and anxiety suggests that individuals with stronger music processing skills may use different cognitive strategies for coping. Musical activity may enhance cognitive control, which in turn supports anxiety regulation (Miendlarzewska & Trost, 2014). Alternatively, engaging in music listening and understanding may reduce anxiety by providing a form of cognitive distraction.

The Musical Training subscale includes items (Items 32, 33, 35, 36, 37) reflecting both formal and informal musical training and practice. Music education may protect against anxiety by promoting discipline, a sense of accomplishment, and increased self-efficacy. Studies show that higher self-efficacy is associated

with lower levels of music performance anxiety (Muthuswamy & Ragavendran, 2024; Wang & Yang, 2024). Moreover, the supportive and structured environment often found in music education settings may further buffer individuals from anxiety.

The Singing Abilities subscale includes items (Items 4, 10, 7, 25, 29, 30) that measure confidence in one's singing skills. Singing has been widely recognized for its benefits, including emotional expression, physiological relaxation (Fancourt et al., 2016), social bonding, and enhanced self-esteem and self-efficacy (Fancourt et al., 2022). These effects may explain the negative relationship observed between singing ability and anxiety.

Together, these subscales contribute to the overall General Musical Sophistication score, reinforcing the idea that perceived musical competence is meaningfully linked to anxiety levels.

The findings indicate that while some aspects of musical sophistication show a negative correlation with anxiety, this is not consistent across all dimensions. In particular, the lack of statistically significant relationships between the Active Engagement and Emotions (F5) subscales and anxiety suggests that not all types of musical engagement are directly linked to anxiety levels.

The Active Engagement subscale includes items (Items 1, 3, 15, 34, 21, 24, 28, 38) that reflect the amount of time and resources devoted to various music-related activities. However, research by Linnemann et al. (2015) shows that the stress-reducing effects of music listening can vary depending on the social setting and the individual's reason for listening. For example, listening to music alone does not always lead to reduced stress. This may help explain why overall levels of active music engagement were not directly associated with anxiety in the current study. It suggests that the benefits of musical activities may depend on context, purpose, and the individual's psychological state.

The Emotions subscale includes items (Items 2, 9, 16, 19, 20, 31) that assess self-perceived emotional responses to music. According to Schäfer et al. (2013), music often serves as a tool for emotional regulation. Yet, in this study, no significant relationship

was found between emotional engagement with music and anxiety. This suggests that the emotional connection people feel with music may not always translate directly to changes in anxiety levels. Alternatively, the effects may operate through more complex mechanisms.

It is possible that emotional responses to music are not merely passive experiences, but are instead actively regulated. This kind of active emotional regulation may have a more direct link to anxiety levels. As Chin and Rickard (2013) argue, the psychological benefits of music are closely tied to the specific emotion regulation strategies that individuals use.

The present study has its limitations. First, due to the study's cross-sectional design, it is not possible to infer a cause-and-effect relationship between musical sophistication and anxiety. Second, the data were collected using self-report scales, which introduces the possibility of response bias. Finally, it is essential to note that although several correlations between musical sophistication and anxiety were statistically significant, their magnitudes were weak. This indicates that the practical significance of these associations is limited and further underscores the exploratory nature of the present study.

5. Conclusion

While confirming the prevalence of anxiety among university students, this study found weak, yet statistically significant, negative relationships between several dimensions of musical sophistication (Perceptual Abilities, Music Training, Singing Ability, and General Musical Sophistication) and anxiety. These exploratory findings suggest a potential association, rather than a causal link, between these musical skills and anxiety. In this context, skill-based engagement with music may be linked to psychological well-being; however, it is crucial to note that the weak correlation coefficients limit the practical significance of this relationship.

The demographic finding that anxiety levels were significantly higher in female students aligns with the extant literature and underscores the need for continued research in this area (Verger et al., 2009; Hernandez-Ruiz, 2022). However, the absence of significant differences in musical sophistication based on age and education level in our sample, which contrasts with some general population findings, highlights the importance of sample characteristics in this line of research.

Future studies should employ longitudinal or experimental designs to elucidate the directionality and underlying mechanisms of the observed associations. To deepen the understanding of this relationship, future research would also benefit from examining potential mediators or moderators, such as musical self-efficacy or specific emotion regulation strategies. Finally, incorporating mixed-methods approaches could provide valuable insights into the subjective experience of using music for anxiety management, complementing the quantitative findings of this exploratory study.

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APPENDICES

A. Complementary statistics regarding scale scores of university students

	Mean	SD	Skewness		Kurtosis		Shapiro-Wilk	
			Skewness	SE	Kurtosis	SE	W	p
BAI	17.66	11.854	0.8638	0.161	0.450	0.320	0.944	<.001
F1	36.09	9.935	-0.0677	0.161	-0.516	0.320	0.991	0.140
F2	46.53	10.156	-0.2314	0.161	-0.778	0.320	0.972	<.001
F3	17.27	8.497	0.7300	0.161	-0.274	0.320	0.925	<.001
F4	31.17	8.139	-0.0342	0.161	-0.639	0.320	0.989	0.082
F5	32.42	6.313	-1.0498	0.161	1.738	0.320	0.938	<.001
FG	106.28	18.359	0.2702	0.161	-0.500	0.320	0.983	0.008

Note. BAI = Beck Anxiety Inventory; F1 = Active Engagement; F2 = Perceptual Abilities; F3 = Musical Training; F4 = Singing Abilities; F5 = Emotions; FG = General Musical Sophistication

B. Comparison of university students' Beck Anxiety Inventory scores by age

Scale	Variable	n	Kruskal-Wallis			Effect Size
			χ^2	df	p	
BAI	Age	229	7.79	3	0.051	0.0341

Note. BAI = Beck Anxiety Inventory

C. Comparison of university students' Beck Anxiety Inventory scores according to faculties

Scale	Variable	<i>n</i>	Kruskal-Wallis			Effect Size
			χ^2	df	<i>p</i>	
BAI	Faculty	229	13.6	11	0.253	0.0599

Note. BAI = Beck Anxiety Inventory

D. Comparison of university students' scores on the Gold-MSI TR inventory by age

Scale	Variable	<i>n</i>	Kruskal-Wallis			Effect Size
			χ^2	df	<i>p</i>	
F1	Age	229	1.188	3	0.756	0.00521
F2			2.594	3	0.459	0.01138
F3			0.178	3	0.981	7.80e-4
F4			0.919	3	0.821	0.00403
F5			3.780	3	0.286	0.01658
FG			0.608	3	0.895	0.00267

Note. F1 = Active Engagement; F2 = Perceptual Abilities; F3 = Musical Training; F4 = Singing Abilities; F5 = Emotions; FG = General Musical Sophistication

E. Comparison of university students' scores on the Gold-MSI TR inventory by level of education

Scale	Group	n	Mean	Median	SD	SE	Mann-Whitney U		Effect Size
							Statistic	p	
F1	Undergraduate	179	36.5	37.0	9.79	0.732	3841	0.126	-0.14179
	Graduate	50	34.6	32.5	10.41	1.47			
F2	Undergraduate	179	46.6	47.0	9.94	0.743	4440	0.934	0.00782
	Graduate	50	46.4	48.5	10.99	1.55			
F3	Undergraduate	179	17.1	15.0	8.48	0.634	4225	0.545	0.05598
	Graduate	50	17.8	17.0	8.61	1.22			
F4	Undergraduate	179	31.2	32.0	7.92	0.592	4370	0.801	-0.02346
	Graduate	50	31.0	29.0	8.96	1.27			
F5	Undergraduate	179	32.6	33.0	5.87	0.439	4382	0.822	-0.02089
	Graduate	50	31.7	33.5	7.71	1.09			
FG	Undergraduate	179	106.4	105.0	17.86	1.335	4314	0.697	-0.03609
	Graduate	50	105.7	104.0	20.23	2.86			

Note. F1 = Active Engagement; F2 = Perceptual Abilities; F3 = Musical Training; F4 = Singing Abilities; F5 = Emotions; FG = General Musical Sophistication

F. Comparison of university students' scores on the Gold-MSI TR inventory according to faculties

Scale	Variable	n	Kruskal-Wallis			Effect Size
			χ^2	df	p	
F1	Faculty	229	6.24	11	0.857	0.0274
F2			12.32	11	0.340	0.0540
F3			7.79	11	0.732	0.0341
F4			10.29	11	0.505	0.0451
F5			7.64	11	0.745	0.0335
FG			8.36	11	0.680	0.0367

Note. F1 = Active Engagement; F2 = Perceptual Abilities; F3 = Musical Training; F4 = Singing Abilities; F5 = Emotions; FG = General Musical Sophistication

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Both authors contributed equally to the design, analysis, and writing of this article (50% – 50%).

Research ethics committee approval

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