psychiatry international

MDPI

Article

Music Listening While Studying and Academic Performance Among College Students with Attention Deficit and Hyperactivity Disorder

Raihan K. Khan, Md Towfiqul Alam *, Madalynn Nofplot, Sojib Bin Zaman and Catherine L. Zeman

Department of Health Sciences, James Madison University, Harrisonburg, VA 22807, USA; khanrk@jmu.edu (R.K.K.); nofplome@dukes.jmu.edu (M.N.); zamansb@jmu.edu (S.B.Z.); zemancl@jmu.edu (C.L.Z.)

* Correspondence: alammt@jmu.edu

Abstract

Evidence on whether music listening supports academic performance, particularly among students with attention deficit and hyperactivity disorder (ADHD), remains mixed. We explored associations between music listening while studying and academic performance (GPA: grade point average) among college students, and to evaluate whether the associations differed by ADHD status. We analyzed cross-sectional survey data from college students and conducted linear regression models with self-reported GPA as the dependent variable. Models were adjusted for sex, academic level, college affiliation, primary study location, weekly study hours, and preferred genre of music. A total of 541 students participated. Most of the students were at undergraduate level (84%), with a mean age of 20.78 years and mean GPA of 3.50. Among students with ADHD, listening to music while studying was associated with higher GPA ($\beta = 0.42$; $p < 0.01$), whereas preferring country music was associated with lower GPA ($\beta = -0.33$; $p < 0.01$). Undergraduate students with ADHD were associated with lower GPA ($\beta = -0.31$; $p = 0.033$). Among students without ADHD, preferring rap was associated with higher GPA ($\beta = 0.30$; $p < 0.001$), and CHBS affiliation ($\beta = -0.15$; $p = 0.034$) and listening to jazz ($\beta = -0.16$, $p = 0.03$) were associated with lower GPA. Associations between music listening and GPA differed by ADHD status and by preferred genre, suggesting the potential value of individualized recommendations rather than one-size-fits-all guidance.

Keywords: ADHD; background music; studying; college students; GPA; academic performance

Check for updates

Academic Editor: Roger C.M. Ho

Received: 1 January 2026
Revised: 11 March 2026
Accepted: 27 March 2026
Published: 2 April 2026

Copyright: © 2026 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license.

1. Introduction

Attention deficit and hyperactivity disorder (ADHD) is a common neurodevelopmental condition where the person is attentive and/or has hyperactivity-impulsivity, and is associated with impairment across academic, occupational, and psychosocial domains [1,2]. Among college students, ADHD symptoms are consistently linked with poorer academic adjustment and lower grade point average (GPA) [3–7]. Prior studies suggest that academic underperformance, i.e., lower GPA, among college students with ADHD is caused by a combination of executive function challenges, ineffective study strategies, and difficulty sustaining attention in distracting learning environments [4,6,7].

Many college students study while listening to music, and studies show that students with ADHD might use music as a self-regulation strategy [8,9]. Theoretically, this behavior

aligns with optimal stimulation theory (OST) and the moderate brain arousal (MBA) model [10,11]. OST proposes that individuals with ADHD may seek additional stimulation to reach an optimal arousal level for task engagement [10]. MBA posits that certain forms of added auditory stimulation (e.g., noise) can facilitate performance for some individuals with attention difficulties compared to people who do not have attention deficit, although effects depend on the type and intensity of stimulation and on individual differences [11,12]. These models predict that external sensory input, such as background music, can act as 'neural noise' that facilitates stochastic resonance, effectively optimizing the signal-to-noise ratio in the brain and improving focus [10,11]. At the same time, music can introduce competing auditory information and may interfere with reading and other cognitively demanding academic activities for some learners [13]. In one study by Laura Dunbar, there was no significant benefit of listening to music while studying among undergraduate students with ADHD [14]. In another study, Johannes Vorster reported that listening to music did not elicit any significant benefit in attention retention among college students [15]. It is important to note that many of these studies did not measure college students' academic performance directly; for example, Johannes Vorster measured oxygen concentration in the prefrontal cortex of participants' brains as a proxy for measuring concentration [15], and Dunbar used a computerized test to measure attention-related performance [14]. Thus, there is a necessity for measuring students' academic performance as GPA to fill in the knowledge gaps. Moreover, while the Optimal Stimulation Theory and Moderate Brain Arousal model are often used to discuss performance on discrete cognitive works, the use in discussing GPA as academic performance gives us an opportunity to bridge the gap between theories and practical application [10,11]. GPA is universally used in many countries as one of the primary indicators of academic success for college students, especially those with ADHD [3,4]. If music is used in the background while studying, it might reduce neural noise and optimize arousal/concentration [8]; on the other hand, if music is a distractor, then it might reduce attention and cognitive resource [16]. Thus, utilizing GPA as an outcome can allow us to evaluate the overall impact of music listening on academic performance.

Findings by other researchers on background music and academic performance are mixed. Meta-analytic and systematic review evidence show that background music can have small beneficial, null, or detrimental effects depending on task demands, music characteristics (e.g., lyrics, familiarity, tempo), and participant characteristics [17,18]. During reading, auditory distraction can impair comprehension, with lyrical or speech-like content often showing stronger disruption than instrumental music [19–21]. Individual differences in attentional control and working memory capacity also appear to moderate susceptibility to music-related distraction [22–27]. Furthermore, self-selected genre preferences may further shape the direction and magnitude of associations with academic outcomes [8,28–30].

Shenandoah Vally, a region in the broader Appalachia, is historically underserved [31,32]. Very few studies have been conducted on the effect of music listening on students with ADHD [33]. This region has several large public universities. The student population comes from both Appalachian and non-Appalachian backgrounds, providing a unique demographic for our study [34].

While the above-mentioned theories (OST, MBA) have been used to explore the effect of music while studying in controlled laboratory settings using discreet tasks, the long-term effect on academic performance (GPA) remains to be explored. Therefore, the purpose of this observational cross-sectional study was to examine associations between music listening while studying, and GPA (as academic performance) among college students, and to evaluate whether associations differed by ADHD status. We hypothesize that listening

to music while studying is positively associated with GPA among students with ADHD. To assess this, we developed two linear regression models (model 1/unadjusted model, model 2/adjusted model for total students, and stratified analysis for music listening and ADHD vs. non-ADHD interaction) using GPA as the dependent variable.

2. Materials and Methods

2.1. Study Design and Participants

We conducted a cross-sectional survey at a large public university. Eligible participants were currently enrolled undergraduate or graduate students aged 18 years or older. Recruitment occurred via university communication channels (e.g., bulk email distribution, in-person flyer distribution, and course announcements). Participation was voluntary and anonymous. The study was approved by the Institutional Review Board (IRB) of the PI's institution (protocol number: IRB-FY25−285).

2.2. Data Collection

The survey was administered online. Participating students provided informed consent prior to participation. No identifying information was collected.

2.3. Measures

The primary outcome was self-reported overall GPA, which was recorded as a continuous variable. Listening to music while studying (yes/no) was the main predictor variable. Other independent variables/covariates included demographic variables such as age, biological sex (male, female), academic level (recoded into undergraduate, graduate), college affiliation, primary study location (on campus, off campus), weekly study hours, taking medicine for ADHD (yes/no), and the music genre the respondent believed helped them retain more information or study more effectively ("pop," "rock," "classical," "rap," "country," "EDM," "jazz," "indie," "folk," "R&B," "alternative," and "Latin"). ADHD diagnosis status (yes/no) was self-reported, which might influence (effect modifier) our main association of listening to music while studying and self-reported overall GPA. Genre responses were dummy coded with classical as the reference category. College affiliation was re-coded into two major categories: CHBS (College of Health and Behavioral Studies), and non-CHBS. The questionnaire asked which genre the participants preferred when listening to music. This is how we were able to use a single preferred genre for data analysis and discussion.

2.4. Statistical Analysis

Descriptive statistics were estimated to examine demographic variables by ADHD status. Continuous variables were expressed as means and standard deviations, percentages with frequency were used for categorical variables. Multicollinearity was assessed to ensure that none of the independent variables were strongly associated with each other. To examine the association between music listening and academic performance, we conducted linear regression in two steps. In step one, or the unadjusted/crude model, we included only the dependent variable (self-reported overall GPA) and the main predictor variable (listening to music while studying). This step one or unadjusted model was set up for all three groups: total students, students with ADHD, and students without ADHD. In step 2, or the adjusted model, we included other covariates (age, sex, academic year, college, primary study location, and type of music genre believed to help when studying) to conduct the regression in stratified sample (students with ADHD and without ADHD) as well as the interaction between listening to music while studying and ADHD status in the total students. Stratification is of public health interest especially if the effect of the primary

exposure differs across groups; this would imply different interventions may be effective for different demographics [35]. IBM SPSS version 30.0 (IBM Corp., Armonk, NY, USA) was used for regression models, setting a p value < 0.05 to determine statistical significance for all analysis.

3. Results

3.1. Sample Characteristics

The survey was completed by 541 students. Table 1 shows the descriptive statistics in the overall sample and by ADHD status. Results show that most students were undergraduate students (freshmen 20.6%, sophomore 22%, junior 24%, senior 27.3%, graduate school 6%) with a mean age of 20.78 years (SD 4.10) and mean GPA of 3.50 (SD 2.99). A total of 81.2% (n = 405) identified as female and 49.4% (n = 246) said they belonged to the College of Health and Behavioral Studies. About a quarter (n = 134) of the participants said they had been diagnosed with ADHD (27.5%) or that they had another illness that was not ADHD that could impair their ability to study (27.3%), the most frequent being depression and/or anxiety. When asked about study habits, 62.5% (n = 314) said they studied on campus. The mean weekly study hours were 9.41 (SD 7.90). Most participants reported that they did listen to music while studying (73.2%), and 56.5% (n = 262) said they believed they studied better while listening to music. When asked what genre they believed helped them study best, 32.9% (n = 113) said classical music, 12.5% (n = 43) said indie, 11.9% (n = 41) said jazz, and the remaining 42.6% (n = 146) reported other genres (Table 1).

Table 1. Descriptive statistics of study variables by ADHD and non-ADHD status (n = 541).

Variable	Total, *n* (%) or Mean ± SD	ADHD, *n* (%) or Mean ± SD	Without ADHD, *n* (%) or Mean ± SD
Age (years), mean ± SD	499; 20.78 ± 4.10	20.67 ± 3.11	20.57 ± 2.89
Overall GPA, mean ± SD	495; 3.50 ± 2.99	3.22 ± 0.54	3.60 ± 3.62
Weekly study hours, mean ± SD	466; 9.41 ± 7.90	9.39 ± 7.26	9.35 ± 7.85
Sex			
Female	405 (81.2)	104 (78.2)	291 (82.9)
Male	92 (18.4)	29 (21.8)	60 (17.1)
Academic year			
Freshman	103 (20.6)	29 (21.8)	70 (19.8)
Sophomore	110 (22.0)	26 (19.5)	80 (22.7)
Junior	120 (24.0)	33 (24.8)	86 (24.4)
Senior	136 (27.3)	39 (29.3)	93 (26.3)
Graduate	30 (6.0)	6 (4.5)	24 (6.8)
College affiliation			
Arts and Letters	72 (14.4)	26 (19.5)	44 (12.5)
Business	54 (10.8)	16 (12)	36 (10.2)
Education	22 (4.4)	2 (1.5)	20 (5.7)
Health and Behavioral Studies (CHBS)	246 (49.4)	50 (37.6)	190 (54)
Integrated Science and Engineering	31 (6.2)	13 (9.8)	17 (4.8)
Science and Mathematics	47 (9.4)	14 (10.5)	32 (9.1)
Visual and Performing Arts	26 (5.2)	12 (9.0)	13 (3.7)
Primary study location			
On campus	314 (62.5)	88 (65.7)	216 (61)
Off campus	188 (37.7)	46 (34.3)	138 (39)

Table 1. *Cont.*

Variable	Total, *n* (%) or Mean ± SD	ADHD, *n* (%) or Mean ± SD	Without ADHD, *n* (%) or Mean ± SD
ADHD diagnosis			
Yes	134 (27.5)	-	-
No	354 (72.5)	-	-
ADHD medication use			
Yes	78 (18.3)	76 (56.7)	2 (0.7)
No	348 (81.7)	58 (43.30	290 (99.3)
Other diagnosed disorder:			
Yes	132 (27.3)	56 (41.8)	76 (21.7)
No	352 (72.7)	78 (58.2)	274 (78.3)
Listening to music while studying			
Yes	341 (73.2)	99 (78)	242 (71.4)
No	125 (26.8)	28 (22)	97 (28.6)
Preferred genre most helpful for studying			
Classical	113 (32.9)	29 (30.2)	84 (34)
Indie	43 (12.5)	10 (10.4)	33 (13.4)
Jazz	41 (12.0)	14 (14.6)	27 (10.9)
Pop	26 (7.6)	5 (5.2)	21 (8.5)
Country	23 (6.7)	1 (1.0)	22 (8.9)
Electronic Dance Music (EDM)	23 (6.7)	7 (7.3)	16 (6.5)
Alternative	19 (5.5)	7 (7.3)	12 (4.9)
R&B	15 (4.4)	6 (6.4)	9 (3.6)
Rock	14 (4.1)	8 (8.3)	6 (2.4)
Rap	12 (3.5)	5 (5.2)	7 (2.8)
Folk	9 (2.6)	3 (3.1)	6 (2.4)
Latin	5 (1.5)	1 (1.0)	4 (1.6)

3.2. Linear Regression Model for GPA and Music Listening (Step 1)

A simple linear regression was estimated in step 1/the unadjusted model between the GPA and music listening (main predictor) for total students, students with ADHD, and students without ADHD (Table 2). The bivariate regression results were not significant for any of the groups, i.e., total students [F (1,461) = <0.01, $p = 0.99$)], students with ADHD [F (1,126) = <0.01, $p = 0.99$)], and those without ADHD [F (1,335) = <0.05, $p = 0.82$)]. This model suggests that without considering other factors/covariates, music listening was not a significant predictor of the students' GPA (academic performance) in all three categories (total students, students with ADHD, students without ADHD). In step 2/the adjusted model, we included other covariates in the regression analysis for each of these groups to further investigate the relationships. The results for the total students and the stratified subgroups are discussed separately to highlight how these additional variables adjusted the primary association between music listening and GPA.

Table 2. Simple linear regression model.

Model	β	T	*p*-Value	95% CI (B)
Combined (all students)	0.001	0.011	0.991	(−0.019, 0.019)
Students with ADHD	−0.001	−0.008	0.994	(−0.037, 0.036)
Students without ADHD	0.013	0.232	0.816	(−0.020, 0.25)

3.3. Multiple Linear Regression Model for GPA Among Students with ADHD (Step 2)

A multiple linear regression model was estimated for students with ADHD after adjusting for covariates. The model was statistically significant (R^2 = 0.366; adjusted R^2 = 0.201; F (19,73) = 2.22; p = 0.008). Listening to music while studying was associated with higher self-reported GPA (β = 0.42; $p < 0.01$). This indicates that among students with ADHD, those who listened to music while studying had significantly higher GPA than those who did not listen to music. Undergraduate status was associated with lower GPA (β = −0.31; p = 0.033). Relative to the reference genre (classical), reporting country (n = 1) was associated with lower GPA (β = −0.33; $p < 0.01$). Other covariates and genres were not statistically significant (Table 3).

Table 3. Multiple linear regression model for GPA among students with ADHD.

Covariates	β	T	*p*-Value	95% CI (B)
Age (years)	−0.079	−0.528	0.599	(−0.009, 0.005)
Sex (male)	−0.014	−0.126	0.900	(−0.044, 0.039)
Academic level (undergraduate)	−0.310	−2.179	0.033 *	(−0.213, −0.009)
College affiliation (CHBS)	−0.132	−1.225	0.224	(−0.052, 0.013)
Primary study location (on campus)	0.149	1.385	0.170	(−0.010, 0.056)
Weekly study hours	0.046	0.456	0.650	(−0.002, 0.003)
Listens to music while studying (yes)	0.416	3.438	<0.01 **	(0.072, 0.270)
Taking medicine for ADHD	−0.035	−0.337	0.737	(−0.035, 0.025)
Genre: Rock (vs. Classical)	0.041	0.384	0.702	(−0.048, 0.070)
Genre: Pop vs. Classical)	0.164	1.390	0.169	(−0.023, 0.129)
Genre: Rap (vs. Classical)	−0.031	−0.302	0.763	(−0.085, 0.063)
Genre: Country (vs. Classical)	−0.335	−3.295	<0.01 **	(−0.379, −0.093)
Genre: EDM (vs. Classical)	−0.063	−0.578	0.565	(−0.078, 0.043)
Genre: Jazz (vs. Classical)	−0.011	−0.101	0.919	(−0.047, 0.043)
Genre: Indie (vs. Classical)	0.001	0.013	0.990	(−0.050, 0.051)
Genre: Folk (vs. Classical)	0.000	0.000	1.000	(−0.083, 0.083)
Genre: R&B (vs. Classical)	−0.032	−0.304	0.762	(−0.071, 0.052)
Genre: Alternative (vs. Classical)	0.171	1.652	0.103	(−0.010, 0.104)
Genre: Latin (vs. Classical)	0.015	0.154	0.878	(−0.126, 0.147)

* $p < 0.05$; ** $p < 0.01$; β = standardized beta; CI = Confidence Interval.

3.4. Multiple Linear Regression Model for GPA Among Students Without ADHD (Step 2)

Another linear regression model was utilized for students without ADHD after adjusting for covariates. The model was statistically significant (R^2 = 0.202; adjusted R^2 = 0.122; F (19,188) = 2.51; $p < 0.001$). Unlike students with ADHD, those without ADHD did not have any significant relationship between music listening while studying and their GPA. Relative to the classical genre, reporting rap (n = 7) (β = 0.30; $p < 0.001$) as the most helpful genre was associated with higher GPA. Undergraduate status (β = −0.19; p = 0.032), CHBS affiliation (β =−0.15; p = 0.034), and listening to jazz (n = 27) (β = −0.16, p = 0.03) were associated with lower GPA (Table 4).

Table 4. Multiple linear regression model for GPA among students without ADHD.

Covariates	β	t	*p*-Value	95% CI (B)
Age (years)	−0.009	−0.094	0.925	(−0.007, 0.007)
Sex (male)	−0.108	−1.541	0.125	(−0.070, 0.009)
Academic level (undergraduate)	−0.189	−2.166	0.032 *	(−0.160, −0.007)
College affiliation (CHBS)	−0.148	−2.138	0.034 *	(−0.064, −0.003)
Primary study location (on campus)	0.100	1.329	0.186	(−0.011, 0.058)
Weekly study hours	−0.019	−0.271	0.787	(−0.002, 0.002)
Listens to music while studying (yes)	0.063	0.903	0.368	(−0.029, 0.079)
Taking medicine for ADHD	0.013	0.195	0.845	(−0.195, 0.238)
Genre: Rock (vs. Classical)	−0.140	−2.080	0.039	(−0.221, 0.006)
Genre: (Pop vs. Classical)	−0.113	−1.606	0.110	(−0.099, 0.010)
Genre: Rap (vs. Classical)	0.300	4.358	<0.001 **	(0.101, 0.268)
Genre: Country (vs. Classical)	0.021	0.291	0.771	(−0.045, 0.061)
Genre: EDM (vs. Classical)	−0.038	−0.531	0.596	(−0.079, 0.046)
Genre: Jazz (vs. Classical)	−0.156	−2.182	0.030 *	(−0.108, 0.005)
Genre: Indie (vs. Classical)	−0.106	−1.385	0.168	(−0.082, 0.014)
Genre: Folk (vs. Classical)	−0.101	−1.503	0.134	(−0.189, 0.026)
Genre: R&B (vs. Classical)	−0.019	−0.286	0.775	(−0.089, 0.066)
Genre: Alternative (vs. Classical)	0.002	0.023	0.982	(−0.085, 0.087)
Genre: Latin (vs. Classical)	−0.019	−0.274	0.784	(−0.125, 0.094)

* $p < 0.05$; ** $p < 0.01$; β = standardized beta; CI = Confidence Interval.

3.5. Multiple Linear Regression (Including Interaction) Model for GPA Among Total Students (Step 2)

To test the moderation effect or effect modification of ADHD status on the association between music listening while studying and GPA (grade point average), an interaction term was added to the full model containing all covariates of the total sample. The interaction between music listening and ADHD status was not statistically significant (β = 0.111; $p = 0.093$) (Table 5). This suggests that while the stratified analysis showed a significant effect of music listening on the students' GPA for the ADHD group (Table 3) vs. no such effect for the non-ADHD group (Table 4), it does not translate into a statistically significant moderation effect in the total student population. Interestingly, in this model, students who reported listening to rap also had a significantly higher self-reported GPA (β = 0.12; $p < 0.01$) than those who reported listening to classical music. GPA was also positively associated with age (β = 0.61; $p < 0.01$). The relationship between music listening and GPA was non-significant.

Table 5. Multiple linear regression model for GPA among total students with interaction term.

Covariates	β	T	*p*-Value	95% CI (B)
Age (years)	0.613	7.223	<0.01 *	(0.446, 0.781)
Sex (male)	−0.027	−1.794	0.074	(−0.057, 0.003)
Academic level (undergraduate)	−0.083	−2.578	0.010 *	(−0.146, −0.020)
College affiliation (CHBS)	−0.028	−2.341	0.020 *	(−0.052, −0.005)
Primary study location (on campus)	0.024	1.887	0.060	(−0.001, 0.050)

Table 5. *Cont.*

Covariates	β	T	*p*-Value	95% CI (B)
Weekly study hours	<0.01	0.123	0.902	(−0.001, 0.002)
Listens to music while studying (yes)	0.014	0.549	0.584	(−0.035, 0.063)
Taking medicine for ADHD	−0.019	−0.932	0.352	(−0.060, 0.021)
Genre: Rock (vs. Classical)	−0.038	−1.185	0.237	(−0.100, 0.025)
Genre: (Pop vs. Classical)	−0.026	−1.104	0.270	(−0.071, 0.020)
Genre: Rap (vs. Classical)	0.116	3.683	<0.01 *	(0.054, 0.177)
Genre: Country (vs. Classical)	0.001	0.026	0.979	(−0.046, 0.047)
Genre: EDM (vs. Classical)	−0.013	−0.540	0.590	(−0.059, 0.034)
Genre: Jazz (vs. Classical)	−0.036	−1.874	0.062	(−0.074, 0.002)
Genre: Indie (vs. Classical)	−0.023	−1.206	0.229	(−0.060, 0.014)
Genre: Folk (vs. Classical)	−0.044	−1.151	0.251	(−0.119, 0.031)
Genre: R&B (vs. Classical)	−0.011	−0.379	0.705	(−0.066, 0.045)
Genre: Alternative (vs. Classical)	0.018	0.645	0.519	(−0.038, 0.075)
Genre: Latin (vs. Classical)	−0.008	−0.174	0.862	(−0.097, 0.082)
Listens to music while studying × Has ADHD	0.111	1.688	0.093	(−0.018, 0.240)

* $p < 0.05$; β = standardized beta; CI = Confidence Interval.

4. Discussion

In this study, among students with ADHD, listening to music while studying was associated with higher GPA, supporting the hypothesis that music listening helps improve the GPA among this group of students. Those who were undergraduates and preferred country music (vs. Classical) had significantly lower GPA. Among students without ADHD, music listening was not significantly associated with GPA. Those who preferred rap (vs. classical) reported significantly higher GPA. On the other hand, undergraduate students who were enrolled in CHBS and listened to jazz had significantly lower GPA. In the interaction model among total students, higher GPA was associated with age and listening to rap, and lower GPA was associated with being an undergraduate and enrolled in CHBS.

Our study results provide partial support for the theoretically derived hypothesis that we proposed at the beginning, that listening to music while studying is positively associated with GPA among students with ADHD. The positive association between studying with music and GPA among students with ADHD is consistent with optimal stimulation perspectives, which suggest that additional stimulation may help some individuals with ADHD regulate arousal and sustain task engagement [10]. Prior studies similarly showed that added auditory stimulation can facilitate cognitive performance for some individuals with attention difficulties, although the direction of effect depends on stimulus type and the individual [11]. At the same time, our results underscore that 'music' is not a uniform exposure: genre preference may proxy differences in lyrical content, tempo, predictability, or emotional valence that can shape attentional capture and cognitive load [17,18,30]. The negative association found for country music in the ADHD group may reflect greater lyric density or personal salience for some listeners, which could compete with verbal working memory resources during reading- and language-heavy study tasks [20,21,35].

Findings in the non-ADHD stratum highlight similar heterogeneity. Although previous studies reported average decrements in academically relevant tasks under background music, especially when lyrics were present, effects varied by task complexity and by individual differences in attention control [18–21,35,36]. For example, a study on auditory dis-

traction during reading suggested that irrelevant sound could impair comprehension [19], and another study showed that working memory capacity could buffer the detrimental impact of music on reading performance [36]. In our study, listening to rap was associated with higher GPA among students without ADHD. This pattern may reflect selection effects (e.g., students with stronger study skills selecting certain genres) or contextual factors, such as listening at lower volumes or using music as a pacing/motivation tool rather than as a focal stimulus [8,17,18].

Our results also show that undergraduate students and those enrolled in CHBS (College of Health and Behavioral Studies) reported significantly lower GPA if listening to music while studying. In all three groups (ADHD, non-ADHD, and total students), being an undergraduate was associated with lower GPA. Undergraduate students are still emerging into adulthood, and have not yet reached the maturity of graduate level students. Some undergraduate participants were freshmen who had just completed high school. During this time, research shows that the prefrontal cortex of the human brain is still undergoing maturation. This developmental trajectory can lead to higher volatility in their GPA compared to more mature graduate students [37,38]. Academically, admission to graduate programs typically requires a higher undergraduate GPA, which effectively filters out many undergraduate students with lower GPAs. Thus, graduate students who participated in the study should be considered as those who have already demonstrated higher levels of resilience and have better study behaviors to achieve higher grades compared to undergraduate students [4,8]. Students in CHBS study human health-related subjects, which require a lot of concentration while studying; thus, listening to music during that time can be detrimental. Further work using objective measures of study context (volume, lyrics, headphones vs. speakers) and attention (e.g., performance tasks) would help disentangle these competing explanations.

Several limitations should be considered. GPA, ADHD status, and music listening were self-reported, which may introduce recall or social desirability bias, misclassification, and reporting bias. The wide distribution of GPA might be due to several factors, such as participants from different colleges within the university, difference in the academic year of the participants, and students reporting a partial GPA as they had not yet completed their degrees. While self-reported GPA is widely used, access to the student's academic transcript is often scrutinized by universities for privacy concerns. Thus, this limitation shows the importance of using other institutional records as a proxy for students' academic performance in future studies. It is difficult to determine if music listening facilitates higher academic performance or if higher-achieving students with ADHD are simply more likely to utilize music as a known coping strategy. Consequently, the standardized beta coefficients reported here should be viewed cautiously to determine effect size due to their smaller size. Furthermore, the sample sizes on several predictor variables were relatively small. We were also unable to establish a causal inference in our study and cannot rule out reverse causality due to the cross-sectional nature, such as students with ADHD who might be more interested in using music to help them study, rather than music as the contributory factor for their improved GPA. Similarly, those who already had lower GPA might avoid listening to music while studying. In addition, despite adjusting for several demographic and academic covariates, we cannot rule out residual confounding. We did not include variables such as study environments (quiet or noisy), socioeconomic factors, difficulty of the courses, and specific music features (e.g., tempo, lyrics, volume). The survey did not capture potentially important music characteristics (e.g., presence of lyrics, tempo, familiarity, volume, length of listening music) or study task characteristics, limiting interpretation of mechanisms. Residual confounding is likely (e.g., socioeconomic factors, course load, mental health, sleep, and time management were not measured). The relatively

small sample sizes within some music genres reduce statistical power and may render some genre-specific findings unstable. Also, we need to be mindful about genre-specific associations since the study was observational, and since many genre types were included in the analysis, some genres had smaller sample sizes. Our study was not adequate to explain the effects of different genres on their GPA. Therefore, future studies need to be designed to elaborately explore the effects of genres on students' GPA and limit the number of genres in the analysis. Despite several limitations, our approach provides evidence that associations between music listening and academic performance may differ by ADHD status and by preferred genre, supporting the need for tailored recommendations and more granular measurement in future research. In the future, to complement survey data, a qualitative part (one-to-one interview or focus group discussion) should be incorporated (thus a mixed method analysis) to gain a better understanding of the student's perception of the benefit of music listening on their academic activities. Also, instead of a cross-sectional design, future studies can implement experimental longitudinal designs (ADHD vs. non-ADHD) to assess the benefit of music listening on academic performance.

Our findings highlight the importance of individualized self-experimentation. Helps et al. suggested that each individual has a unique arousal threshold [12]. Listening to music while studying can be a beneficial factor in reducing noise in one student's brain, but can completely overwhelm another student's cognitive resources, especially if that student has lower working memory capacity [36]. Health care providers, behavioral specialists, and counselors who work with the student population should encourage students with ADHD to adopt a trial and error approach, so they can find whether listening to music helps them achieve a better GPA and also identify which type of music helps them more. By monitoring their own productivity and GPA in two settings (listening to music vs. no music), students can develop their own strategy to benefit their neuro-cognitive needs.

5. Conclusions

Music listening while studying was common among college students and showed different associations with GPA by ADHD status. Listening to music while studying was positively associated with GPA among students with ADHD but not among students without ADHD. ADHD students reported listening to country music as negatively associated with their GPA, and non-ADHD students reported listening to Rap as positively associated, Jazz as negatively associated with their GPA. Undergraduate students in both ADHD and non-ADHD groups reported lower GPA associated with listening to music while studying. Universities and clinicians should avoid one-size-fits-all recommendations about studying with music. Students may benefit from structured self-experimentation (e.g., comparing silence, instrumental, and lyrical conditions for specific tasks) and from access to both quiet and distraction-managed study spaces. Future studies should incorporate objective outcomes, test specific music features (lyrics, tempo, familiarity), and better characterize ADHD heterogeneity in university populations to clarify when, for whom, and under what conditions music supports learning. Future longitudinal and experimental studies that characterize music features and study tasks are needed to clarify when and for whom music supports academic performance. Mixed method analysis for future studies is also recommended.

Author Contributions: Conceptualization, R.K.K. and M.N.; methodology, R.K.K., M.T.A. and M.N.; software, R.K.K.; validation, R.K.K.; formal analysis, R.K.K., M.T.A. and M.N.; investigation, R.K.K. and M.N.; resources, R.K.K. and M.T.A.; data curation, R.K.K.; writing—original draft preparation, R.K.K. and M.N.; writing—review and editing, R.K.K., M.T.A., S.B.Z. and C.L.Z.; supervision, R.K.K.; project administration, R.K.K. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Review Board (IRB) of James Madison University (protocol code IRB-FY25-285 and date of approval: 14 February 2025).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to ethical/privacy issues.

Conflicts of Interest: The authors declare no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

ADHD	Attention Deficit/Hyperactivity Disorder
GPA	Grade point average
OST	Optimal stimulation theory
MBA	Moderate brain arousal
OR	Odds ratio
CI	Confidence interval
SD	Standard deviation
IBM	International Business Machines
SPSS	Statistical Package for the Social Sciences
CHBS	College of Health and Behavioral Studies
EDM	Electronic dance music
R&B	Rhythm and blues
Pop	Popular

References

1. *Attention-Deficit Hyperactivity Disorder: A Handbook for Diagnosis and Treatment*, 4th ed.; The Guilford Press: New York, NY, USA, 2015; 898p, ISBN 978-1-4625-1772-5.
2. CDC About ADHD. Available online: https://www.cdc.gov/adhd/about/index.html (accessed on 8 March 2026).
3. DuPaul, G.J.; Weyandt, L.L.; O'Dell, S.M.; Varejao, M. College Students with ADHD: Current Status and Future Directions. *J. Atten. Disord.* **2009**, *13*, 234–250. [CrossRef]
4. Pagespetit, È.; Pagerols, M.; Barrés, N.; Prat, R.; Martínez, L.; Andreu, M.; Prat, G.; Casas, M.; Bosch, R. ADHD and Academic Performance in College Students: A Systematic Review. *J. Atten. Disord.* **2025**, *29*, 281–297. [CrossRef]
5. Norwalk, K.; Norvilitis, J.M.; MacLean, M.G. ADHD Symptomatology and Its Relationship to Factors Associated with College Adjustment. *J. Atten. Disord.* **2009**, *13*, 251–258. [CrossRef]
6. Advokat, C.; Lane, S.M.; Luo, C. College Students With and Without ADHD: Comparison of Self-Report of Medication Usage, Study Habits, and Academic Achievement. *J. Atten. Disord.* **2011**, *15*, 656–666. [CrossRef] [PubMed]
7. Stewart, C.M.; Master, A.; Mire, S.S.; Hassett, K.S.; Smith, B.H. Perceptions of Academic Performance, Impairment, and Mental Health in University Students With and Without ADHD. *J. Atten. Disord.* **2024**, *28*, 1746–1759. [CrossRef] [PubMed]
8. Lindstrom, W.; Nelson, J.M.; Foels, P. Postsecondary Attention-Deficit/Hyperactivity Disorder and Deliberate Practice: Study Time, Study Quality, and Self-Perceptions. *Psychol. Sch.* **2020**, *57*, 44–61. [CrossRef]
9. Lachance, K.-A.; Pelland-Goulet, P.; Gosselin, N. Listening Habits and Subjective Effects of Background Music in Young Adults with and without ADHD. *Front. Psychol.* **2025**, *15*, 1508181. [CrossRef] [PubMed]
10. Zentall, S. Optimal Stimulation as Theoretical Basis of Hyperactivity. *Am. J. Orthopsychiatry* **1975**, *45*, 549–563. [CrossRef]
11. Söderlund, G.; Sikström, S.; Smart, A. Listen to the Noise: Noise Is Beneficial for Cognitive Performance in ADHD. *J. Child Psychol. Psychiatry* **2007**, *48*, 840–847. [CrossRef]
12. Helps, S.K.; Bamford, S.; Sonuga-Barke, E.J.S.; Söderlund, G.B.W. Different Effects of Adding White Noise on Cognitive Performance of Sub-, Normal and Super-Attentive School Children. *PLoS ONE* **2014**, *9*, e112768. [CrossRef]
13. Abikoff, H.; Courtney, M.E.; Szeibel, P.J.; Koplewicz, H.S. The Effects of Auditory Stimulation on the Arithmetic Performance of Children with ADHD and Nondisabled Children. *J. Learn. Disabil.* **1996**, *29*, 238–246. [CrossRef]
14. Dunbar, L.L. The Effect of Music on Impulsivity in College Undergraduate Students with Attention Deficits. Ph.D. Thesis, The University of Arizona, Tucson, AZ, USA, 2014.

15. Vorster, J.G. The Influence of Music on Concentration in Individuals with ADHD. Ph.D. Thesis, Stellenbosch University, Stellenbosch, South Africa, 2020.
16. Furnham, A.; Strbac, L. Music Is as Distracting as Noise: The Differential Distraction of Background Music and Noise on the Cognitive Test Performance of Introverts and Extraverts. *Ergonomics* **2002**, *45*, 203–217. [CrossRef]
17. Kämpfe, J.; Sedlmeier, P.; Renkewitz, F. The Impact of Background Music on Adult Listeners: A Meta-Analysis. *Psychol. Music.* **2011**, *39*, 424–448. [CrossRef]
18. Cheah, Y.; Wong, H.K.; Spitzer, M.; Coutinho, E. Background Music and Cognitive Task Performance: A Systematic Review of Task, Music, and Population Impact. *Music. Sci.* **2022**, *5*, 20592043221134392. [CrossRef]
19. Vasilev, M.R.; Kirkby, J.A.; Angele, B. Auditory Distraction During Reading: A Bayesian Meta-Analysis of a Continuing Controversy. *Perspect. Psychol. Sci.* **2018**, *13*, 567–597. [CrossRef]
20. Perham, N.; Currie, H. Does Listening to Preferred Music Improve Reading Comprehension Performance? *Appl. Cogn. Psychol.* **2014**, *28*, 279–284. [CrossRef]
21. Souza, A.S.; Barbosa, L.C.L. Should We Turn off the Music? Music with Lyrics Interferes with Cognitive Tasks. *J. Cogn.* **2023**, *6*, 24. [CrossRef]
22. Shelton, R.C.; McNeill, L.H.; Puleo, E.; Wolin, K.Y.; Emmons, K.M.; Bennett, G.G. The Association Between Social Factors and Physical Activity Among Low-Income Adults Living in Public Housing. *Am. J. Public Health* **2011**, *101*, 2102–2110. [CrossRef]
23. Lehmann, J.A.M.; Seufert, T. The Influence of Background Music on Learning in the Light of Different Theoretical Perspectives and the Role of Working Memory Capacity. *Front. Psychol.* **2017**, *8*, 297754. [CrossRef] [PubMed]
24. Thompson, W.F.; Schellenberg, E.G.; Husain, G. Arousal, Mood, and the Mozart Effect. *Psychol. Sci.* **2001**, *12*, 248–251. [CrossRef]
25. Schellenberg, E.G. Music and Cognitive Abilities. *Curr. Dir. Psychol. Sci.* **2005**, *14*, 317–320. [CrossRef]
26. Martin-Moratinos, M.; Bella-Fernández, M.; Blasco-Fontecilla, H. Effects of Music on Attention-Deficit/Hyperactivity Disorder (ADHD) and Potential Application in Serious Video Games: Systematic Review. *J. Med. Internet Res.* **2023**, *25*, e37742. [CrossRef] [PubMed]
27. Mendes, C.G.; de Paula, J.J.; Miranda, D.M. Effects of Background Music on Attentional Networks of Children With and Without Attention Deficit/Hyperactivity Disorder: Case Control Experimental Study. *Interact. J. Med. Res.* **2024**, *13*, e53869. [CrossRef] [PubMed]
28. Pelham, W.E.; Waschbusch, D.A.; Hoza, B.; Gnagy, E.M.; Greiner, A.R.; Sams, S.E.; Vallano, G.; Majumdar, A.; Carter, R.L. Music and Video as Distractors for Boys with ADHD in the Classroom: Comparison with Controls, Individual Differences, and Medication Effects. *J. Abnorm. Child Psychol.* **2011**, *39*, 1085–1098. [CrossRef]
29. Goltz, F.; Sadakata, M. Do You Listen to Music While Studying? A Portrait of How People Use Music to Optimize Their Cognitive Performance. *Acta Psychol.* **2021**, *220*, 103417. [CrossRef]
30. De la Mora Velasco, E.; Hirumi, A. The Effects of Background Music on Learning: A Systematic Review of Literature to Guide Future Research and Practice. *Educ. Technol. Res. Dev.* **2020**, *68*, 2817–2837. [CrossRef]
31. Lobao, L.; Partridge, M.; Hean, O.; Kelly, P.; Chung, S.; Ruppert, B. Socioeconomic Transition in the Appalachia Coal Region. Available online: https://documents.worldbank.org/en/publication/documents-reports/documentdetail/531201635134585522 (accessed on 24 June 2025).
32. Marshall, J.; Thomas, L.; Lane, N.; Holmes, G.; Arcury, T.; Randolph, R.; Silberman, P.; Holding, W.; Villamil, L.; Thomas, S.; et al. *Health Disparities in Appalachia*; Appalachian Regional Commission: Washington, DC, USA, 2017.
33. Coyne, C.A.; Demian-Popescu, C.; Friend, D. Social and Cultural Factors Influencing Health in Southern West Virginia: A Qualitative Study. *Prev. Chronic Dis.* **2006**, *3*, A124.
34. Khan, R.K.; Alam, M.T.; Zaman, S.B.; Jehi, T. College Students' Mental Health During the COVID-19 Pandemic. *Psychiatry Int.* **2025**, *6*, 112. [CrossRef]
35. VanderWeele, T.J. On the Distinction Between Interaction and Effect Modification. *Epidemiology* **2009**, *20*, 863–871. [CrossRef]
36. Christopher, E.A.; Shelton, J.T. Individual Differences in Working Memory Predict the Effect of Music on Student Performance. *J. Appl. Res. Mem. Cogn.* **2017**, *6*, 167–173. [CrossRef]
37. Weyandt, L.L.; Dupaul, G.J. ADHD in College Students: Developmental Findings. *Dev. Disabil. Res. Rev.* **2008**, *14*, 311–319. [CrossRef] [PubMed]
38. Arnett, J.J. *Emerging Adulthood: The Winding Road from the Late Teens Through the Twenties*; Oxford University Press: Oxford, UK, 2014; ISBN 978-0-19-992938-2.

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.