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Association of Music with Stress, Test Anxiety, and Test Grades Among High School Students

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Music is an integral part of many adolescents' lives and has been shown to have anxiety-relieving effects in high-stress settings, such as hospitals. Adolescents also face high levels of stress in academic environments, which have been correlated with poor academic performance, particularly test grades. However, the relationship between stress, academic performance, and music listening among adolescents has not been studied. We hypothesized that students who spent more time listening to music while studying would report lower levels of stress and receive higher test grades. A survey assessing academic stress, test anxiety, and music listening habits was administered in science classes following quarterly testing. Test grades were obtained as objective measures of academic performance. We found that time spent listening to music while studying was positively correlated with test anxiety and academic stress and negatively correlated with test performance. Though girls reported higher levels of stress than boys, they did not have significantly different test grades. Music-listening habits differed between academic levels, with introductory levels reporting more time listening to music, higher levels of stress, and poorer test grades than more advanced levels. When adjusted for these differences, the association of music with test grades was rendered non-significant suggesting that academic rigor and test anxiety mediated the association of music with test grades. Because music was not found to be associated with decreased stress in academic settings, it is possible that it might be distracting in the study environment. The distraction theory, which posits that music helps individuals cope by distracting them from stressful scenarios, has been proposed to explain the pain-relieving nature of music in hospital settings. This may explain the lack of stress-reduction by music in an academic context. These findings may help students create more effective, less stressful study environments.

INTRODUCTION

Given the omnipresence of music, it is relevant to explore its effects on various aspects of adolescents' lives. Personalization of music listening through MP3 players and online radio stations allows adolescents to listen to music throughout the day (Vogel et al., 2009). Listening to music has also been associated with neurological stimulation and alleviation of anxiety (Fukui & Toyoshima, 2008; Koyama et al., 2009; Wachi et al., 2007). In stressful environments such as operating rooms, emergency rooms, and waiting areas in hospitals, music reduces anxiety associated with pain, both in adults and children (Austin, 2010; Holm & Fitzmaurice, 2008; Klassen et al., 2008; Nilsson, 2008). However, the relationship between music and reduction in other forms of stress, especially academic stress among adolescents, remains unclear.

Academic stress, related to test performance, student-teacher relationships and peer relationships (Abouserie, 1994; Kouzma & Kennedy, 2004), plays an important role in students' ability to learn and thereby influences school performance and participation. Therefore, it is relevant to investigate patterns of stress in an adolescent population. It is important to note that the academic setting includes not only the physical location of classes and testing but the study environment as well. Test anxiety, a form of academic stress that is characterized by a feeling of nervousness before or during an exam (Sarason & Gordon, 1953), is a particularly salient form of stress among high school students. Test anxiety is advantageous in low levels as it can increase the student's focus on the test, recollection of key facts, and usage of problem solving skills (Cassady & Johnson, 2002). However, high levels of test anxiety are associated with poorer recall and decreased ability to focus during exams (Dutke & Stöber, 2001; Eysenck et al., 2007). Highly test-anxious students have been shown to have lower grade-point averages regardless of material knowledge or time spent studying (Chapell et al., 2005; Culler & Holahan, 1980). Debilitating levels of test anxiety are associated with an ineffective study environment, so a more conducive environment may help with better preparation (Eysenck et al., 2007), thereby reducing test anxiety. Though music has been shown to decrease perceived levels of stress in clinical settings, whether an equivalent relationship exists among adolescents in the academic setting of the study environment has not been elucidated.

Studies have investigated the association of music with stress in college students and have found beneficial emotional responses, such as decreased levels of stress, associated with the music conditions, which involved listening to music as opposed to sitting in silence (Hirokawa & Ohira, 2003; Labbé et al., 2007). However, these studies were conducted in a controlled environment, where students took cognitive tests and then either listened to music or sat in silence. While this study addressed the effects of music after a stressful experience, the role music plays

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before a stressful experience, such as during study periods before exams, needs to be researched further. Additionally, in the college student cohorts, it was observed that females generally reported higher levels of stress than their male counterparts (Abdulghani et al., 2011; Eum & Rice, 2011). It would therefore be relevant to consider whether similar sex differences are present in a younger high school student population. Thus, this study was conducted to address these gaps in knowledge by administering surveys about music listening habits and test performance to high school students. In order to investigate the relationship between music and stress prior to the testing situation, we asked students about their study environments. It was hypothesized that students who spent more time listening to music would report lower stress levels and receive higher test grades. We further hypothesized that gender would be a significant determinant of stress levels among adolescents. Our findings will help understand what kinds of study environments are associated with lower stress levels and better performance.

MATERIALS AND METHODS

Participants

In this cross-sectional study, students enrolled at Scarsdale High School, a suburban public high school in Scarsdale, NY, completed a survey about music preferences, study habits, test anxiety, and academic stress. The study was conducted between January 2010 and February 2010.

Measure

The students provided demographic details including their age, gender, grade, class and academic level to which they were assigned. The students also indicated the amount of time spent listening to music while studying for their science tests. To assess the students' perspectives on their test, the survey included items about difficulty of material, time spent studying, and use of extra help provided by the teachers. These items, included in the demographic section, were ultimately not relevant to the research questions and were therefore omitted during analysis.

The survey used two previously validated measures, Sarason's Test Anxiety Scale (TAS) and Abouserie's Academic Stress Questionnaire (ASQ) to quantify stress and test anxiety (Abouserie, 1994; Sansgiry & Sail, 2006; Sarason & Gordon, 1953). Both the TAS and the ASQ, designed for college age students, have also been validated among high school students (Kouzma & Kennedy, 2004; Sarason & Gordon, 1953). These measures were chosen because they used simple language and addressed several causes and effects of stress. All individual items of the surveys were included and the scaling model was kept the same. The format of the two tests was true-false for the TAS and a Likert scale for the ASQ. The TAS was divided into two domains: emotional and physical. Similarly, the ASQ was divided into four domains: social, performance, diligence, and time management. These distinct domains allows for the identification of specific aspects of behavior influenced by stress that may have impacted test performance. The survey administered had a total of 44 questions, including 11 demographic questions, 21 questions from the ASQ and 12 questions from the TAS.

Study design

The survey was administered the day following the designated quarterly testing date for science classes. The participants completed the survey in class. Although given the choice to opt out, all the students agreed to complete the survey. The students were blinded to the purpose of the study and were informed that purpose of the survey was to determine the utility of music in creating a more conducive study environment in the common areas in the school building. The teachers then collected the survey and reported the students' grades from the most recent quarterly exam on the survey itself. Test performance provides one of the most objective measures of the students' ability to handle the pressure and anxiety (Cassady & Johnson, 2002). Before the surveys were returned to the author, the students' names were removed to maintain anonymity. The study was approved by the school's Institutional Review Board.

Statistical analysis

Reliability analysis was done to ensure the internal consistency of the chosen items in each of the scales. Internal consistency refers to the correlation between individual items and the total score of each of the questionnaires to gauge the reliability of the measures. The Cronbach's alpha values resulting from the reliability analyses were 0.66 for the TAS and 0.87 for the ASQ. The standard cutoff value used to evaluate consistency based on the Cronbach's alpha is 0.7. While the ASQ meets this standard, the TAS is just below the value, in the acceptable but not ideal range, perhaps due to the smaller number of items in that portion of the survey (Tavakol & Dennick, 2011). The domains for each test were determined using factor analysis after the data was collected. The questions were not separated by domain in the survey that was administered. In the TAS, questions that dealt with physical responses to stress, such as stomach aches or irregular heart rates, were placed in the "physical" domain and items that indicated emotional response to stress, such as forgetfulness of known facts and lack of concentration, were placed in the "emotional" domain. Descriptive analysis was done on the demographic variables. Composite mean scores of the ASQ and TAS as well as means of individual domains were calculated. Time spent listening to music was converted to a discrete variable by assigning the middle value for each choice (i.e. 1.5 hours for the 1-2 hour choice). The mean was then calculated for each group of interest, such as students in a particular academic level or students of a specific gender.

Test grades were the primary outcome of interest. Means of test grades, survey composite scores, those of individual domains, and time spent listening to music were compared between the genders using a t-test. The same variables were compared between multi-level categorical variables (e.g., grade in school and academic level) using the analysis of variance with Bonferroni correction for post-hoc testing to determine which groups were significantly different from one another ($\alpha = 0.05$). Pearson correlation coefficients were calculated to assess the

relationships between test grades as well as with time spent listening to music with each of the survey's domains. Multivariate analysis using linear regression was performed to identify independent predictors of test grades after adjusting for any confounding variables. An alpha value of 0.05 was used to determine significance of interactions.

RESULTS

Seven hundred and twenty eight students completed the survey (Table 1). These included students from all four high school grades (9^{th}-12^{th}), three levels of academic rigor (regular, honors and advanced placement (AP)) and six sciences (biology, chemistry, physics, earth science, geology and environmental science). Each student was only enrolled in one science class of a given academic rigor. While participation did not differ by gender, fewer 12^{th} graders than any other grade completed the survey. As fewer students take AP classes, the number of participants in AP classes was smaller than the number of students in honors and regular level classes. Average time taken to complete the survey was 15 minutes.

We found that time spent listening to music while studying had a small but significant negative correlation with test grades (p=0.049) (Table 2). While the diligence (p=0.01) and social (p=0.01) domains of the ASQ and the emotional domain (p<0.01) of the TAS correlated positively with time spent listening to music, there was a negative correlation between the physical domain of the TAS and time spent listening to music (p=0.02) (Table 2). All domains in ASQ and TAS were negatively correlated with test grades. In particular, the performance (p=0.01) and diligence (p<0.01) domains of the ASQ and both the physical (p<0.01) and emotional (p<0.01) domains of the TAS reached statistical significance.

In addition to the correlations between music, stress, and test performance, it was found that both time spent listening to music (p=0.04) and academic stress (p=0.002) were negatively associated with academic rigor. Test performance was positively associated with the academic rigor of the science classes (Table 3). Students in the AP level scored significantly higher on their science exams than the students in the regular level (p<0.001) and the honors level (p=0.001). Furthermore, students in the AP level listened to significantly less music than students in the regular level (p=0.04) and scored significantly lower in the ASQ (p=0.002). There was also a significant difference in the emotional domain of the TAS, with AP students reporting lower levels of emotional stress than regular students (p=0.003).

Given prior studies of gender differences in reported academic stress, we investigated if these differences develop at the level of high school. While there was no significant difference in the test scores or time spent listening to music (p=0.47) between male and female students (p=0.9), females reported significantly higher levels of stress in both the ASQ (p<0.001) and TAS (p<0.001) than males (Table 4).

Upon multivariate analysis, it was found that the TAS emotional domain (p<0.001) and the academic rigor of the classes (p=0.003) were significant independent predictors of test performance (Table 5). In particular, those in AP classes averaged 3.9 points higher on their tests than those in regular level classes (p=0.003). In addition, those reporting an emotional response to the testing situation scored 9.1 points lower than those who did not (p<0.0001). Moreover, the time spent listening to music was significantly different between the three academic levels, although its association with test grades was rendered non-significant (p=0.1) when adjusted for academic level and emotional response.

Characteristics	n	%
Gender		
Boys	375	52.5
Girls	339	47.5
Grade		
9th	191	27
10th	215	30.4
11th	174	24.6
12th	127	18
Academic Rigor		
Regular	276	38.5
Honors	369	51.5
Advanced Placement	72	10
Test Grade		
A+	94	13.1
A	121	16.9
A-	95	13.2
B+	75	10.5
B	103	14.4
B-	63	8.8
C+	55	7.7
C	30	4.2
C-	24	3.3
D	34	4.7
F	21	2.9

Table 1. Demographics of the study sample.

DISCUSSION

The purpose of this study was to investigate the relationship between music listening habits, academic stress, test anxiety, and test grades among high school students. We hypothesized that students who spent more time listening to music while studying would have higher test grades and report lower levels of stress. Instead, we found that time spent listening to music was associated with higher levels of stress in high school students. In addition, we found a negative association between time spent listening to music and test scores, an association that was mediated by levels of test anxiety as well as by the academic rigor of the classes. Students in higher academic levels reported

Variable	Time Spent Listening to Music		Test Grades	
	Correlation	*p*-value*	Correlation	*p*-value*
Academic stress questionnaire (ASQ)				
Composite score	0.002	0.96	-0.04	0.28
Performance	-0.02	0.54	-0.09	**0.01**
Diligence	0.10	**0.01**	-0.14	**0.0001**
Time Management	-0.05	0.15	-0.05	0.16
Social	0.1	**0.01**	-0.04	0.3
Test Anxiety Survey (TAS)				
Composite score	0.01	0.77	-0.23	**<0.0001**
Physical	-0.09	**0.02**	-0.12	**0.001**
Emotional	0.11	0.004	-0.28	**<0.0001**

*significant *p*-values (α=0.05) are bolded

Table 2. Association of ASQ and TAS domains with time spent listening to music and test grades

lower levels of stress but also spent less time listening to music. Together, our findings suggest that there is a positive association between time spent listening to music and test anxiety, both of which are negatively associated with test performance among high school students.

To the authors' knowledge, this is the first study demonstrating a relationship between music, stress, and academic performance in high school students. Our findings of the negative correlation between stress and performance among high school students extend those reported among college students (Cassady & Johnson, 2002; Sarason, 1984). However, our results on the association of music with stress and test performance differ from studies among college students. Our distinct findings may be due to differences in the study settings. Studies among college students assigned experimental conditions with or without music in which students completed the cognitive tests and reported beneficial effects of music (Hirokawa & Ohira, 2003; Labbé et al., 2007). In contrast, our study investigated the association of music listening during study periods before the test was taken. Our results differed from studies investigating music in a pre-testing environment as well. Studies in which classical music was played prior to cognitive testing report increased performance (Rauscher et al., 1995; Rauscher & Shaw, 1998), while we observed a negative relationship between listening to music before an exam and test performance.

The cognitive distraction effect of music during study periods may also explain our results. This distraction theory has been proposed as an explanation for the palliative effect music has in in-patient and oncology wards (Huang, Good et al., 2007; Mitchell et al., 2006; Ruscheweyh et al., 2011) and more recently, in academic situations (Doyle & Furnham, 2012). As per the distraction theory, music may play a different role in stress-mediation depending on its usage in an academic or non-academic environment. Students who listen to music while studying may not focus as effectively on the material. Less effective studying may result in a false sense of preparedness, which has been shown to lead to greater test anxiety, and is strongly correlated with poor performance in our study as well (Cassady & Johnson, 2002; Culler & Holahan, 1980).

Our findings suggest that the influence of music on stress varies by the populations studied. We observed that academic levels mediated this relationship such that the negative association of music with school performance was greater among those at regular academic levels as compared to those in the

Table 3: Comparisons of test grade, music listening, and ASQ and TAS domains by level of academic rigor.

Variable	Regular	Honors	Advanced Placement	*p*-value*
Test grade	84.87±10.8	85.84±9.65	90.35±7.9	**0.002**
Time Spent Listening to Music	2.01±1.25	1.78±1.22	1.73±1.28	**0.04**
ASQ Mean	2.47±0.64	2.43±0.75	2.22±0.42	**0.002**
ASQ Performance	2.94±0.65	2.94±0.61	2.74±0.71	**0.05**
ASQ Diligence	2.35±0.64	2.23±0.61	2.01±0.58	**0.0001**
ASQ Time Management	2.88±0.64	2.81±0.62	2.78±0.65	0.29
ASQ Social	1.77±0.68	1.66±0.56	1.48±0.49	**0.0012**
TAS Mean	0.44±0.21	0.43±0.21	0.38±0.21	0.13
TAS Physical	0.47±0.29	0.50±0.29	0.45±0.28	0.23
TAS Emotional	0.37±0.26	0.33±0.25	0.26±0.23	**0.003**

* p-value derived from ANOVA. Significant *p*-values (α=0.05) are bolded. All values are reported as mean ± standard deviation.

Variable	All participants	Male (375)	Female (339)	*p*-value*
Test grade	85.92±10.07	85.96±9.83	85.86±10.36	0.90
Time Spent Listening to Music (hours)	1.86±1.24	1.83±1.22	1.90±1.27	0.47
ASQ Mean	2.43±0.68	2.33±0.61	2.53±0.74	**<0.0001**
ASQ Performance	2.92±0.64	2.80±0.03	3.05±0.03	**<0.0001**
ASQ Diligence	2.25±0.63	2.21±0.63	2.30±0.62	0.05
ASQ Time Management	2.84±0.63	2.71±0.67	2.98±0.56	**<0.0001**
ASQ Social	1.69±0.61	1.65±0.60	1.74±0.61	0.05
TAS Mean	0.43±0.21	0.37±0.21	0.48±0.2	**<0.0001**
TAS Physical	0.49±0.29	0.41±0.28	0.57±0.27	**<0.0001**
TAS Emotional	0.34±0.25	0.31±0.24	0.38±0.26	**0.0001**

* Comparison between genders. Significant *p*-values (α=0.05) are bolded. All values are reported as mean ± standard deviation.

Table 4: comparisons of test grades, music listening and ASQ and TAS domain scores by gender.

honors and AP levels. A possible explanation for this finding is that students in more rigorous classes may handle stress differently than students in more introductory courses, as reflected by their disparate test grades and music-listening habits. Test anxiety, the second mediator of test performance, may independently mediate the relationship between music and test performance because students who are test anxious may look to music as a source of stress relief. However, our findings suggest that such a utilization of music to mitigate stress does not lead to either decrease in stress or improved academic performance.

Furthermore, although girls did not listen to music for longer durations in our study than their male counterparts, they reported higher stress levels. This difference in stress levels was not reflected in academic performance between girls and boys. These findings corroborated the previously reported observation that girls report higher levels of stress than boys, although their performance is unaffected (Eum & Rice, 2011; Kouzma & Kennedy, 2002). This may be due to the decreased effect of stress on performance among the girls or that girls are more conscious of their level of stress and thus report a higher level compared to boys.

This study has certain limitations. Since it is cross-sectional in nature, we cannot confirm the causal efficacy of music or whether poor academic performance precedes increased use of music for stress reduction. Moreover, the study population was relatively homogenous, limiting the generalizability of the findings. Also, since the test scores were taken only from science classes, to get a more general idea of a student's performance, it will be necessary to evaluate students' grades in non-science courses in future studies. Yet, the findings provide pilot evidence of the association of music with academic performance and test anxiety among adolescents. Further studies are needed to investigate if similar associations exist in different age ranges, ethnic groups, and geographic locations. Future researchers can also consider creating an experimental environment in which students either listen to standardized music or music of their own choice to determine whether there is a relationship between genre of music and anxiety or test performance. Future longitudinal studies in more diverse populations are needed to identify a temporal relationship between stress and time spent listening to music. Additionally, given that the TAS was not as internally consistent as the ASQ, it would be important to reevaluate test anxiety in this population using a more consistent measure.

In summary, we found that that time spent listening to music was negatively associated with school performance as measured by test grades among high school students. This relationship was mediated by the level of academic rigor since adolescents in more challenging academic levels listened to less music, suggesting that they may have alternate stress coping mechanisms. Given the growing role of music and media in teenagers' lives, the study is important as it links performance with anxiety in a particular kind of study environment in which the student chooses to listen to music. The results can be explained in part by using the distraction theory, lending credence to one mechanism that explains the relationship between music and stress. These results can help students make informed decisions about their study environment as well as their preparation techniques for their exams since there is substantial indication that study environments without music are associated with less stress and better grades. Moreover, the findings may provide insight into the mechanism by which music and stress are related in a cognitive setting. Overall, this study highlights the complex interaction between study environment, anxiety levels, academic material, and students' performance.

Table 5: Multivariate Analysis of the Predictors of Test Performance

Predictor	*β*-value	*p*-value*
Time spent listening to music	-0.44 (-1.1 to 0.2)	0.1
Academic rigor	3.9 (1.3 to 6.5)	**0.003**
ASQ performance domain	0.53 (-0.86 to 1.92)	0.45
ASQ diligence domain	-0.83 (-2.1 to 0.49)	0.22
TAS emotional domain	-9.14 (-12.4 to -5.9)	**<0.001**
TAS Physical domain	-1.41 (-4.4 to 1.57)	0.35

* Significant *p*-values (α=0.05) are bolded.

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