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## Music therapy as a tool for anxiety modulation in first-year dental students: A dose-effect study

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### Abstract

This study aims to investigate whether there is a dose-effect relationship between music intervention and anxiety reduction in first-year dental students. We hypothesized that more frequent sessions of music concerts would result in a larger and longer lasting anxiety reduction outcome. To test our hypothesis, we invited first-year dental students to attend five live string-quartet music concerts over two consecutive academic terms. We assessed anxiety levels (STAI-6) and the students' music concert perceived experience. Our results demonstrated that first-year dental student posed the highest anxiety levels before the series of concerts initiated. There was an overall significant reduction in anxiety levels, which plateaued over time. Dental students exhibited a strong positive perception of the live music concerts experience and wanted to have the music concert experience more often. We conclude that music concerts are a feasible tool to reduce anxiety in dental students particularly for female dental students.

**Keywords:** Music therapy, education, dental, anxiety

### 1. Introduction

Music is a brain modulator that can be used to reduce anxiety, and to improve well-being and performance [1, 2]. In the brain, music therapy was shown to increase grey matter volume in patients who suffered brain trauma [2]. Such grey matter increase was correlated with neuroanatomical changes in the brain and cognitive improvement, which was maintained after six-month follow-up [2].

Additionally, musical activities, such as listening to music or playing a musical instrument, facilitate creativity. Such activities are also enjoyable, accessible and may have a significant impact in key health indicators such as a reduction in stress and anxiety [3, 5].

Anxiety disorders affect a vast number of people worldwide [6].

The World Health Organization (WHO) estimates that in the United States anxiety disorders will affect 31% of the population up to 75-years-old [7]. Anxiety is frequently associated with health problems that can lead to disability [7, 9]. More specifically, stress and anxiety affect the ability of students to cope with the academic challenges, which may negatively impact the students' academic performance [10]. Among students, dental students highly suffer from anxiety, which was shown to be reduced with the use of music interventions and music therapy [4, 11-13]. Different strategies using music as an anti-anxiety approach have been shown to control and decrease stress and anxiety before exams and also improve exam performance [14]. A series of live string-quartet music concerts has shown to reduce anxiety in first-year dental students [4].

However, whether there is a dose-effect in the music intervention induced anxiety reduction in dental students is still unknown [4]. Thus, in this study, we aimed to investigate the dose-effect of music interventions in anxiety reduction in first-year dental students. We hypothesized that more frequent music concert experiences will positively impact first-year dental students by reducing the students' anxiety levels over two academic terms, Fall and Winter.

### 2. Materials and methods

The University of Michigan (UM) Institutional Review Board reviewed and approved this

study based on the following methods (HUM00151893). During two consecutive pre-clinical laboratory courses (Fall 2018 and Winter 2019), first-year dental students (N = 109) were invited to attend a series of five string-quartet live music concerts. During the Fall semester, students attended two concerts, and in the following Winter term, students attended three concerts.

To establish the baseline levels, students were invited to voluntarily and anonymously answer the State and Trait Anxiety Inventory short form (STAI-6) in six random survey moments over the Fall 2018 and the Winter 2019 terms. The STAI-6 contains 6 questions as shown in Table 1. STAI-6 scores vary from 20-80; being scores 20-36 considered normal anxiety levels [15, 16].

Scores higher than 36 are considered moderate to severe anxiety, which suggests a need for further professional evaluation.

**Table 1:** State and Trait Anxiety Inventory – STAI-6

	Not at all	Somewhat	Moderately	Very Much
I feel calm	1	2	3	4
I feel tense	1	2	3	4
I feel upset	1	2	3	4
I feel relaxed	1	2	3	4
I feel content	1	2	3	4
I am worried	1	2	3	4

The anxiety levels after the live string quartet music concerts (post-concert anxiety levels) were also surveyed using the STAI-6 questionnaire right after each one of the five live music concerts (two concerts in the Fall and three in the Winter). For demographic data, we only asked for the gender of the respondent, as there was no significant age gap among our student’s population. The study design and timeline can be seen on Table 2.

**Table 2:** Study Design and Timeline

Survey Moments	Fall 2018	Winter 2019
Baseline anxiety (STAI-6)	3	3
Post-concert Anxiety (STAI-6) Music concerts students’ perceived experience	2	3

Graduate students from The University of Michigan School of Music and Theater (UMSMT) performed the concerts in partnership with the University Musical Society (UMS). The duration of the concerts varied between 30-40 minutes. Following previous used methods [4], the live string-quartet music concerts consisted in short introductions of each music piece to be played. Dental students were invited to follow along with the performance’s storyline and make emotional connections to each piece being performed. Dental students were also engaged in suggesting authors and music styles they would like to listen prior to the concerts. Therefore, a variety of works were offered ranging from canonic classical selections to modern minimalist works in an effort to share the diversity of musical options with the students. A short selection of the musical works included those by Haydn, Debussy, Glass, Shaw, and others. After the concerts, the students were invited to answer the STAI-6 questionnaire and a short questionnaire that assessed the student-perceived value held for the experience with the music concerts (Table 3). The responses on a 5-point Likert scale of 1 to 5 were recorded both in the Fall and in the Winter terms.

**Table 3:** Music concerts perceived experience

<b>1</b>	<b>I enjoyed the music concert today.</b>				
	Totally disagree	Disagree	agree	Neutral	Agree
<b>2</b>	<b>I felt calmer after the music concert today.</b>				
	Totally disagree	Disagree	Neutral	Agree	Totally agree
<b>3</b>	<b>I would like to have another music concert before the lab sessions.</b>				
	Totally disagree	Disagree	Neutral	Agree	Totally

Statistical analysis was conducted using Statistical Analysis Systems (SAS Version 9.4). Individual items from the STAI-6 scale were added to create a Total Anxiety Score for each respondent. The Total Anxiety Score was considered a continuous variable with a minimum value of 20 and maximum value of 80 [16].

To account for unequal sample sizes before and after the concerts, the datasets from baseline surveys were merged and then compared with a merged post-concert data set. This analysis was performed for both Fall and Winter term data. Comparison of mean anxiety scores was made using Student’s

*t*-test for both terms of Fall and Winter. Multiple Linear Regression models were used to analyze the association between baseline and post-concert survey data across four time points (Baseline Fall, Post-concert Fall, Baseline Winter, Post-concert Winter). A p-value <0.05 was considered to be statistically significant.

In the Fall semester, 88 students responded the first baseline survey, 61 students responded the second baseline survey, and 68 responded the third baseline survey.

During the Fall semester, we had 103 students attending and answering the survey for the first live music concert, and 91 for the second concert. In the winter semester, the highest participation rate of 82% for attendance and survey participation in the second concert (N=90).

However, because attendance and survey reply were voluntary, not all students filled out the post-concert surveys. Detailed information of the number of respondents for each survey is provided in Table 4.

**Table 4:** Demographics – fall 2018 (F) and winter 2019 (W)

Timepoint	Males	Females	Total (N)
Baseline 1 (F)/Baseline 1 (W)	46/34	42/35	88/69
Baseline 2 (F)/Baseline 2 (W)	24/27	37/34	61/61
Baseline 3 (F)/Baseline 3 (W)	32/26	36/25	68/51
Post-concert 1 (F)/ Post-concert 1 (W)	51/28	52/34	103/62
Post-concert 2 (F)/Post-concert 2 (W)	40/49	51/41	91/90
Post-concert 3 (W)	26	25	51

### 3. Results & Discussion

For the fall term, the mean overall (female and male dental students) values of the total anxiety score was recorded as 51.70 at baseline and 43.12 at follow up post-concert moments, which accounts for a 16.59% decrease in the mean anxiety score levels.

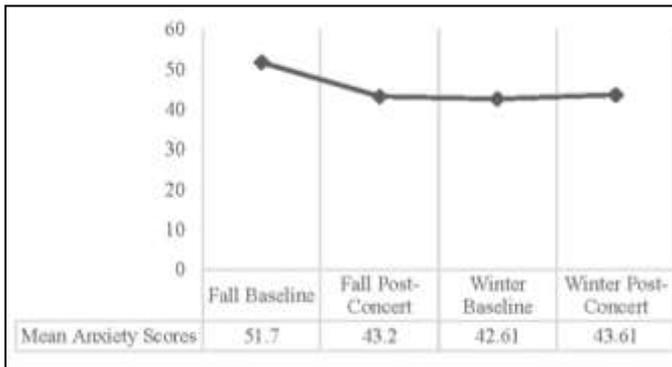
This difference was found to be statistically significant ( $p < 0.05$ ) (Table 5). For the winter term the mean overall values of the total anxiety score was recorded as 42.60 at baseline and 43.60 at follow up.

Thus, we did not find a statistically significant difference in the anxiety scores before and after the concerts in the winter term ( $p = 0.6716$ ) (Table 5).

**Table 5:** Comparison of means for anxiety scores- Fall 2018 (F) and Winter 2019 (W)

Timepoints	N	Anxiety Score	95% CL Mean	Std Dev	Std Err	t Value	P > It.	
Baseline (F)	94	51.70	48.60	54.79	15.10	1.55	4.25	<0.0001
Post-concert (F)	110	43.12	40.52	45.71	13.72	1.30		
Baseline (W)	78	42.60	39.26	45.94	14.82	1.67	-0.42	0.67
Post-concert (W)	97	43.60	40.37	46.83	16.02	1.62		

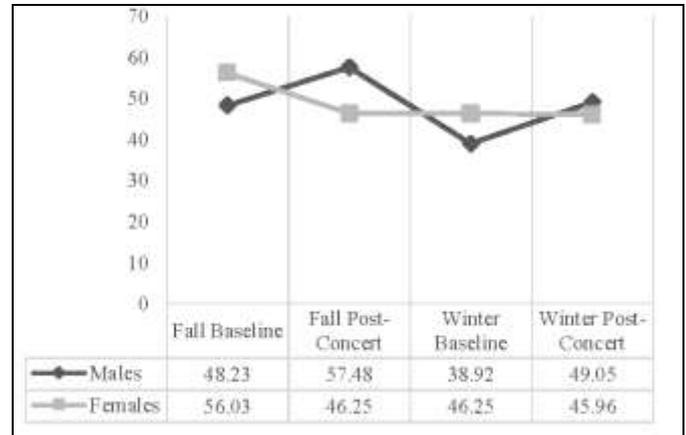
Generalized Linear Regression Models were used to compare mean values of the total anxiety scores across all four timepoints (Figure 1). We found that mean anxiety score at Fall baseline was significantly higher than all other timepoints. ( $p < 0.0001$ ). There was also a statistically significant difference ( $p < 0.0001$ ) between Fall and Winter baselines (Figure 1).



**Fig 1:** Comparison of mean anxiety scores across Fall and Winter

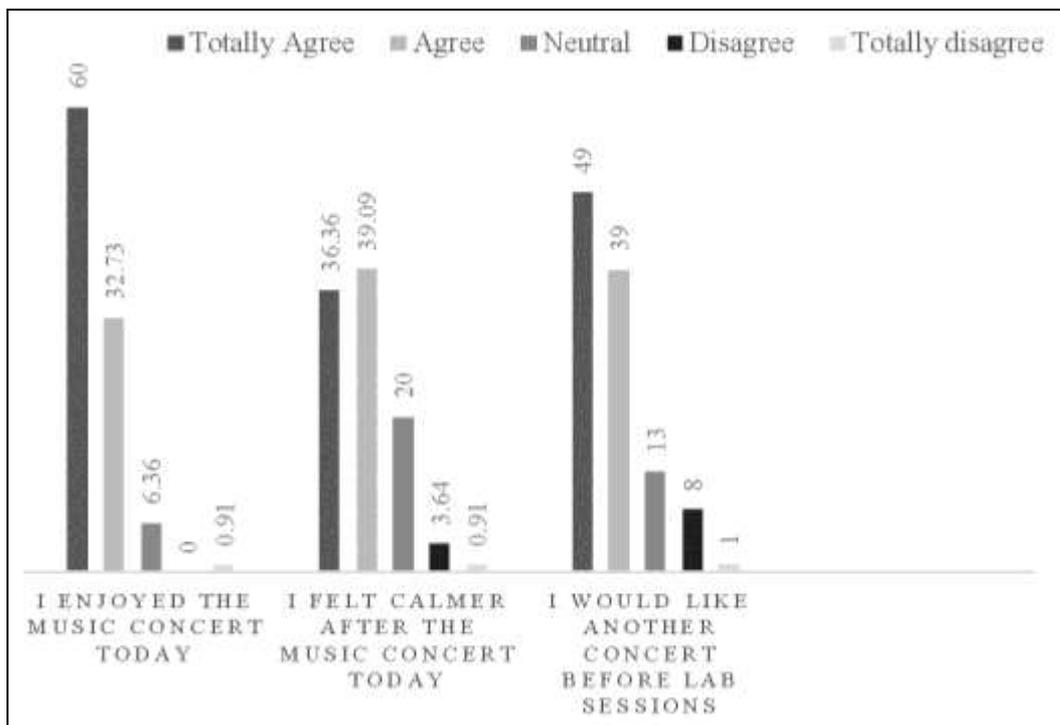
In order to test whether there were differences related to gender over time, we plotted the mean scores of male and female dental students during Fall and Winter baseline and post-concert timepoints. Female dental students began with a higher mean anxiety score (56.03), which was reduced at the end of the study (45.96). This difference was found to be

statistically significant ( $p < 0.0001$ ). We also noticed an interesting trend of overall lower anxiety scores from the Fall baseline to Winter baseline for female and male dental students. However, mean anxiety scores among the male dental students varies through the course of the study and increases from baseline to post-concert scores in both Fall and Winter term concerts. The overall interaction between gender and timepoints was found to be statistically significant. ( $p < 0.001$ ) (Figure 2).



**Fig 2:** Mean anxiety scores across Fall and Winter by gender

The participants perceived experience with the music concerts can be seen in Figures 3 and 4. In the Fall semester, almost 60% of the students totally agreed to having enjoyed the live music concerts, 36% totally agreed and 39% agreed that they felt calmer after the music performance, and 49% of the students totally agreed to having another performance before the course laboratory sessions (Figure 3). We note similar higher percentages in the “totally agree” and “agree” categories in the winter semester for all 3 questions (Figure 4).



**Fig 3:** Fall Students’ Music concerts perceived experience

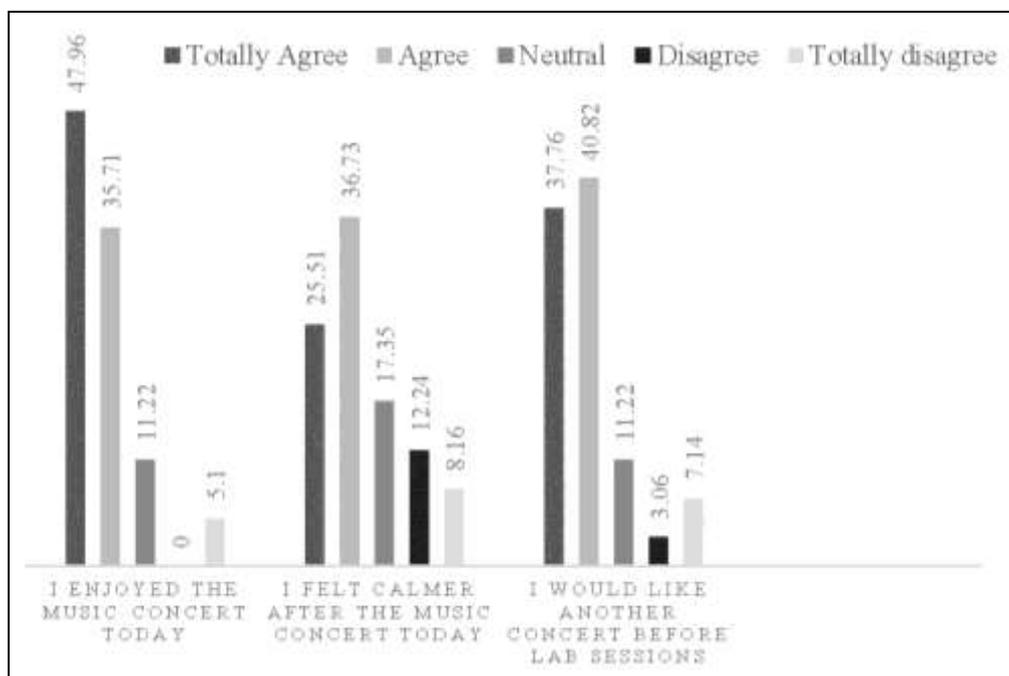


Fig 4: Winter Students' Music concerts perceived experience

Our initial hypothesis was that there was a positive correlation between exposure to music therapy and reduced levels of anxiety among first-year dental students in a dose dependent manner. In general, and specifically for female students, the results of the Fall term demonstrated that music therapy interventions have a positive impact on reducing anxiety level of first-year dental students. However, the effect plateaued after a specific dose of music sessions which could suggest that more frequent exposures to live music concerts may stabilize the reduction of anxiety levels in dental students as observed previously [17].

It is possible that during the Fall term, as first-year dental students were less familiar with the dental school demands and curriculum, they also felt more anxious. By the Winter term, the anxiety could have partially been reduced by their acclimation to the academic demands.

However, a previous study demonstrated, the anxiety levels among UM School of Dentistry dental students are particularly higher among first-year students along all academic terms [11]. It is also possible that the most anxious first-year dental students chose to answer the questionnaires and attend the music concerts, which could also have affected our findings. Interestingly, female and male students reacted differently to music exposure during the studied Fall and Winter terms.

Female dental students showed a higher level of anxiety but responded better to the live string-quartet music concerts. Meanwhile, male dental students seem to be less affected by the concerts as previous observed [4].

Our study has three important limitations. Because the attendance and survey participation to the music concerts were voluntary, it is possible that the most anxious students responded the surveys during the course of this study while the less anxious students attended the music concerts but opted not to respond the post-concert surveys. Additionally, because the survey was anonymous to encourage truthful responses, our data did not detect the individual effects of music intervention over the consecutive two academic terms. Therefore, the sample size of baseline and post-concert surveys is different as some participants may have attended the concerts but have not responded all surveys. Finally, we

used the STAI-6 because it is a short and non-invasive anxiety survey tool. However, the STAI-6 does not allow a final diagnosis of mental health, but only a classification of the students according to their anxiety score levels [16].

#### 4. Conclusions

From our results, we concluded that music therapy is a feasible approach to manage anxiety among first-year dental students. This is supported by other studies [4, 17, 19] and by the music concerts perceived experience survey completed by the participants in this study (Figures 3 and 4). Additionally, our results demonstrate that music interventions, such as live string-quartet music concerts, may have an important and significant impact on reducing anxiety levels in first-year female dental students. Future studies are needed investigate more effective anti-anxiety approaches for male dental students, while controlling of sample size for baseline and post-interventions and individual responses over time.

#### 5. Acknowledgments

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