Tuning Out Anxiety: An Experimental Investigation of Music's Effects on Test Anxiety in a Beijing University Classroom

Sijun Li

April 2024

AP Research

Abstract

Background: Listening to music has generally been shown to be effective in reducing anxiety, but not test anxiety in particular.
Method: This study employed a quantitative pretest-posttest randomized controlled trial to examine music's effects on the anxiety levels of undergraduate computer science students. Participants from this study were chosen from students enrolled in an Introduction to Computer Science course. 64 participants were randomly assigned to a control group ($n = 31$) and a treatment group ($n = 33$) Students' anxiety levels were collected both before and after music treatment with the State-Trait Anxiety Inventory (STAI).
Results: The control group showed a significant increase in test anxiety ($p < 0.0001$) while the treatment group had no significant difference between pretest and posttest anxiety levels. However, after accounting for initial anxiety levels and individual variability, a mixed-effects model showed that while pre-test anxiety level was the most significant predictor of post-test anxiety level ($p < 0.001$), the music treatment had a significant reducing effect on test anxiety ($p = 0.036$).
Conclusions: Listening to music can significantly reduce anxiety in undergraduate computer science students. Furthermore, the anxiety-reducing effects of music increases as participants' initial anxiety levels increase.

1 Introduction

Test anxiety is a psychological state in which an individual experiences feelings of fear and tension due to tests that evaluate their performance. Chapell et al. (2005) found that test anxiety is associated with lower academic performance. In addition, Putwain et al. (2023) conclude that test anxiety can also significantly impact individuals' well-being and mental health.

This has been a major problem for high school and college students around the world, and more so for students in China, under an especially test-heavy education system. A cross-sectional survey among undergraduate medical students in China reported that 71.4% of students find test anxiety to be problematic, and 33.7% of students experience severe test anxiety (Liu et al., 2021).

Listening to music has been widely believed to be an effective way of reducing stress and anxiety in many circumstances. A majority of research on this topic is done in different populations of patients undergoing stressful medical procedures, and the literature agrees on a significant reduction of stress due to listening to music in these situations. There is, however, a discrepancy in the literature concerning its effects on testing-provoked anxiety. The purpose of this study is to further look into and explain that discrepancy and potentially extend the general results found in the present literature to the more specific scenario of academic testing.

2 Literature Review

2.1 Theoretical Framework

Researchers have developed preliminary theories to try to explain the connection between music and anxiety. Research shows that listening to music can induce responses in the autonomic nervous system, manifesting in lower levels of systolic and diabolic blood pressure. Many studies have found that listening to music can lead to lower levels of cortisol, blood glucose, and other biomarkers that are part of the biological stress pathways (Finn & Fancourt, 2018).

There are also psychological explanations for the effects of anxiety-reducing music. Gebhart et al. (2020) reported significantly less anxiety response in all participants treated with distraction-focused interventions, including music therapy. This supports that distraction from stressors may be one pathway through which music can reduce anxiety. Lecamwasam et al. (2023) found that music treatment was more effective in reducing perceived stress when they allowed their participants to personalize their music stimuli. This aligns with the theory that music reduces stress by distracting individuals from anxiety-provoking stimuli, which explains why personalized music is most effective.

Neurologically, music has been found to arouse areas of the brain that are involved in processing emotional experiences, including the amygdala, the hippocampus, the prefrontal cortex, and more (Hou et al., 2017; Koelsch, 2014). The dysregulation of these brain structures are usually the cause of anxiety disorders. Music's stimulatory effect on these neuroanatomical structures give it the power to regulate mood and anxiety.

2.2 The Effects of Music on Anxiety

There is an extensive literature on the effects of music in reducing anxiety in general. Most researchers in this field simulate stressors for their studies with laboratory condition stress protocols.

Burns et al. (2002), who studied the effects of different types of music on anxiety, told their participants that they would take a mental rotation task that is "difficult

and stressful" and administered the randomly-assigned treatment (hard-rock, classical music, self-selected music, or silence). They then collected anxiety levels with the STAI-Y1 survey and physiological symptoms with medical equipment before administering the mental rotation task.

Building upon the findings of Burns et al. (2002), Labbé et al. (2007) used a "cognitive speed test" to simulate a negative stressor and randomly assigned participants into four groups: three music treatment groups that listened to three specific genres of music (heavy-metal, classical, and self-selected) while taking the test, and a control group that took the test in silence. They then collected physiological data and state anxiety levels during the test and compared those between the four groups.

Thoma et al. (2013) compared the effects of relaxing music and the sound of rippling water on the mental stress of female university students. Participants were randomly assigned to one of two treatment groups or the control group. After administering the treatment, the researchers exposed the participants to the Trier Social Stress Test, and recorded physiological data and self-reported anxiety levels during the test.

Besides in laboratories, music has also been found to reduce stress in practical situations, especially in the hospital.

Jeppesen et al. (2019) experimented with patients who were undergoing bronchoscopy for suspected lung cancer. The 300 patients were randomly split into three groups for a randomized controlled trial. One group listened to self-selected music, one group listened to specially designed music, and one group served as the control group. They noticed a significant decrease in anxiety scores after listening to self-selected music compared to the control group. The existing literature consistently supports that listening to music, especially classical music, has a significant positive effect on reducing mental stress in subjects compared to other treatment or control groups.

2.3 The Effects of Music on Testing Anxiety

Even though music has been found to be effective in reducing anxiety in general, its effects on testing anxiety specifically has only been studied by a small literature and is highly controversial.

On one hand, some studies supported the conclusion in the more general literature – that listening to music helped reduce anxiety.

Ince and Çevik (2017) performed a randomized controlled trial on nursing students taking the Fundamentals of Nursing course. They randomly assigned the participants to a treatment group and a control group. All participants took the same skill training before being evaluated for their blood-draw performance, and participants in the treatment group listened to music during the skill training while participants in the control group did not. They found that listening to music during training can reduce anxiety and forgetting compared to the control group.

Gosselin et al. (2016) also used a randomized controlled trial to study nursing students. They randomly split 38 students enrolled in an accelerated BSN program into a treatment and a control group. The participants were preparing for a nursing simulation in a heart-failure situation that was "designed to allow the instructor to evaluate the student on their assessment, clinical reasoning, and practice skills" (Gosselin et al., 2016). During the preparation time, the music treatment was administered. Physiological data and self-reported anxiety and self-efficacy levels were collected prior to and after the treatment for both control and treatment groups. They reported a significant decrease in anxiety levels in students in the music treatment group compared to the control group, which led them to conclude that music had a significant effect on reducing test anxiety.

Lai et al. (2008) also performed research on college nursing students, but in an

academic exam condition. They designed a randomized crossover trial in which each participant took two exams, one with music and the other in silence, in random order. For each group, physiological data and self-reported anxiety levels were recorded both before and after the exam. They concluded that listening to music during the 40-minute examination reduces anxiety and increases performance.

Galal et al. (2021) experimented on two different music treatment methods: passive (listening to self-selected music) and active (playing drums). They split 202 pharmacy students randomly into the two treatment groups, and recorded their baseline anxiety levels, and anxiety levels both before (while studying for an assessment) and after the music intervention (which is after the assessment). They found that both treatments produced a similar reduction in anxiety for pharmacy students just after a knowledge assessment.

On the other hand, there are also many studies that did not support a significant effect of music on reducing test anxiety.

Lilley et al. (2014) designed a randomized controlled trial for undergraduate psychology students in order to study two variables' effects on testing anxiety and performance: music and grade consequences. Their ANCOVAs concluded that regardless of grade consequences, students who listened to calming music while preparing for a test showed physical symptoms (primarily lower heart rates) of being less anxious compared to those who listened to obnoxious music, but their self reported anxiety levels (STAI scores) were not significantly lower. These findings were very interesting because they contradicted the more general literature, as a meta-analysis by Panteleeva et al. (2018) concluded that music had a significant effect on reducing self-reported anxiety but its effects on physiological symptoms of anxiety were unclear or insignificant. Furthermore, the difference in heart rate and other physiological responses to stress between the treatment and control group was not significant for students whose grades were not threatened. As a result, the researchers were not able to conclude that music had an absolute effect on students' test anxiety levels. Their results show that there were more variables involved in this process, such as initial anxiety levels.

In addition, Goldenberg et al. (2013) also experimented on the effects of music listening on psychology students in a test-taking environment. They designed two studies, one of them a randomized controlled trial in which students were split into a music listening group (music is played during studying and test-taking process) and a control group. They ran an ANCOVA test with variables "students' performance on prior course exams, year in college, age, the amount of time they typically listened to music when studying, how often they listened to classical music generally, and the strength of the students' condition preference as covariates" (Goldenberg et al., 2013). The test showed that there was no significant difference in anxiety levels between students who listened to music during studying and testing and those who did not.

2.4 Research Gap

A general conclusion cannot be made about the effect of music on reducing test anxiety due to the discrepancy in the literature. In addition, to the best of my knowledge, all validated studies on the effects of music on testing anxiety have been done on a subject population of medical students. The main reason for this is that anxiety is more prevalent in medical students. A recent meta-analysis found that more than one in three medical students globally have anxiety – "a prevalence rate which is substantially higher than the general population" (Quek et al., 2019). However, for research purposes, medical students cannot represent the general student body because most evaluations they undergo are quite different from academic tests that regular students take.

The problem is that more research is needed to validate the studies in this field

and explain the discrepancy in the findings, and to generalize the results to a larger population of the general body of undergraduate students. The current study aims to fill this gap in the literature by studying the effects of listening to music on testing anxiety levels of undergraduate computer science students. Based on this topic, the research question has been identified as: does listening to music reduce test anxiety for undergraduate computer science students?

H_0 = Music has no effect on test anxiety.

H_a = Music significantly reduces test anxiety.

The alternative hypothesis was identified based on related studies, as it had been shown true by a large body of literature. The purpose of this study is to validate H_a, and expand it to a broader context than had been studied before.

3 Method

3.1 Participants

I contacted the computer science department of the Renmin University of China (which is across the road from my high school), and they gave me permission to contact individual professors to see if they were willing to help me conduct the experiment. The participants in this study are 75 undergraduate students taking the introduction to computer science course. The sample size was limited by practical constraints. Informed consent was obtained from all participants prior to the study and all participants had the choice to withdraw from the study at any time. The research was timed in accordance to the course schedule so the experiment can be conducted during a scheduled course exam session. The participants were randomly assigned to either the music treatment group or the control group, as shown in Figure 1.

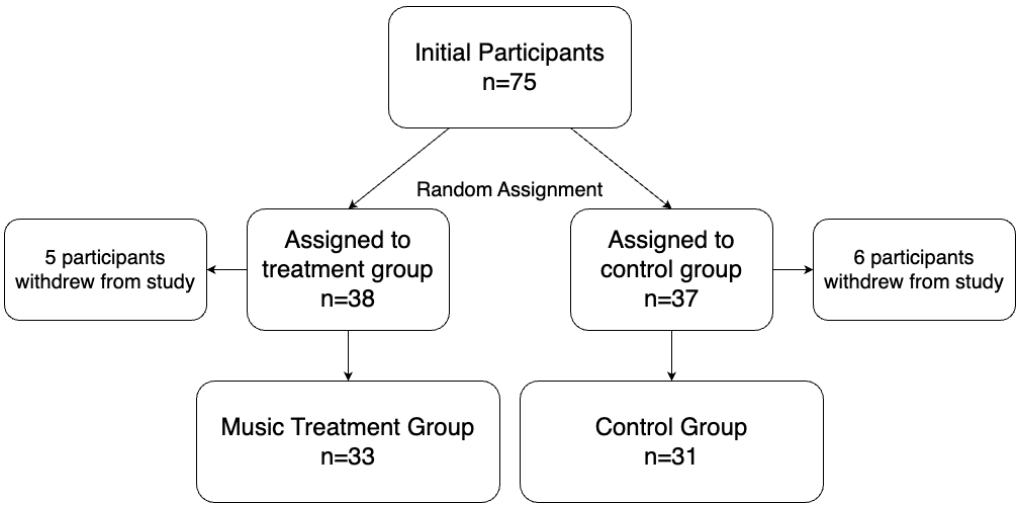


Figure 1: The random assignment of participants into the treatment group and the control group.

Exclusion Criteria

Any participants that had experienced or were previously diagnosed with any type of anxiety disorder were excluded from the study. This is because, according to Bandelow and Michaelis (2015), people with pre-existing anxiety disorders have different baseline levels of anxiety and stress reactivity. These participants cannot represent the general population and may confound the results of the study. Any participants that suffered

from impaired hearing were excluded from the study. Any participants that did not wish to participate were excluded from the study.

3.2 Materials

Both groups of participants underwent the experiment in identical rooms with exam conditions. The testing rooms were sufficiently far apart such that music played in one room cannot be heard in the other room. The music for the treatment group was played without earphones using audio speakers in the classroom at a comfortable volume.

According to the literature, the most significant effects on reducing anxiety have been observed on classical music (Burns et al., 2002; Labbé et al., 2007). The resources available in this experiment did not allow for multiple music treatment groups to compare between different genres of music, therefore to align with the mainstream literature, the music treatment group listened to a classical music piece chosen by the researcher, Prelude Op.28 No.15 by Frédéric Chopin. This piece is approximately six minutes long with a slow tempo, and has calming qualities.

Participants' state-anxiety levels were assessed with the Spielberger Test Anxiety Inventory, form Y1 (STAI-Y1) (Spielberger, 1983). This is a 20-item validated evaluation form for test anxiety, with each item being evaluated on a four-point scale ranging from 1 (not at all) to 4 (very much so). All studies mentioned in the previous literature review used STAI as one of their methods for evaluating the test anxiety of their participants (some used slightly altered versions of the same form for language clarity purposes specific to their treatment and participants). In the current study, the STAI-Y1 form was used to collect state anxiety levels of the participants. The Chinese version was used, and specific instructions for answering the pre-test and post-test surveys were included in the form (see Appendix B for details). This survey had a high internal consistency in the current sample (Cronbach's $\alpha = 0.9365$).

3.3 Procedure

Many research designs are employed in order to eliminate random variability between treatment and control groups. Lai et al. (2008) used a randomized crossover trial, in which each participant went through both treatment and control conditions in random order, and their anxiety responses were compared with themselves. Given the time limit of the current study, however, this design is not feasible. The most popular design used is a randomized controlled trial (RCT), which is a powerful research design because it eliminates any systematic differences between intervention groups due to known or unknown uncontrolled factors by random assignment of intervention (Sibbald & Roland, 1998). Accounting for feasibility and validity, the most suitable design for the current study is a randomized controlled trial.

In trying to explain why their results did not align with the mainstream literature, Goldenberg et al. (2013) conceded that only evaluating their participants' anxiety levels after the exam but not prior to the exam may be a source of bias. They also hypothesized that the effects of the music intervention was unnoticeable because their students scored relatively low on the anxiety scale in general, and the difference in anxiety levels between the two groups may become significant if the students had higher levels of anxiety to begin with. Therefore, a pre-test post-test design was used in this study in order to evaluate participants' anxiety levels both prior to and during the exam. This can also provide results to confirm a potential connection between the effectiveness of music treatment and students' initial anxiety levels, as hinted by the results of Lilley et al. (2014).

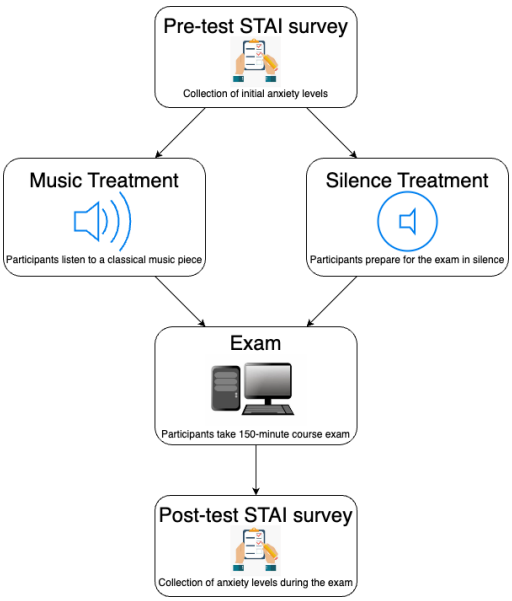


Figure 2: A flowchart of the study design.

After reviewing the relevant literature, it was decided that a pretest-posttest randomized controlled trial would be the most suitable research design for this study, as it can not only produce results to validate part of the existing literature, but examine potential reasons that explain the discrepancy in the literature as well. The exams in the given course are taken on computers, and are 150 minutes in length. After random assignment of treatment and control groups, all students are told to arrive at the exam room early to set up their computer environment for the exam. Upon arrival, pre-test anxiety levels were collected for every participant using STAI-Y1 forms. While setting up the environment, classical music is played in the background for the music treatment group. Both groups then took the exam simultaneously. After the exam, the participants answered the STAI surveys again, and were explicitly instructed to do so based on how they felt during the exam. The surveys were all distributed on paper and data was collected and prepared for analysis. Detailed procedure of this study is shown in Figure 2. Because this study required working with human subjects, approval was sought from and granted by the RDFZ International Curriculum Center Institutional Review Board (IRB). The approval form is included in Appendix A.

3.4 Data Preparation

There are three variables involved in this experiment. Post-test anxiety levels is the dependent variable being studied, and the music treatment, a binary variable, is the independent variable that is manipulated. The goal of the data analysis was to identify connections between the dependent and independent variables. Pre-test anxiety levels is also a variable in this study, and will be accounted for as a covariate in the data analysis process.

Pre-test and post-test anxiety scores were calculated as the sum of the scores for each question. According to the STAI-Y1 manual, 10 items would be scored positively (responses 1, 2, 3, and 4 corresponds to scores 1, 2, 3, and 4) and 10 items would be scored negatively (responses 1, 2, 3, and 4 corresponds to scores 4, 3, 2, and 1). The anxiety score is calculated as a sum of all item scores, with a maximum score of 80 and minimum score of 20 (Spielberger, 1983). A few participants skipped one or two

questions on the surveys. To account for this, their scores were calculated with the sum of the scores of questions that were not left blank, then standardized to the regular 20-question scale. If participants left more than two of the 20 items blank, they are removed from the analysis.

4 Data Analysis & Results

All data analysis tests are run with the Stata software.

Variable	Obs	Mean	SE	SD	95% Confidence Interval
pre	33	49.42424	2.4458	14.05005	[44.442231, 54.40617]
post	33	53.81212	2.368367	13.60523	[48.98792, 58.63633]
diff	33	−4.387879	2.210461	12.69813	[−8.89044, 0.1146825]

Degrees of Freedom	t-statistic	p-value
32	−1.9851	0.558

Table 1: Paired t-test results for pre-test and post-test anxiety scores of the music treatment group.

Two paired t-tests were run to evaluate the change in anxiety levels before and after the treatment for both the control group and the treatment group. According to literature, it was hypothesized that the treatment group will show a more significant decrease in anxiety than the control group. The results, however, did not support this. There were no significant differences in the pre-test and post-test anxiety levels of the treatment group (Table 1), with a p-value of 0.0558; meanwhile, post-test anxiety levels were significantly higher than pre-test anxiety levels for the control group ($p < 0.0001$, Table 2). These results did not allow for a conclusion to be reached on the effects of the music treatment, as the treatment group showed no significant change in anxiety. This led to the realization that there are more factors that explain the change in anxiety.

Variable	Obs	Mean	SE	SD	95% Confidence Interval	
pre	31	49.16129	1.975167	10.99726	[45.12746,	53.19512]
post	31	58.88452	1.85917	10.35107	[55.08771,	62.68132]
diff	31	−9.723226	1.891014	10.52872	[−13.58519,	−5.86126]

Degrees of Freedom	t-statistic	p-value
30	−5.1418	< 0.0001

Table 2: Paired t-test results for pre-test and post-test anxiety scores of the control group.

In order to isolate the effects of the music treatment on the reducing test anxiety, individual differences in initial anxiety levels must be controlled for. An analysis of covariance (ANCOVA) of post-test anxiety scores with pre-test scores and treatment showed that after controlling for individual differences in pre-test anxiety scores, the music intervention (listening to music before the exam) has a statistically significant effect on reducing self-reported anxiety scores during the exam compared to the control group ($p = 0.45$). Additionally, the test confirmed that pre-test anxiety scores were the

most significant predictor of anxiety during the exam ($p < 0.0005$), and there was high variability in how participants responded to the treatment based on their initial anxiety states. Extensive results for the test are shown in Table 3.

Source	SS	df	MS
Model	3234.31065	2	1617.15533
Residual	6314.60557	61	103.518124
Total	9547.91622	63	151.570099

Number of obs	=	64
$F(2, 61)$	=	15.62
Prob $> F$	=	0.0000
R-squared	=	0.3387
Adj R-squared	=	0.3170
Root MSE	=	10.174

post	Coef.	SE	t	$\mathbb{P} > \|t\|$	95% Confidence Interval
pre	0.5327898	0.1020242	5.22	0.000	[0.3287798, 0.7367998]
treatment	−5.212338	2.544981	−2.05	0.045	[−10.30134, −0.1233349]
_cons	32.69173	5.33816	6.12	0.000	[22.01742, 43.36604]

Table 3: ANCOVA results for post-test anxiety scores against pre-test scores and treatment.

In order to further account for individual randomness, a mixed-effects analysis was employed. The model showed very similar results. This test further supports the importance of pre-test anxiety in predicting post-test anxiety scores ($p < 0.0005$). After accounting for that influence on testing anxiety levels due to initial anxiety, the music intervention is found to significantly affect post-test anxiety scores ($p = 0.036$). The significant negative coefficient for the treatment variable (95% CI $[-10.0821, -0.3425751]$) implies that listening to music before an exam has a beneficial effect in reducing anxiety levels, aligning with the expectation that listening to music can be a calming activity that helps mitigate test anxiety. Full results are shown in Table 4. This analysis, by accounting for random effects (individual differences) and fixed effects (treatment and pre-test scores), provides a comprehensive understanding of the factors influencing post-test anxiety scores and supports the effectiveness of the treatment in reducing anxiety.

Log likelihood	=	− 237.74771	Wald $chi2(2)$	=	32.78
Number of obs	=	64	Prob $> chi2$	=	0.0000

post	Coef.	SE	z	$\mathbb{P} > \|z\|$	95% Confidence Interval
treatment	−5.212338	2.484619	−2.10	0.036	[−10.0821, −0.3425751]
pre	0.532789	0.0996044	5.35	0.000	[0.3375679, 0.72801]
_cons	32.69177	5.21155	6.27	0.000	[22.47732, 42.90622]

Random-effects Parameters	Estimate	SE	95% Confidence Interval
var(Residual)	98.66586	17.44182	[69.77411, 139.521]

Table 4: Mixed-effects model results for post-test anxiety scores against pre-test scores and treatment.

Based on the results for both the ANCOVA and the mixed-effects model, H_0 can be successfully rejected in favor of H_a, as both analyses show that the music treatment had a significant effect on reducing test anxiety in the studied population after controlling for other factors.

5 Discussion

This study aims to further evaluate the potential of music treatment to be an effective method in reducing test anxiety that has been supported by a small literature. Specifically, this experiment is a randomized controlled trial on undergraduate computer science students, a population that is under-represented in the literature.

My results suggest that listening to music prior to an exam has a significant positive influence on reducing anxiety during testing for undergraduate computer science students. These results are aligned with a majority of the literature (Galal et al., 2021; Ince & Çevik, 2017; Lai et al., 2008). Although both the control group and the treatment group experienced an increase in mean anxiety levels during the exam compared to before the exam started, the increase for the control group is statistically significant while that for the treatment group is not. Furthermore, the data suggests that a significant part of the variability in test anxiety levels is due to initial anxiety levels, and a significant effect of the music intervention can be observed after controlling for individual differences in initial anxiety levels. This partly explains why Goldenberg et al. (2013) did not see significant results for their experiment – they only recorded anxiety levels after the exam and could not account for individual differences in overall anxiety levels.

In addition, a high variability in individual responses to the music treatment was observed in the studied sample. Although this variation is strongly correlated with participants' initial anxiety levels, there was high individual randomness. This difference is observed in many other studies, and aligns with Burns et al. (2002) and Labbé et al. (2007)'s findings about how each individual experiences the largest reduction in anxiety after listening to different, self-selected music. This also means that the anxiety-reducing findings are significantly due to the chosen piece of music. Therefore, the current study can extend general literature results on the anxiety-reducing effects of classical music to the studied population, but does not provide implications for any other types of music.

The main contribution of the current study to the literature is that the results from this study led to the discovery of a trend that people with higher initial anxiety levels experience a more significant effect of listening to music. This trend may be visible on a larger sample size and may need to be further validated with more research. This implies that future research that aims to study the effect of music on anxiety should use high-anxiety participants or employ stronger anxiety-provoking conditioning in order to obtain more significant results.

6 Limitations

The current study is limited by a few aspects. Most importantly, the significance and generalizability of the results of this study is limited by its relatively small sample size. Because of the limited number of participants in the chosen course, a larger sample size is not accessible in the limited time that I have. Many tests report "somewhat" significant results, where the p value is very close to the 0.05 significance threshold. Nevertheless, the implications of this study provide valuable insights into a likely effect of listening to music on reducing test anxiety among undergraduate computer science students. Future research should build upon the results in this study and aim to validate and extend these results with a larger sample size.

In addition, the experiment was also limited by the researcher's lack of control over the exam itself. The experiment had to align with the scheduling of the Renmin University of China's Computer Science department. The exam that served as the stimuli for test anxiety was 150 minutes long, which is much longer than any of the testing conditions used in other studies (Galal et al., 2021; Goldenberg et al., 2013; Lilley et al., 2014). This meant that the post-test responses of the STAI survey would be less valid,

since longer time has passed and participants' recollection of their anxiety levels during the exam may have been inaccurate. Further studies can validate these current findings further by employing a more suitable test anxiety stimuli, like a 20-minute questionnaire.

Another limitation of this study is the limited access to equipment for data collection. While the STAI form is the most validated and most direct evaluation of the state-anxiety levels of participants, it is only collected twice in this study and cannot provide continuous evaluation of individuals' anxiety levels. With more resources, future researchers should avoid repeating the STAI survey too many times throughout their studies by collecting continuous physiological data like heart rate and blood pressure that reflect anxiety levels (Lilley et al., 2014). These data can be used to reinforce the STAI form responses, and evaluate how anxiety levels continuously change over time to gain further and more specific understanding of how listening to music may reduce testing anxiety.

Furthermore, the participants of the current study were all of Chinese ethnicity. The relationship between cultural background and effectiveness of music therapy is not clearly defined by the literature, despite many studies including participants from multiple ethnicity groups (Lilley et al., 2014). While Asians are an underrepresented ethnicity group in the current literature and this study can contribute to that gap, the generalizability of the current results are also limited to students of Asian ethnicity.

7 Conclusion

It was found that listening to classical music prior to an exam had a significant effect on the test anxiety levels of undergraduate computer science students. This result aligned with the more general literature. Furthermore, students with higher initial anxiety levels were found to be more responsive (experiencing a more significant drop in anxiety levels) to the music treatment. This explains some of the discrepancies in the existing literature and why some studies were not able to obtain significant results whilst others were.

These results imply that music's anxiety-reducing effects can extend to testing anxiety and for the general student body, not just medical students. If undergraduate students feel highly anxious prior to an exam they can reduce their anxiety significantly by listening to classical music.

References

Bandelow, B., & Michaelis, S. (2015). Epidemiology of anxiety disorders in the 21st century. *Dialogues in Clinical Neuroscience*, *17*(3), 327–335. Retrieved April 30, 2024, from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4610617/

Burns, J. L., Labbé, E., Arke, B., Capeless, K., Cooksey, B., Steadman, A., & Gonzales, C. (2002). The Effects of Different Types of Music on Perceived and Physiological Measures of Stress. *Journal of Music Therapy*, *39*(2), 101–116. https://doi.org/10.1093/jmt/39.2.101

Chapell, M. S., Blanding, Z. B., Silverstein, M. E., Takahashi, M., Newman, B., Gubi, A., & McCann, N. (2005). Test Anxiety and Academic Performance in Undergraduate and Graduate Students. *Journal of Educational Psychology*, *97*(2), 268–274. https://doi.org/10.1037/0022-0663.97.2.268

Finn, S., & Fancourt, D. (2018). The biological impact of listening to music in clinical and nonclinical settings: A systematic review. *Progress in Brain Research*, *237*, 173–200. https://doi.org/10.1016/bs.pbr.2018.03.007

Galal, S., Vyas, D., Hackett, R. K., Rogan, E., & Nguyen, C. (2021). Effectiveness of Music Interventions to Reduce Test Anxiety in Pharmacy Students. *Pharmacy*, *9*(1), 10. https://doi.org/10.3390/pharmacy9010010

Gebhart, V., Buchberger, W., Klotz, I., Neururer, S., Rungg, C., Tucek, G., Zenzmaier, C., & Perkhofer, S. (2020). Distraction-focused interventions on examination stress in nursing students: Effects on psychological stress and biomarker levels. A randomized controlled trial. *International Journal of Nursing Practice*, *26*(1), e12788. https://doi.org/10.1111/ijn.12788

Goldenberg, M. A., Floyd, A. H. L., & Moyer, A. (2013). No Effect of a Brief Music Intervention on Test Anxiety and Exam Scores in College Undergraduates. *Journal of Articles in Support of the Null Hypothesis*, *10*(1), 1. https://www.jasnh.com/pdf/Vol10-No1-article1.pdf

Gosselin, K. P., Holland, B., Mulcahy, A., Williamson, S., & Widacki, A. (2016). Music for Anxiety Reduction and Performance Enhancement in Nursing Simulation. *Clinical Simulation In Nursing*, *12*(1), 16–23. https://doi.org/10.1016/j.ecns.2015.12.002

Hou, J., Song, B., Chen, A. C. N., Sun, C., Zhou, J., Zhu, H., & Beauchaine, T. P. (2017). Review on Neural Correlates of Emotion Regulation and Music: Implications for Emotion Dysregulation. *Frontiers in Psychology*, *8*, 501. https://doi.org/10.3389/fpsyg.2017.00501

Ince, S., & Çevik, K. (2017). The effect of music listening on the anxiety of nursing students during their first blood draw experience. *Nurse Education Today*, *52*, 10–14. https://doi.org/10.1016/j.nedt.2017.02.009

Jeppesen, E., Pedersen, C. M., Larsen, K. R., Walsted, E. S., Rehl, A., Ehrenreich, J., Schnoor, S., & Backer, V. (2019). Listening to music prior to bronchoscopy reduces anxiety – a randomised controlled trial. *European Clinical Respiratory Journal*, *6*(1), 1583517. https://doi.org/10.1080/20018525.2019.1583517

Koelsch, S. (2014). Brain correlates of music-evoked emotions. *Nature Reviews Neuroscience*, *15*, 170–180. https://doi.org/10.1038/nrn3666

Labbé, E., Schmidt, N., Babin, J., & Pharr, M. (2007). Coping with Stress: The Effectiveness of Different Types of Music. *Applied Psychophysiology and Biofeedback*, *32*(3), 163–168. https://doi.org/10.1007/s10484-007-9043-9

Lai, H.-L., Chen, P.-W., Chen, C.-J., Chang, H.-K., Peng, T.-C., & Chang, F.-M. (2008). Randomized crossover trial studying the effect of music on examination anxiety. *Nurse Education Today*, *28*(8), 909–916. https://doi.org/10.1016/j.nedt.2008.05.011

Lecamwasam, K., Gutierrez Arango, S., Singh, N., Elhaouij, N., Addae, M., & Picard, R. (2023). Investigating the Physiological and Psychological Effect of an Interactive Musical Interface for Stress and Anxiety Reduction. *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*, 1–9. https://doi.org/10.1145/3544549.3585778

Lilley, J. L., Oberle, C. D., & Thompson Jr., J. G. (2014). Effects of music and grade consequences on test anxiety and performance. *Psychomusicology: Music, Mind, and Brain*, *24*(2), 184–190. https://doi.org/10.1037/pmu0000038

Liu, Y., Pan, H., Yang, R., Wang, X., Rao, J., Zhang, X., & Pan, C. (2021). The relationship between test anxiety and emotion regulation: The mediating effect of psychological resilience. *Annals of General Psychiatry*, *20*(1), 40. https://doi.org/10.1186/s12991-021-00360-4

Panteleeva, Y., Ceschi, G., Glowinski, D., Courvoisier, D. S., & Grandjean, D. (2018). Music for anxiety? Meta-analysis of anxiety reduction in non-clinical samples. *Psychology of Music*, *46*(4), 473–487. https://doi.org/10.1177/0305735617712424

Putwain, D. W., Jansen in de Wal, J., & van Alphen, T. (2023). Academic Buoyancy: Overcoming Test Anxiety and Setbacks. *Journal of Intelligence*, *11*(3), 42. https://doi.org/10.3390/jintelligence11030042

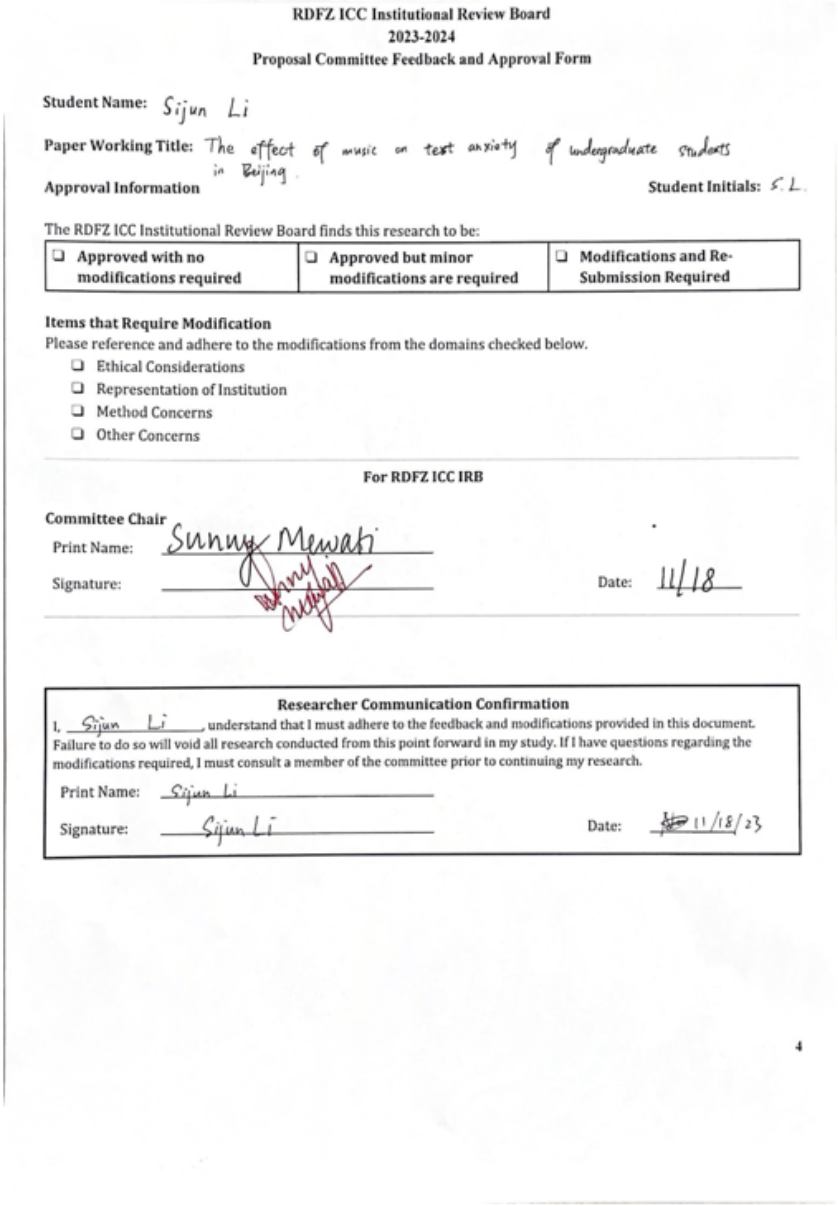
Quek, T. T.-C., Tam, W. W.-S., Tran, B. X., Zhang, M., Zhang, Z., Ho, C. S.-H., & Ho, R. C.-M. (2019). The Global Prevalence of Anxiety Among Medical Students: A Meta-Analysis. *International Journal of Environmental Research and Public Health*, *16*. https://doi.org/10.3390/ijerph16152735

Sibbald, B., & Roland, M. (1998). Understanding controlled trials. Why are randomised controlled trials important? *British Medical Journal*, *316*(7126), 201. https://doi.org/10.1136/bmj.316.7126.201

Spielberger, C. D. (1983). *Manual for the State-Trait Anxiety Inventory STAI (Form Y)*. Palo Alto, CA: Consulting Psychologists Press.

Thoma, M. V., Marca, R. L., Brönnimann, R., Finkel, L., Ehlert, U., & Nater, U. M. (2013). The Effect of Music on the Human Stress Response. *PLOS ONE*, *8*(8), e70156. https://doi.org/10.1371/journal.pone.0070156

A IRB Approval Form



RDFZ ICC Institutional Review Board
2023-2024
Proposal Committee Feedback and Approval Form

Student Name: Sijun Li

Paper Working Title: The effect of music on test anxiety of undergraduate students in Beijing.

Approval Information **Student Initials:** S. L.

The RDFZ ICC Institutional Review Board finds this research to be:

❑ Approved with no modifications required	❑ Approved but minor modifications are required	❑ Modifications and Re-Submission Required

Items that Require Modification
Please reference and adhere to the modifications from the domains checked below.

- ❑ Ethical Considerations
- ❑ Representation of Institution
- ❑ Method Concerns
- ❑ Other Concerns

For RDFZ ICC IRB

Committee Chair
Print Name: Sunny Mewati
Signature: Sunny Mewati Date: 11/18

Researcher Communication Confirmation
I, Sijun Li, understand that I must adhere to the feedback and modifications provided in this document. Failure to do so will void all research conducted from this point forward in my study. If I have questions regarding the modifications required, I must consult a member of the committee prior to continuing my research.
Print Name: Sijun Li
Signature: Sijun Li Date: 11/18/23

4

B STAI-Y1 Forms Chinese Version

问卷编号: 学号:

考前焦虑问卷

对于下面每一个表述，请从四个选项中选出一个最能体现你当下感受的。这些问题没有正确答案，不要在某一选项上犹豫，只需快速在你认为最恰当的一个选项上画 √ 。

编号	问题	①完全没有	②有些	③中等程度	④非常明显
1	我感到心情平静	①	②	③	④
2	我感到安全	①	②	③	④
3	我感到紧张	①	②	③	④
4	我有压力	①	②	③	④
5	我感到轻松	①	②	③	④
6	我感到烦躁	①	②	③	④
7	我正为某事感到担心	①	②	③	④
8	我感到满意	①	②	③	④
9	我感到害怕	①	②	③	④
10	我感到舒适	①	②	③	④
11	我对自己有信心	①	②	③	④
12	我感到焦虑	①	②	③	④
13	我感到不安	①	②	③	④
14	我感到优柔寡断	①	②	③	④
15	我很放松	①	②	③	④
16	我感到心满意足	①	②	③	④
17	我感到担忧	①	②	③	④
18	我感到疑惑不解	①	②	③	④
19	我感觉镇定	①	②	③	④
20	我感到愉快	①	②	③	④

此表中得到的任何原始数据将不会以任何形式发布，你的回答将被匿名化后用于研究报告中。

问卷编号:　　学号:

考中焦虑问卷

对于下面每一个表述，请从四个选项中选出一个最能体现你在考试中的感受的。不需在某一选项上过度考虑，只需快速在你认为（对于**考试期间的感受**）最恰当的一个选项上画 √ 。

编号	问题	①完全没有	②有些	③中等程度	④非常明显
1	我感到心情平静	①	②	③	④
2	我感到安全	①	②	③	④
3	我感到紧张	①	②	③	④
4	我有压力	①	②	③	④
5	我感到轻松	①	②	③	④
6	我感到烦躁	①	②	③	④
7	我正为某事感到担心	①	②	③	④
8	我感到满意	①	②	③	④
9	我感到害怕	①	②	③	④
10	我感到舒适	①	②	③	④
11	我对自己有信心	①	②	③	④
12	我感到焦虑	①	②	③	④
13	我感到不安	①	②	③	④
14	我感到优柔寡断	①	②	③	④
15	我很放松	①	②	③	④
16	我感到心满意足	①	②	③	④
17	我感到担忧	①	②	③	④
18	我感到疑惑不解	①	②	③	④
19	我感觉镇定	①	②	③	④
20	我感到愉快	①	②	③	④

此表中得到的任何原始数据将不会以任何形式发布，你的回答将被匿名化后用于研究报告中。