

The Effects of Music and Movies on Dental Anxiety

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Abstract

The main purpose of this study was to determine methods that alleviate physiological symptoms of dental anxiety. Past studies have shown that visual presentations of dental stimuli lead to increases in the sweat gland response measured by skin conductance. Previous research focused on the behavioral impact of movies or music on dental anxiety. However, the physiological effects have yet to be examined. For this study, participants were presented with dental tools and images of dental tools while their skin conductance responses were recorded. Participants were placed into one of three groups; the movie group had a movie playing while they performed the task, the music group had music playing while they performed the task, and the control group had nothing in the background while they performed the task. The data indicated that music listening was more effective at alleviating physiological symptoms than movie watching while being exposed to dental tools. Surprisingly, this was even more evident for those who were exposed to images of tools and less so for those presented with the actual dental tools. This pattern was strongest for those participants who scored as anxious on the Dental Anxiety Scale.

Keywords: dental anxiety, psychophysiology, skin conductance

1. Introduction

Dental Anxiety (DA) is an abnormal fear or dread of visiting the dentist for preventive care or therapy and unwarranted anxiety over dental procedures¹. DA affects patients worldwide, an issue prevalent in Western and Eastern countries such as the United Kingdom, Germany, Australia, Sweden, China, Iran, and Singapore^{2,3}. In North America alone, approximately 1 in 5 adults are affected by DA which leads to avoidance behaviors of dental treatment⁴. Other data indicates that as many as 80% of Americans have some anxiety regarding dental treatment³.

However, DA is not the only concern for patients receiving treatment. The scarcity of proper dental insurance also plays a role in DA. An estimated 49 million people in the US do not have access to a dental care provider⁵ due to insurance network access regulations and geographic residency. Additionally, 47 million Americans who have private health insurance do not have dental insurance⁵. These limitations play a role in perpetuating dental care avoidance. Furthermore, the lack of regular appointments can lead to larger dental issues such as cavities, tooth decay, or gum disease which can worsen DA symptoms. Regardless of insurance availability, Americans avoid dental appointments due to their fear of procedures and potential pain. Therefore, it is not enough to have coverage and access to providers, but it is important to also treat the underlying anxiety that keeps patients away from the dentist.

Park and colleagues⁶ conducted a study to examine the relationship between socioeconomic status and dental care. Their study evaluated how different socioeconomic statuses affected oral hygiene. The researchers evaluated participants' socioeconomic status, oral health behavior and their physical health. The results aligned with previous findings as they found that oral health is significantly associated with various systemic diseases such as cardiovascular disease, diabetes mellitus, chronic respiratory disease and rheumatoid arthritis^{7,8}. Moreover, another study conducted⁹

on Chilean adults found that individuals who have low paying jobs tend to have a higher degree of clustering of multiple risk factors for poor dental hygiene, as compared with those in higher socioeconomic positions.

DA induces both physiological and behavioral manifestations which impacts a patient's compliance to dental visits and impacts their overall health. Behavioral alterations of patients because of DA includes restlessness, irritation, and avoidance of the dentist. This is a particular concern in pediatric dentistry¹⁰. However, researchers found that dentist office atmosphere, veracity of the dentist, and communicative abilities of the dentist played a role in whether a child was cooperative or uncooperative¹⁰. DA also evokes physiological symptoms such as palpitation, palmar sweating, and excess saliva secretion. Patients with severe dental anxiety can suffer from intense symptoms such as tachycardia (faster than normal heart rate) or high blood pressure¹¹. Palmar sweating is a common physiological symptom among young children when visiting the dentist office, thus demonstrating their fear and anxiety of the procedure. Kato and colleagues¹² worked with the Department of Pediatric Dentistry in Japan to assess the state of stress, fear, and anxiety of children by measuring the amount of physiological palmar sweating while at the dentist office. The study had a sample size of 12 boys (mean age of 4.9 years) and 12 girls (mean age 5.3 years). The researchers measured participants' palmar sweating in three different locations: the waiting area, on the dental chair, and during dental procedure (e.g., tooth brushing and turbine sound). Significant amount of palmar sweating in children was observed as they were guided to the dental chair from the waiting area. Secondly, the turbine sound caused more palmar sweating than tooth brushing during the procedure. Lastly, the girls exhibited a significantly larger amount of palmar sweating than did the boys¹². It is possible that the significant differences in palmar sweating between both genders are due to cultural norms allowing more emotional displays from girls than boys underlying this effect¹³.

DA is a prevalent issue in children and young adults that causes several challenges for dentists when providing treatment for their patients. Numerous psychologists and scientists have stated that this fear often manifests itself during childhood, which is usually due to traumatic past experiences and modelling. Ollendick and King¹⁴ describe children's dental fear as resulting from observing others' (e.g., media, friends, family) anxious behaviors leading to a vicarious threat response. These observations of others' fear towards dental procedures are most likely internalized and create some level of dental anxiety. Moreover, a study conducted by Öst and Hugdahl¹⁵ on young adults' notes that 13% of their dental phobia were traced from vicarious experiences during childhood. Additionally, the presence of dental tools, sounds and smells associated with the dentists' office are generally frightening and likely to increase the fear response. For example, Kleinknecht and colleagues¹⁶ found that anesthesia needles, drills, and other dentistry tools are the greatest source of fear that increases a patient's dental anxiety. The dental tools along with the invasive procedures may be disturbing enough to the patient that they limit follow-up treatment or fail to schedule future appointments.

Another causal mechanism of DA is patients' exposure to dentists with poor bedside manners. For instance, Milgrom and colleagues¹⁷ found that young adults were nine times more likely to be anxious of dental treatment if they thought their dentist was unsympathetic. This is because individuals are more appreciative with dentists who are more sensitive to their anxieties. Moreover, Weinstein and colleagues^{18,19} found that dentists who were coercive towards patients struggled with uncooperative and agitated behavior during the procedure. In contrast, dentists who utilized a more sympathetic and friendly approach had more success getting cooperation and their patients reported being less anxious and more at ease during the entire procedure. Townsend and colleagues²⁰ also found that dentists' chairside manner affected patients' stress and anxiety which then affected their behavior during the procedure. These authors indicated that dentists could modulate a patients' anxious behavior by being responsive to their needs.

Dentists can provide nitrous oxide to their patients that is inhaled before and during a procedure¹¹. However, the inhalation of nitrous oxide may cause very unpleasant side effects¹¹. This treatment option is not accessible for uninsured and under-insured individuals. It may also not be an option for those in rural communities or even those with full dental coverage, as insurance companies do not view this treatment as necessary. Therefore, patients must pay the difference if they choose to receive nitrous oxide. In a study by Zhang and colleagues²¹, patients were given nitrous oxide and were asked to watch a movie of their choice as the dentist performed a dental extraction. The movie was included during the dental procedure to assess its effectiveness in reducing their anxiety by creating a distraction. During the procedure, the researchers recorded patients' heart rates, respiration rates, blood pressure, and lowest arterial oxygen saturation prior to being sedated and every five minutes during the dental extraction. Zhang and colleagues²¹, findings showed that movie intervention was effective at steering patients' attention from dental tools (such as syringes, scalpels, and dental forceps) and procedures. Thus, causing lower levels of patients' heart rate, respiration rate and blood pressure. In addition, patients who were given nitrous oxide only (no movie) remained nervous as they continued to focus their attention on the local anesthesia syringe, the noisy drill, the bright light and other dental tools²¹.

Music therapy is another intervention that some dentists have utilized to reduce DA in patients and improve their overall experience during an appointment. Music therapy has been used in multiple clinical settings to test its

effectiveness in affecting one’s mood and reducing pain during a dental procedure²². Apart from music therapy, which is used to alleviate dental anxiety, Kemp²³ assessed various behavioral modification techniques that are applied to resistance of dental treatment. Some techniques are modelling, desensitization, education/information, parent control and distraction (listening to music, watching a movie or comedy show). Desensitization is a behavioral technique in which the patient is gradually exposed to the fear object or situation-- dental instruments or simulations of dental procedures (tooth extraction and root canals etc.). Kemp²³ found that desensitization is effective but expensive because it requires several therapy sessions. In modelling, the patients observe a similar procedure being done on someone else either live or recorded. During the session, the patients get exposed to some coping mechanisms that are being used by the individual in real life or video. Research by Allen and Stokes²⁴ concludes that modelling is generally effective for patients resisting dental treatment or feeling apprehensive.

The purpose of the current study was to assess the effectiveness of music or a movie in reducing dental anxiety. Participants were presented with visual images of dental tools while recording their skin conductance responses (SCR). Some participants were presented with the physical dental tools while others were presented with pictures of the dental tools. These Stimulus Type groups were randomly assigned. Additionally, participants were placed into one of three conditions; the movie group had a movie playing while they performed the task, the music group had music playing while they performed the task, and the control group had nothing in the background. Finally, this study focused on how individual differences in general dental anxiety as a trait affected SCR while viewing dental tools (or images) in the various conditions. Toward this goal, we had participants complete dental anxiety assessments and categorized individuals into anxious versus non-anxious groups. Thus, the experimental design was a 3 *Conditions* x 2 *Stimulus Types* x 2 *Dental Anxiety Levels* Between Subjects design. Based on previous literature it was hypothesized that the Music and Movie groups would exhibit reduced SCR compared to the control group while viewing the dental tools. We were also interested in testing two other exploratory hypotheses. First, that the presentation of images of dental tools would not activate the autonomic system as much as the presentation of the tools themselves. Second, that those who scored high on the Dental Anxiety scale would exhibit increased SCR and that this would interact with condition and stimulus type.

2. Methods

2.1. Participants

The participants in this study were 49 undergraduate students (44 females and 5 males) enrolled in Psychology 101 and other upper level psychology courses. Each subject received extra credit in their course for participating in the study. All participants gave informed consent, were informed that they would be de-identified, and that they could withdraw participation at any point during the study. Grades were not penalized for those who chose not to participate or opt out at any given time during the study. The mean age of our sample was 21(*SD*= 3.48). The sample was predominantly female (90%) and primarily Caucasian (66%; 14% African American; 11% Bi-racial, 6.8% Hispanic, 2% Asian American). A full breakdown of participant demographics can be found in Table 1.

Table 1. Participant demographics

Race	Male	Female	Total
White	3	29	32
African American	1	6	7
Hispanic	-	3	3
Asian	-	1	1
Mixed Race	1	5	6
Total	5	44	49

2.2. Measures

2.2.1. *beck depression inventory*

Participants were asked to complete the Beck Depression Inventory-II (BDI-II)²⁵ for screening purposes. The BDI-II is a depression inventory for adults and adolescents that consists of 21 self-report items. Not typically used as a diagnostic tool, it provides a good indication of individuals experiencing depressive episodes based on 2 weeks of symptoms. The inventory requires 6th grade reading comprehension and takes under 15 minutes to complete and to be scored²⁶. Beck and colleagues²⁵ found an internal consistency of .92 and test-retest reliability of .93. Individuals who scored high (above 14) on the report were flagged and prevented from participating in the research. Additionally, any participant who scored above 20 was also referred to the Salisbury University counselling center. Participants who were excluded from the research still received extra credit.

2.2.2. *norman corah dental anxiety scale*

The Norman Corah Dental Anxiety Scale (DAS-R)²⁷ consists of 4 multiple choice items asking the participant how they would respond to various events associated with visiting a dental office (e.g., planning a trip to the dentist, waiting in the dental office to be called, sitting in the dentist's chair while watching the tools be prepared). Each item has 5 possible responses and are scored by using the following format: a=1, b=2, c=3, d=4, e=5. The total sum score possible is 20 points. Patients scoring 9-12 points are considered to have moderate dental anxiety, those scoring 13-14 points are considered to have high dental anxiety, and individuals who score 15-20 points are considered to have severe dental anxiety. The scale's validity and reliability has been widely accepted and is used in numerous dental facilities^{27,28,29}. Internal consistency has been found to be .85²⁹ and reliability has been found to be .82^{30,31}. Further, Ilguy and colleagues²⁸ suggest the DAS-R is a sensitive and specific test as well. These items were programmed into E-prime and presented, one question at a time, to the participants who responded with button presses on the keyboard.

2.2.3. *dental concerns assessment*

The Dental Concern Assessment (DCA)³² is made up of 26 three-point Likert scale items (1=low anxiety; 3=high anxiety) asking about specific aspects of the dental office experience (e.g., sights, sounds, and sensations associated with equipment or personnel). A score of 2 or higher on any of the items is considered to indicate anxiety towards the dental procedure being queried. The DCA items were programmed into E-prime and presented, one question at a time, to the participants who responded with button presses on the keyboard.

2.2.4. *stress response to stimuli*

The participant's stress response to the presentation of the dental stimuli was measured by self-report and by recording skin conductance responses (SCR). The DAS-R and DCA were measured by presenting the participant with a question on-screen via E-prime asking them to respond, on a 5-point Likert scale (1=Not Stressful; 5=Very Stressful), how anxious the dental stimulus in front of them was making them. To measure their SCR, electrodes were placed on participants' non-dominant hand and the signal was amplified and recorded using Biopac (Goleta, CA) MP-150 equipment. After placing the electrodes on two of their fingertips, participants were asked to remain still for about 1-2 minutes before beginning the experiment to collect baseline SCR data.

2.3 Procedure

Experimental procedures took place in the Laboratory for Psychological Science in the East Campus Complex at Salisbury University. Upon arrival, participants were seated in the waiting area and were given a consent form, demographic questionnaire, and the BDI-II to complete. Once the forms were completed and written consent obtained, experimenters confirmed that the participant understood the purpose of the study and what the procedures entailed. Consent was verbally confirmed before the experimenter escorted the participant to the testing area. Participants were seated at a table in front of a computer and keyboard. Once seated, the experimenters attached electrodes to the middle

of the pointer finger and the middle of the middle finger. Once the electrodes were attached, the participants were asked to remain still for two minutes before the experiment began.

2.3.1 random assignment to experimental conditions

The participants were randomly assigned to an Intervention group (music, movie, or control) and Stimulus Type condition (real stimulus or image stimulus). Participants in the Music Intervention (MS) group listened to an Apple music station (No Lyric Playlist) during the experimental procedures. Those in the Movie Intervention (MV) group watched “The Incredibles” during the experimental procedures. The participants assigned to the Control group were exposed to no movies or music during the experimental procedures. Finally, participants assigned to the Real Stimulus (RS) condition were presented with actual dental stimuli while those in the Image Stimulus (IS) condition were presented with pictures of dental stimuli.

2.3.2. stimulus presentation

After being connected to the transducers the experiment began. For the MV group, the movie was started and for the MS group the music was played. The control was not presented with any movie or music intervention. Then participants were presented with four dental stimuli (dental bone saw, dental forceps, dental syringe and dental scaler) while SCR was recorded. As described previously, for the participants on the RS condition these stimuli were the actual dental instruments while the participants in the IS condition were shown images of the dental instruments. While each stimulus was presented, on screen the participants viewed a 5-point Likert scale item asking how anxious the stimulus made them. Once the participant entered a response on the keyboard the next stimulus was presented. After the four stimuli were presented, the participants completed the DAS-R and DCA on the computer. Upon completion of these tasks, each participant was debriefed, provided with a copy of the consent form, given an opportunity to ask questions, and escorted out of the lab.

3. Results

3.1. Skin Conductance

Table 2 shows the descriptive statistics for the mean SCR amplitude obtained within each Condition x Stimulus Type x Dental Anxiety Level group. Assumption of normality was observed to be satisfied for each of the variables³³. Additionally, we verified that the assumption of homogeneity of variance was satisfied according to Levene’s *F* test for Condition ($F(2,30)=1.39, p=.27$), Stimulus Type ($F(1,31)=0.19, p=.67$), and Dental Anxiety Level ($F(1,31)=0.005, p=.94$).

Table 2. Mean SCR amplitude of Condition x Stimulus Type x Dental Anxiety Level Group

	N	M	SD	Skew	Kurtosis
Condition					
Control	12	11.3	2.48	0.57	-0.87
Music	9	8.23	3.62	0.46	-1.2
Movie	12	11.1	5.16	1.3	1.01
Stimulus Type					
Real	17	10.5	4.13	0.52	0.27
Image	16	10.27	4.08	1.54	4.03
Dental Anxiety Level					
Non-Anxious	15	10.87	3.81	0.93	0.74
Anxious	18	9.99	4.29	1.13	2.66

The SCR amplitude measures were submitted to a 2 (Stimulus Type) x 3 (Condition) x 2 (Dental Anxiety Score) ANOVA. A significant main effect of Condition ($F(2,21) = 8.8, p < .01, \eta^2 = .46$) was observed. Figure 1 shows the

mean SCR amplitude for each of the 3 groups. Bonferroni -corrected post hoc t-tests (family wise error rate set at .05) indicated that the music group ($M=8.23$ S, $SD=3.62$) attained significantly lower SCR amplitude than the control ($M=11.30$ S, $SD=2.48$) and movie ($M=11.10$ S, $SD=5.16$) groups. No significant main effect of Image Type ($F(1,21)=0.75$, $p=0.40$, $\eta^2=.04$) or Dental Anxiety Score ($F(2,21)=0.004$, $p=.95$, $\eta^2=.0002$) was observed.

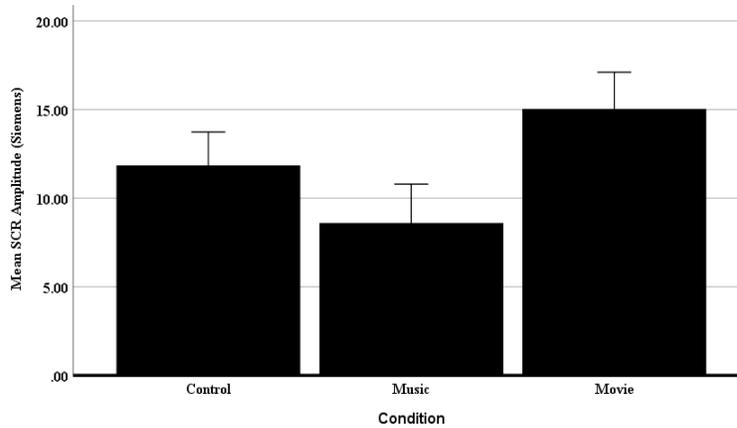


Figure 1. Mean SCR amplitude for each condition

Music Intervention was more effective in reducing Stress Conductive Response (SCR) in comparison to Movie Intervention and no intervention.

A significant Condition x Stimulus Type interaction was observed ($F(2,21)=3.61$, $p<.05$, $\eta^2=.26$). Figure 2 shows the mean SCR amplitude for the 3 conditions grouped by Stimulus Type. Post-hoc analyses indicated that in the Real Stimuli group, participants exhibited significantly different mean SCR amplitude responses depending on their assigned Condition ($F(2,11)=8.00$, $p<.01$, $\eta^2=.59$). Specifically, participants who viewed Real Stimuli in the Music condition attained significantly lower mean SCR amplitude ($M=5.91$ S, $SE=1.66$) compared to the Control ($M=13.10$ S, $SE=1.47$; $p<.05$) or Movie condition ($M=14.80$ S, $SE=1.47$; $p<.01$). There was no significant difference between the Control and Movie condition when viewing Real Stimuli ($p=.45$). Post-hoc analyses further indicated that in the Image group participants did not exhibit significantly different mean SCR amplitude responses between Conditions ($F(2,10)=3.43$, $p=.07$, $\eta^2=.41$).

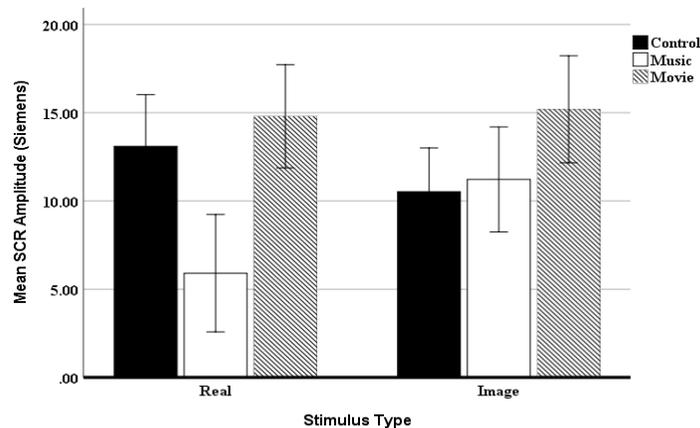


Figure 2. Mean SCR amplitude for condition by stimulus type

Participants in the Music Intervention condition produced less SCR when exposed to dental tools rather than images of tools, whereas participants in the No Intervention condition produced higher SCR when exposed to dental tools instead of images.

A significant Stimulus Type x Dental Anxiety Level interaction ($F(1,21)=4.78, p<.04, \eta^2=.19$) was observed. Figure 3 shows the mean SCR amplitude for the 2 Stimulus Type groups by Dental Anxiety Level. Post-hoc analyses indicated that Anxious individuals (those who scored 9 or higher on the DAS-R) exhibited significantly higher SCR mean amplitude responses to Images ($M=13.67$ S, $SE=1.12$) as opposed to Real Stimuli ($M=9.99$ S, $SE=1.17$; $F(1,12)=5.00, p<.05, \eta^2=.29$). There was no significant difference in mean SCR responses to Images versus Real Stimuli for non-anxious participants.

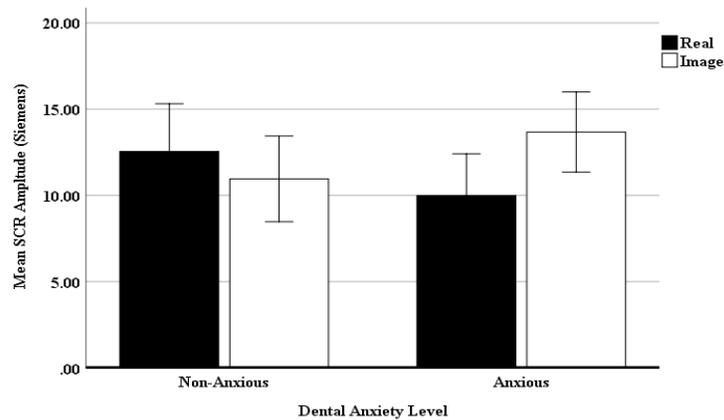


Figure 3. Mean SCR for stimuli type and dental anxiety level

Participants who reported not having dental anxiety produced slightly higher SCR when exposed to dental tools compared to participants who reported having dental anxiety. Reversely, participants who reported having anxiety exhibited slightly higher SCR when exposed to images of dental tools compared to non-anxious participants.

Figure 4 shows a significant 3-way interaction ($F(2,21)=15.15, p<.0001, \eta^2=.59$). Post-hoc analyses indicated a significant Condition x Stimulus Type interaction for Anxious ($F(2,12)=7.60, p<.01, \eta^2=.56$) and Non-Anxious Participants ($F(2,9)=8.78, p<.01, \eta^2=.66$). However, further analyses showed that significant differences between Condition was only apparent for Anxious participants who viewed the Image Stimuli ($F(2,6)=9.54, p<.05, \eta^2=.76$). There was no significant differences observed between Condition for Anxious participants who viewed the Real Stimuli ($F(2,6)=4.15, p=.07, \eta^2=.58$) or for the Non-Anxious participants who viewed Image ($F(2,4)=3.17, p=.15, \eta^2=.61$) or Real Stimuli ($F(2,5)=5.34, p=.05, \eta^2=.68$). Specifically, for the anxious participants viewing Image Stimuli, those in the Movie ($M=22.12$ S, $SE=2.84$) group exhibited significantly greater mean amplitude SCR than those in either the Music ($M=8.58$ S, $SE=1.27; p<.01$) or Control ($M=10.33$ S, $SE=1.67; p<.05$) groups. There was no significant difference in SCR amplitude responses for Music versus Control groups ($p=.43$).

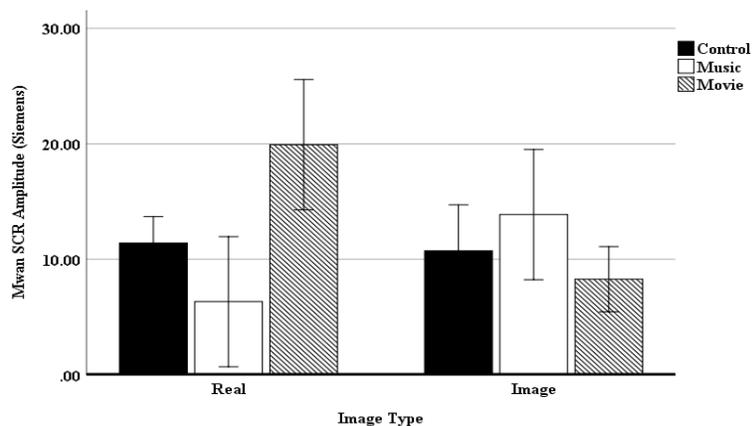


Figure 4a. Mean SCR amplitude condition x stimulus type for non-anxious participants

Non-anxious participants in the music intervention condition produced significantly less SCR when exposed to dental tools instead of images of tools, whereas, non-anxious participants in the movie intervention condition produced significantly higher SCR when exposed to dental tools instead of images.

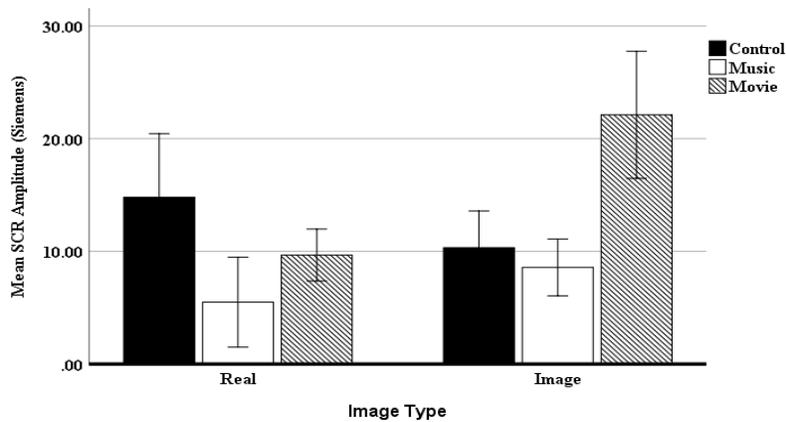


Figure 4b. Mean SCR amplitude condition x stimulus type for anxious participant

In the Real stimulus, participants reported being less anxious when listening to music than individuals in the movie and control group. In the Image stimulus, participants in the movie group reported being extremely anxious, meaning movie intervention was a less effective distractor. Participants who reported dental anxiety in the movie intervention condition exhibited significantly higher SCR when exposed to images of tools rather than physical dental tools.

3.1.1 self-report responses

Participants' self-reported anxiety level in response to the dental stimuli were submitted to a 3 (Condition) x 2 (Stimulus Type) x 2 (Dental Anxiety Score) ANOVA. A significant main effect of Dental Anxiety Score was observed ($F(1,21) = 4.76, p < .05, \eta^2 = .19$). Figure 5 shows the average self-reported anxiety level response for Anxious versus Non-Anxious participants. Anxious participants responded with significantly higher self-report anxiety levels ($M = 3.06, SE = 0.21$) to the dental stimuli than did the Non-Anxious participants ($M = 2.36, SE = 0.23$). There was no significant main effect of Stimulus Type of Condition and no significant interactions.

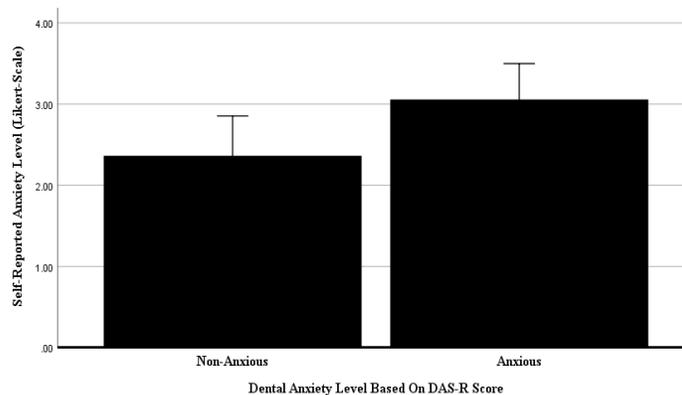


Figure 5. Mean self-reported anxiety level to dental stimuli

Non-anxious participants scored lower on the DAS; Anxious participants scored high on the DAS.

Participants' self-reported anxiety level reaction times were submitted to a 3 (Condition) x 2 (Stimulus Type) x 2 (Dental Anxiety Score) ANOVA. A significant main effect of Stimulus Type was observed ($F(1,21) = 5.32, p < .05$,

$\eta^2=.20$). Figure 6 shows the average self-reported anxiety level reaction time to Real Stimuli versus Images. Participants assigned to the Images ($M=6547.57$ ms, $SE=666.71$) group took significantly longer to record their responses than did those in the Real Stimuli group ($M=4284.7$ ms, $SE=720.38$). There was no significant main effect of Condition or Dental Anxiety Level nor were any significant interactions observed.

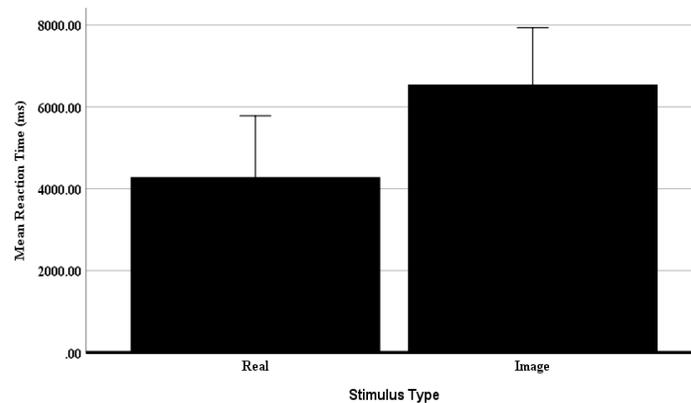


Figure 6. Mean Reaction Times for Real Stimuli Versus Images

Participants in the RS condition quickly reacted once the dental tool was displayed meanwhile those in IS condition reaction was slower.

4. Discussion

These findings partially support the main hypothesis that the intervention conditions (Music and Movie) would exhibit reduced SCR while viewing dental tools. Indeed, music intervention conditions proved to be better than the movie or control conditions at reducing SCR. These findings are aligned with those of Klassen and colleagues²² and Kemp²³. Klassen and colleagues²² found music therapy effective at reducing dental pain, while Kemp²³ found that music was an effective distraction for patients with dental anxiety. Participants in the music intervention condition produced smaller SCR consistently, regardless of stimulus type or dental anxiety scale score. However, the movie group's SCR responses were not significantly different from the control group. Further, there was no evidence of behavioral differences (self-reported anxious responses to the dental stimuli) between the 3 conditions. Participants reported the same levels of anxiety in response to viewing dental stimuli across all conditions and did not differ in their reaction times to the stimuli.

While it was predicted that anxiety level would have an impact on how participants were affected by the stimulus type or condition, this was only partially supported. Anxious individuals produced higher SCR when presented images of stimuli as opposed to the real stimuli. However, this difference was not significant for non-anxious individuals. Further, levels of dental anxiety did not significantly interact with condition (Music vs. Movie vs. Control). Thus, anxious and non-anxious individuals' responses varied similarly within each of the three intervention conditions.

Relatedly, these findings do not support the original prediction that viewing real dental stimuli would activate the autonomic system to a greater extent than viewing images of those stimuli. Although, the significant Stimulus Type x Condition interaction (see figure 2) indicates that those participants viewing images of dental tools were not differentially affected by the condition (Music vs Movie vs Control) in which they were placed. Conversely, those participants presented with real dental stimuli elicited SCR responses that varied differentially according to condition. Those participants in the Music condition who viewed real tools produced significantly smaller SCR responses as the participants in the Control or Movie Conditions.

The sample of our research was not representative to the general population as 90% of participants were female and participants were of average college age. The difficulty in recruiting enough males and females from various ethnic backgrounds to produce a representative sample is quite common in graduate and undergraduate research, especially at primarily white institutions. According to Ellard-Gray and colleagues³⁴, minorities and vulnerable populations tend to mistrust the research process due to a long history of ethical violations by experimenters. In addition, minorities are more likely to be in greater financial struggles with limited assistance. To make ends meet, some students are required

to have several part-time jobs. This, as a result, hinders them from participating in research studies or other extracurricular activities while enrolled in school. Future studies should develop solutions to ensure that subjects are recruited with an even ratio of minorities to non-minorities to provide greater external validity and better representation of the general population.

Although a specific playlist and movie were used for this study, songs were randomly played and participants in the movie condition were shown different scenes from the movie (*The Incredibles*). Some scenes were more violent than others, so it is inconclusive if participants' SCRs are a result of the movie or the dental instruments. Notably, Zhang and colleagues²¹ also found that movie presentation was less effective at reducing dental anxiety. Additional confounding variables, of course, include the plethora of outside stressors experienced by college students during the semester. Another potential concern is related to the presence of the experimenter while presenting the real dental stimuli.

Future studies could measure and examine the physiological response of each dental instrument to see which dental equipment elicits more anxiety. Future studies may also to explore the impact of music and movies in a dental office setting. For example, dental patients could be offered the option to create a playlist from a restricted range of options that they could listen to during their planned procedure. Finally, general or trait anxiety measures would have been useful as a control measure in this study. People with DA do not necessarily also struggle with general or trait anxiety. Conversely, our non-DA participants might have had general or trait anxiety and that might have affected their response to the dental stimuli. Therefore, comparing DA responses to the dental stimuli with those who have more generalized anxiety symptoms would be informative. Nevertheless, our findings provide insight on the positive effects of music for reducing anxiety for those who struggle with dental anxiety and provide an applicable tool to potentially be utilized in real dental office settings.

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