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Music listening and state anxiety in a dental waiting room: an exploratory single-participant study

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ABSTRACT

Introduction: Dental anxiety can intensify during the waiting period before dental treatment because of anticipation and uncertainty. Passive music listening is a potential non-pharmacological approach, but its effects in dental waiting rooms remain uncertain.
Objectives: To describe within-participant differences in state anxiety across three fixed-order dental visits: no music, participant-selected music, and standardized relaxing instrumental music.
Methodology: This exploratory descriptive study involved one 22-year-old woman (N=1) assessed during three separate dental visits. Conditions were not randomized and dental procedures differed between visits. The main descriptive outcome was within-visit change in State-Trait Anxiety Inventory - Form Y1 (score after waiting minus score before waiting). Dental anxiety (Modified Dental Anxiety Scale) was assessed across the three visits, whereas trait anxiety (State-Trait Anxiety Inventory - Form Y2) was assessed only once, during the initial visit. Heart rate, blood pressure, oxygen saturation, and post-consultation satisfaction were also recorded. Music was delivered through headphones during Visits 2 and 3.
Results: State-Trait Anxiety Inventory - Form Y1 changed by +3 points without music, -10 points with participant-selected music, and -14 points with relaxing instrumental music; the corresponding changes in heart-rate were +4, -12 and -12 beats per minute. Modified Dental Anxiety Scale scores were 20, 19 and 19. The observed differences cannot be attributed specifically to music because visit order, dental procedures and auditory isolation were not controlled.
Conclusion: In this participant, state-anxiety scores and heart rates decreased during both waiting periods with music. These descriptive observations are hypothesis-generating and do not establish the efficacy of music listening. Controlled studies with repeated and balanced conditions are required.

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RESUMO

Introdução: A ansiedade dentária pode intensificar-se antes da consulta devido à antecipação e à incerteza. A escuta passiva de música é uma abordagem não farmacológica cujos efeitos na sala de espera permanecem incertos.
Objetivos: Descrever diferenças intraindividuais na ansiedade-estado ao longo de três visitas dentárias numa sequência fixa: sem música, música escolhida pela participante e música instrumental relaxante padronizada.
Metodologia: Realizou-se um estudo exploratório descritivo com uma mulher de 22 anos (N = 1) em três visitas. A ordem das condições não foi aleatorizada e os procedimentos clínicos diferiram entre visitas. O principal resultado descritivo foi a variação da *State-Trait Anxiety Inventory - Form Y1* em cada visita (pontuação após-espera menos pontuação antes da espera). A ansiedade dentária (*Modified Dental Anxiety Scale)* foi avaliada nas três visitas, enquanto a ansiedade-traço (*State-Trait Anxiety Inventory - Form Y2*) foi avaliada uma única vez, na visita inicial. Foram ainda registadas a frequência cardíaca, a pressão arterial, a saturação de oxigénio e a satisfação pós-consulta. A música foi reproduzida através de auscultadores nas visitas 2 e 3.
Resultados: A *State-Trait Anxiety Inventory - Form Y1* variou +3 pontos sem música, -10 com música escolhida pela participante e -14 com música instrumental; as variações correspondentes da frequência cardíaca foram +4, -12 e -12 batimentos por minuto. A *Modified Dental Anxiety Scale* apresentou valores de 20, 19 e 19. Estas diferenças não podem ser atribuídas especificamente à música, devido à ordem fixa, aos procedimentos distintos e ao possível isolamento auditivo.
Conclusões: Nesta participante, as pontuações de ansiedade-estado e frequência cardíaca diminuíram durante ambos os períodos de espera com música. Os resultados são descritivos e geradores de hipóteses, não demonstrando eficácia da intervenção. São necessários estudos controlados, com condições repetidas e equilibradas.

Introduction

Dental anxiety is a common and clinically relevant phenomenon, estimated to affect between 10% and 20% of the adult population across different countries.[1] Clinical consequences include avoidance of dental care and progressive deterioration of oral health, leading to increased complexity of future treatments and a negative impact on patients' quality of life.[1,2]

The literature indicates that dental anxiety is associated with multiple factors, including previous negative dental experiences, fear of pain, sensitivity to auditory stimuli such as the sound of dental instruments, psychological factors such as anxiety traits or phobias, and sociocultural contexts.[1,2] Furthermore, anxiety manifests both subjectively, through patient-reported outcomes, and physiologically, through changes in parameters such as heart rate and blood pressure.[1] These physiological responses are often linked to activation of the sympathetic nervous system, resulting in increased stress and heightened pain perception during dental procedures, potentially compromising patient well-being and clinical cooperation.[1,3]

Dental anxiety is therefore recognized as a public health concern given its association with reduced adherence to preventive dental care and the progression of oral diseases such as dental caries and periodontal disease. Individuals with dental anxiety often delay seeking dental care until treatment becomes unavoidable, typically in the presence of acute pain or advanced oral disease, potentially resulting in more invasive and complex treatments and reinforcing a cycle of fear and treatment avoidance.[1,2] This phenomenon is particularly relevant in university teaching clinics, where prolonged waiting times and patients' perceptions of the clinical teaching environment may further intensify patients´ anxiety and perceived discomfort.[2,3]

Pharmacological options, including anxiolytics and sedation, can be appropriate in selected patients, but may require additional monitoring and resources. Non-pharmacological approaches may provide complementary options to support patient comfort.[3,4] Passive music listening is a low-cost approach that has been examined in dental settings, although reported effects depend on the intervention, clinical context and outcome measures.[4,5]

Music may distract patients from anticipatory thoughts and clinical sounds and may promote subjective relaxation. However, these proposed mechanisms may not operate in every patient, and the present study did not measure neuroendocrine mediators. Previous dental studies have examined music during root canal treatment, crown preparation and other procedures, rather than exclusively in the waiting room.[5-7]

Evidence from a 2024 systematic review and meta-analysis suggests that music-based interventions may reduce dental anxiety, although the included studies differ in their populations, clinical settings and delivery methods.[4] Trials in endodontic treatment, crown preparation and restorative dentistry have reported anxiety-related outcomes during dental procedures.[5,6,8] Whether comparable associations occur during a separate pre-treatment waiting period remains uncertain. Moreover, the same headphones that deliver music may reduce environmental noise, making it difficult to isolate the contribution of the music itself.

Anticipatory dental anxiety may emerge before treatment because of uncertainty, expected pain and perceived lack of control. A waiting-room intervention may therefore be relevant even when it ends before the procedure. The research question was: *In one adult dental patient, how did state anxiety and physiological measurements change during the waiting periods of three fixed-order visits without music, with participant-selected music and with standardized relaxing instrumental music?* The aim was to describe these observations and generate hypotheses, not to establish comparative treatment efficacy.

Methodology

Study design and setting

This was an exploratory single-participant (N=1) study involving repeated within-participant assessments across three dental visits. Three conditions were examined in a fixed sequence: no music, participant-selected music, and standardized relaxing instrumental music. Each condition was implemented during a single visit, without randomization or replication of conditions. State anxiety (STAI-Y1) and physiological parameters were assessed before (T0) and after (T1) the pre-consultation waiting period at each visit. The study was designed to provide a descriptive comparison of observed changes across conditions and to generate hypotheses for future research, rather than to establish causal relationships or demonstrate intervention effectiveness. The study took place in the pre-consultation waiting room of the Dental Pedagogical Clinics of UFP. Although all assessments were conducted in the same waiting room, the dental procedures differed across visits. Furthermore, background noise and external auditory distractions were not systematically monitored, and headphones were used during the two music conditions. These factors limited the comparability of the conditions and the ability to isolate the potential effects of music listening.

Participant and eligibility criteria

One 22-year-old woman attending the dental teaching clinic was recruited through convenience sampling. During the initial triage appointment, she self-reported dental anxiety. The inclusion criterion was based on self-reported dental anxiety, and no formal diagnosis was required. The participant received information about the purpose and procedures of the study and provided written informed consent. To protect confidentiality, the report contains no personal identifiers.

Study procedures and intervention conditions

The conditions followed a fixed, non-randomized sequence: Visit 1, no music; Visit 2, participant-selected music; and Visit 3, standardized relaxing instrumental music chosen by the investigator. The intervals between visits were seven and eight days, respectively. All observation periods took place in the same waiting room. The participant remained seated and was asked not to use a telephone, read or converse. Efforts were made to maintain similar appointment times and environmental conditions, but waiting-room noise, the presence of other patients and external distractions were not systematically measured. The sequence was determined pragmatically and did not control for order effects. Consequently, it did not allow the independent effects of music, visit order or treatment type to be estimated.

Visit 1 consisted of an initial screening and triage appointment lasting approximately 45 minutes; no music was played in the waiting room. Visit 2 included periodontal assessment and scaling, lasting approximately 35–40 minutes. Before this appointment, the participant listened to music for approximately 15 minutes, choosing from available relaxing, classical and instrumental options. The total waiting time for Visits 1 and 2 was not available for analysis.

Visit 3 included restorative treatment of teeth 37 and 47 and lasted more than one hour. Before treatment, the participant listened to standardized relaxing instrumental music selected by the investigator for approximately 15 minutes and spent more than 20 minutes in the waiting room. Music was played only before the consultation and was stopped before treatment began. Dental procedures were conducted by a dental student. Headphones were used for both music conditions, whereas the no-music condition had no equivalent headphone-only exposure. Thus, music exposure was inseparable from possible auditory isolation. Anticipated stress may also have differed because the planned dental procedures were not comparable.

Outcome measures

Dental anxiety was characterized using the Portuguese version of the Modified Dental Anxiety Scale (MDAS; five items scored 1–5, total score 5–25; values of 19 or above indicate high dental anxiety).[9] The main descriptive outcome was the change in state anxiety during each waiting period, assessed by the Portuguese adaptation of the State-Trait Anxiety Inventory, Form Y, state subscale (STAI-Y1; 20 items, total score 20–80, higher scores indicating greater state anxiety).[10] Trait anxiety was assessed once, during the initial visit, using the STAI-Y2 subscale (20 items, total score ranging from 20 to 80). This assessment was used exclusively to characterize baseline trait anxiety and was not considered an outcome measure of the music-listening intervention.[10] Heart rate, blood pressure and peripheral oxygen saturation were recorded as descriptive physiological measures and were not regarded as specific biomarkers of stress. An author-developed, non-validated questionnaire comprising five items was used to assess waiting-room comfort, perceived relaxation, satisfaction with the pre-consultation experience, perceived anxiety reduction, and appreciation of the musical intervention. Each item was rated on a five-point scale, with higher scores indicating more favorable

responses. The music-appreciation item was applicable only to visits involving music exposure.

Data collection

State anxiety and physiological parameters were recorded before the waiting period (T0) and at its end (T1). The participant remained seated at rest for approximately two minutes before physiological measurements were taken. Blood pressure and heart rate were recorded using an automatic Omron sphygmomanometer; oxygen saturation was measured with a Contec digital pulse oximeter (specific device models were not recorded). One physiological reading was obtained at each time point. During the music visits, Bose QuietComfort headphones delivered music at a comfortable volume; the precise volume and degree of external-noise attenuation were not measured. The post-consultation satisfaction questionnaire was administered after the dental appointment and therefore may reflect the treatment experience as well as the waiting period. The STAI-Y2 was administered only once, during the initial visit, to characterize baseline trait anxiety.

Data analysis

Data from all three visits were summarized descriptively. Within-visit change was calculated as T1 minus T0 for STAI-Y1 and heart rate; blood-pressure values and oxygen saturation were described without inferential analysis. Because there was only one observation per condition, no hypothesis tests or causal comparisons were performed, and no confidence intervals or treatment-effect estimates were calculated. MDAS scores obtained across the three visits were summarized descriptively. The single STAI-Y2 score obtained during the initial visit was used exclusively to characterize baseline trait anxiety and was not included in comparisons within-visit or between-conditions. The original five-item questionnaire specified an overall score calculated as the arithmetic mean of all five items. Based on the item scores reported in Table 2, the five-item mean was 4.40/5 for both music visits. However, because the music-appreciation item was not applicable to Visit 1, an additional post hoc descriptive mean was calculated using the four items common to all three visits: calmness during waiting, waiting-room comfort, perceived lower anxiety compared with previous consultations, and pre-consultation satisfaction. Each item contributed equally to the calculation. The resulting four-item means were 2.00/5, 4.25/5, and 4.25/5 for Visits 1, 2, and 3, respectively. The music-appreciation item was reported separately. These means were used exclusively for descriptive comparison and were not interpreted as validated composite measures of satisfaction. Based on the available data, no responses were missing for the four items applicable to all visits. Given the different procedures and fixed order, between-visit differences were interpreted as exploratory observations only.

Ethical considerations

The study protocol was approved by the Ethics Committee of Universidade Fernando Pessoa (Approval N.º FCS/MMED–788/25-5). Written informed consent for study participation was obtained before data collection. The participant was informed about the study procedures and the confidentiality of the information collected. No directly identifying participant information is included in this manuscript.

Results

Table 1 reports scores and physiological readings across the three visits. During Visit 1 (no music), the MDAS score was 20/25, and STAI-Y1 increased from 52 at T0 to 55 at T1 (change +3). Heart rate increased from 81 to 85 beats/min (+4). Blood pressure changed from 106/78 to 109/70 mmHg and oxygen saturation remained at 98%. The mean of the four common questionnaire items was 2.0/5.

The STAI-Y2 was administered only during the initial visit, yielding a score of 51/80. This measurement was used to characterize baseline trait anxiety and was not repeated during subsequent visits. Therefore, no assessment of changes in trait anxiety across visits was performed.

Table 1. Anxiety scores and physiological measurements across the three visits.

Visit	Condition	MDAS	STAI-Y1 T0	STAI-Y1 T1	Δ STAI-Y1	STAI-Y2	HR T0	HR T1	Δ HR	BP T0	BP T1	SpO_2 T0	SpO_2 T1
1	No music	20	52	55	+3	51	81	85	+4	106/78	109/70	**98**	**98**
2	Patient-selected music	19	49	39	-10	--	85	73	-12	104/76	108/75	**98**	**98**
3	Relaxing instrumental music	19	58	44	-14	--	105	93	-12	117/72	113/68	**98**	**98**

MDAS: Modified Dental Anxiety Scale; STAI-Y1: State-Trait Anxiety Inventory – State subscale; STAI-Y2: State-Trait Anxiety Inventory – Trait subscale; HR: heart rate; BP: blood pressure; SpO_2: peripheral oxygen saturation; T0: baseline assessment before the waiting period; T1: assessment after the waiting period.

Note: STAI-Y2 was administered only during Visit 1 to characterize baseline trait anxiety. Dashes indicate that the instrument was not administered during Visits 2 and 3.

At Visit 2 (participant-selected music), the MDAS score was 19/25. STAI-Y1 decreased from 49 at T0 to 39 at T1 (change -10), and heart rate from 85 to 73 beats/min (-12). Blood pressure changed from 104/76 to 108/75 mmHg and oxygen saturation remained at 98%. The mean of the four common questionnaire items was 4.25/5. Music appreciation was rated 5/5. These results describe a single visit and do not establish that music caused the observed differences.

At Visit 3 (standardized relaxing instrumental music), the MDAS score was 19/25. STAI-Y1 decreased from 58 at T0 to 44 at T1 (change -14), and heart rate from 105 to 93 beats/min (-12). Blood pressure changed from 117/72 to 113/68 mmHg and oxygen saturation remained 98%. The mean of the four common questionnaire items was 4.25/5. Music appreciation was rated 5/5. Compared with Visit 2,

the baseline STAI-Y1 score, planned dental procedure and waiting circumstances differed.

Table 2. Post-consultation questionnaire scores by visit, with the mean calculated from four common items.

Visit	Comfort	Calmness during waiting	Pre-consultation satisfaction	Perceived lower anxiety compared with previous dental appointments	Music appraisal	Mean (4 common items)
1	2/5	2/5	3/5	1/5	N/A	2.00/5
2	4/5	5/5	4/5	4/5	5/5	4.25/5
3	5/5	4/5	4/5	4/5	5/5	4.25/5

Table 2 presents the post-consultation questionnaire responses across the three visits. Four items were applicable to all visits, whereas the item assessing music appreciation was applicable only to Visits 2 and 3. For the four items assessed in all visits, the arithmetic mean was 2.00 at Visit 1 and 4.25 at both Visits 2 and 3. The separate music-appreciation item was rated 5/5 at both music visits and was not applicable at Visit 1. The highest rating for calmness during waiting (5/5) occurred at Visit 2, whereas the highest waiting-room comfort rating (5/5) occurred at Visit 3. As the questionnaire was completed after consultation, these ratings cannot be attributed exclusively to the preceding waiting period.

Note: All items were rated on a five-point scale. The mean was calculated post hoc from the four items common to all visits: comfort, calmness during waiting, pre-consultation satisfaction, and perceived anxiety reduction. Music appraisal was reported separately and was not applicable to Visit 1. The calculated mean is a descriptive measure and does not represent a validated composite satisfaction score.

Within-visit STAI-Y1 and heart-rate changes were +3 points and +4 beats/min at Visit 1, -10 points and -12 beats/min at Visit 2, and -14 points and -12 beats/min at Visit 3. MDAS scores were 20, 19 and 19 across these visits. Peripheral oxygen saturation remained unchanged at 98% between T0 and T1 across all three visits. No inferential analyses or causal comparison between conditions were performed.

Discussion

Dental anxiety can involve anticipation of discomfort, uncertainty and perceived loss of control even before treatment begins.[1,2,3] The waiting room is therefore a clinically relevant, but relatively underexamined setting for non-pharmacological strategies.[4] In this exploratory study, STAI-Y1 and heart rate increased within the no-music visit and decreased within the two music visits. However, because each exposure occurred at a different appointment, these changes are observations across visits rather than estimates of any independent effect of music.

The observations may be considered alongside published studies, although direct comparisons are limited. A systematic review by López-Valverde et al. evaluated music-based approaches to dental anxiety across trials with different methods and clinical contexts.[4] Abdulhameed et al. studied music and informative videos during root canal treatment, while Lal et al. evaluated music listening and iatrosedation during crown preparation.[5,6] Karapicak et al. studied music during restorative treatment.[8] By contrast, in the present case music was used only before the consultation, with no simultaneous music during treatment. Differences in timing, procedure type, control condition, sample size and outcome assessment prevent direct comparison of effect magnitudes or claims of comparable efficacy.

The distinction between state- and trait-related measures is central to interpretation. STAI-Y1 is designed to reflect anxiety at the time of assessment, making pre- and post-waiting scores within each visit relevant to the descriptive question.[10] The MDAS measures dental-specific anxiety in typical situations, and the visit-level scores (20, 19 and 19) should not be interpreted as proof of an intervention effect or a meaningful shift in dental anxiety.[9] The STAI-Y2 assesses trait anxiety and was administered only once, during the initial visit, yielding a score of 51/80. This measurement provided a baseline characterization of trait anxiety and was not intended to assess changes associated with music exposure.[10] Heart rate and blood pressure are also influenced by factors other than psychological stress, and oxygen saturation showed no variation in this case.

Several uncontrolled factors could explain the observed pattern. First, intervention condition and visit order were fully confounded: no music always came first, followed by participant-selected music and then standardized instrumental music. Second, the clinical procedures differed (triage, periodontal care and restoration), potentially influencing the participant's expectations and emotional response. Third, music was delivered through headphones without a headphone-only comparison, so the potential effect of reduced background-noise exposure cannot be distinguished from the music itself. Other unrecorded variables may have included sleep quality, caffeine or stimulant use, acute stress on the appointment day, previous dental experiences, expectations, pain or discomfort, and familiarity with the clinicians and clinic. Familiarization over repeated visits and regression towards typical anxiety levels are alternative explanations. In particular, the largest STAI-Y1 decline occurred during Visit 3, but this visit also began with the highest STAI-Y1 score (58); this does not demonstrate that standardized instrumental music was more effective than participant-selected music. The two music visits also had different ratings of relaxation and waiting-room comfort, without a consistent advantage in the common-item satisfaction mean.

Clinically, providing a patient with the option to listen to music before an appointment may be feasible and compatible with person-centered dental care, but feasibility and efficacy are separate questions. Musical preferences, volume tolerance, sensory sensitivity and the desire to hear clinical announcements should be discussed

with each patient; some may prefer silence or another form of support. Offering a choice may support autonomy and perceived control, without assuming a greater anxiety reduction from self-selected music. The use of headphones also raises practical considerations, including hygiene, communication and auditory isolation. This single observation can inform the design of such patient-centred options, but is insufficient to justify recommending a routine protocol or replace established anxiety-management approaches.[4,6,8]

Future research directions

Future studies should include larger samples and either randomized comparisons or single-participant designs with repeated exposure to each condition, with a balanced or randomized order of exposure when feasible. In particular, repeated observations under each condition would help separate intervention-related differences from day-to-day fluctuation and period effects. Study visits should involve similar procedures, or procedure type and anticipated treatment complexity should be measured and considered in the analysis. A headphone-only or equivalent auditory-control condition is needed to distinguish music exposure from environmental-noise attenuation. Waiting time, sound volume, perceived familiarity and pleasantness of the music, baseline sleep quality, caffeine use, appointment-day stress and prior dental experiences should be documented prospectively. STAI-Y1 should be specified a priori as a state-anxiety outcome, and physiological outcomes should be assessed using repeated measurements under standardized resting conditions. Post-consultation satisfaction should be treated as a separate patient-experience measure, not conflated with pre-treatment state-anxiety change.

Limitations

This report has substantial methodological limitations. It describes one participant, one observation per condition, a fixed non-randomized sequence and different clinical treatments at each visit. No repeated withdrawal and reintroduction phases, independent control group, blinding or equivalent headphone-only condition were used. The effects of intervention condition, visit order and procedural complexity therefore cannot be disentangled. Waiting-room noise and external distractions were not systematically recorded; the observed effects might reflect reduced sound exposure, expectancy or progressive familiarization rather than music itself. The participant's sleep quality, caffeine and other stimulant use, acute stress, emotional state, pain, prior experience and menstrual-cycle phase were not prospectively controlled. Physiological parameters were measured only once at each time point and are not specific measures of stress. The short, non-validated satisfaction questionnaire was completed after clinical treatment and may reflect the entire appointment; the comparable four-item mean was calculated post hoc. Finally, the STAI-Y2 was administered only once for baseline characterization and was not used to evaluate changes associated with the intervention.

Conclusion

In this exploratory single-participant study, STAI-Y1 scores and heart rate decreased during the waiting periods in which music was played, while both increased within the no-music visit. These descriptive differences do not establish that music listening caused the observed changes, because order of exposure, dental procedures and use of headphones were not controlled independently. Dental-specific anxiety scores remained elevated across visits, while trait anxiety was assessed only once at baseline and was not evaluated as an intervention outcome. The case generates hypotheses about whether optional music listening while waiting for dental care might support patient comfort and perceived control. Studies with repeated and balanced intervention conditions, adequate auditory controls and larger samples are needed before clinical effectiveness can be evaluated.

The data supporting the findings of this study are presented in Tables 1 and 2. Additional participant-level data are not publicly available due to confidentiality and data protection considerations.

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