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528Hz: The Sound Of Tranquillity And Its Effect On Anxiety

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Abstract
Sound healing, based on music therapy, explores the therapeutic potential of specific frequencies for anxiety. The Solfeggio frequency of 528 Hz has gained attention for its ability to resonate with the body's natural frequencies, promoting relaxation, reducing stress, and enhancing emotional well-being.
This study explores the potential of pure 528 Hz sound to reduce state anxiety. 48 subjects were randomly assigned to either an experimental group, which received a 3-minute exposure to 528 Hz music, or a control group, which completed a neutral reading task. State anxiety levels were measured using the STAI, pre and post intervention. Data analysis included paired-sample t-tests and a two-way repeated measures ANOVA. Results showed a significant drop in level of anxiety among experimental group ($p = 0.022$). Additionally, paired-sample t-tests confirmed a decrease in state anxiety scores within the experimental group ($p = 0.006$).
These findings provide empirical evidence suggesting the anxiolytic properties of 528 Hz. This study offers preliminary evidence that 528 Hz sound exposure may effectively reduce state anxiety. Future research should elucidate the mechanisms and examine the effectiveness of this approach in broader contexts. This research contributes to the exploration of sound frequencies as a potential non-invasive intervention for anxiety management.

KEY WORDS: 528hz, State Anxiety, Experimental Design, Sound therapy, Sound Healing, Solfeggio Frequencies

Introduction
Sound healing explores therapeutic potentials through specific sound frequencies, vibrations, and rhythms. The Solfeggio frequency, notably 528 Hz, is believed to align with the body's natural frequencies, promoting relaxation, reducing stress, and enhancing emotional well-being (Hutchens, 2018). Sound, particularly vibration, is a pervasive sensory input from sources like cars, music, and speech, influencing mindfulness and mood levels even beyond conscious perception (Margolin et al., 2011). Studies suggest correlations between high-frequency vibrations and improved mood, such as with Brain Wave Vibration training and ultrasound techniques (Bowden et al., 2011; Hameroff, 2013), highlighting their impact on human well-being despite unclear mechanisms.
Anxiety, characterized by tension, worried thoughts, and physiological changes like increased blood pressure (American Psychological Association, n.d.), affects a significant portion of the global population, with adolescents particularly vulnerable (WHO, 2019; Kessler et al., 2023; U.S. Census Bureau, 2023; ADAA, 2023). Understanding sound's potential to influence state anxiety offers promising avenues for non-invasive management strategies. The prevalence of anxiety disorders among young adults in India underscores the need for affordable, non-invasive tools like online cognitive-behavioural therapy and mindfulness (Pal et al., 2022; Vaidya et al., 2021), crucial for addressing this growing issue efficiently.

Sound and emotion
Sound and emotions share a deep connection, proposed by Darwin as stemming from a shared emotional signal system influenced by environmental sounds. Emotional responses to speech and music capitalize on changes in frequency spectrum, rate, and intensity, crucial for adaptive reactions to biologically significant experiences (Ma & Thompson, 2015).
Musical rhythmicity, a fundamental element of vibratory effects, is characterized by events per second and seconds per event. Cognitive event fusion transitions from perceiving individual events to processing pitch frequencies when events exceed 16 per second (Snyder, 2001). Solfeggio frequencies, like 528 Hz, are believed to operate on similar principles.
Solfeggio frequencies, including 396 Hz, 417 Hz, 528 Hz, among others, have gained popularity for their healing properties in alternative medicine circles. Originally used in ancient chants like Gregorian and Sanskrit, these frequencies resonate at 7.83 Hz, known as the "Schumann Resonance Frequency," linked to Earth's natural vibrations. However, human-made electromagnetic fields (EMFs) may disrupt this balance, potentially impacting human health. Ivonin et al. (2012) found that ancient sounds like "OM," resonating at 528 Hz, induce significant decreases in heart rate compared to negative sounds.
Literature reviews indicates that - 528 Hz, Babayi & Riazi (2017) explored its potential to counteract ethanol-induced damage in astrocytes. Using MTT, LDH, and ROS assays, they found that exposure to 528 Hz sound waves significantly

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increased cell viability by 20% and halted ROS production compared to ethanol-treated controls. These findings suggest that 528 Hz may mitigate ethanol-related cytotoxicity in astrocytes, warranting further in vivo and complex cellular model research.

Daylari et al. (2018) investigated the impact of 528 Hz sound on anxiety-related behaviors in animal models. Rats exposed to daily 528 Hz for 2 hours over 21 days showed reduced anxiety behaviors compared to controls. This suggests 528 Hz may alleviate anxiety symptoms in animal models, highlighting its potential therapeutic use.

Akimoto et al. (2018) studied the stress-reducing effects of 528 Hz music compared to standard 440 Hz music in healthy individuals. They found that listening to 528 Hz music significantly lowered cortisol levels, boosted oxytocin, and improved mood scores, unlike 440 Hz. This indicates that music frequency can influence stress response, with 528 Hz showing promise for stress management after short listening sessions.

While these studies provide initial evidence for the anxiolytic effects of 528 Hz, gaps in knowledge remain. Understanding the mechanisms of action and conducting human-based studies are critical to fully assessing its therapeutic potential.

Rationale

The current study investigates the effects of 528 Hz pure tone on state anxiety, focusing on its immediate anxiolytic effects. Unlike music tuned to 528 Hz, using pure tone allows control over potential music-induced effects. By employing a true experimental design with human models, this study establishes strong causal links. It aims to reveal the clinical efficacy of 528 Hz in anxiety management, potentially integrating it into therapeutic strategies. This approach highlights its promise in managing daily stress and anxiety triggers, offering practical applications to enhance overall well-being.

Method

This study aims to explore the effectiveness of 528 Hz sound waves in managing state anxiety. The research objectives include testing the impact of the 528 Hz frequency on state anxiety within the sample and comparing pre- and post-experiment anxiety levels between the control and experimental groups. A true experimental quantitative design was employed, utilizing a 2x2 factorial design with both control and experimental groups. Pre-test and post-test analyses were conducted to detect any within-group differences. Participants (N=48), aged 18-22, were selected through purposive sampling, recognizing adolescents as ideal for studying anxiety due to their heightened emotional reactivity and vulnerability to anxiety disorders during this developmental phase.

Experimental Setup:

The experimental group experienced a 3-minute exposure to 528 Hz pure tone, while the control group engaged in a 3-minute neutral reading task. This approach facilitated precise measurement and statistical analysis of anxiety changes before and after the intervention. The Independent Variable is 528 Hz Pure Tone Frequency and Dependent Variable assessed is State Anxiety.

Analysis and Theoretical Framework:

Data analysis in this study utilized IBM SPSS Statistics version 27. Initial data screening procedures were conducted to ensure data reliability. Descriptive statistics, including means and standard deviations, provided an overview of participants' state anxiety scores across both control and experimental groups before and after the intervention.

A two-way repeated measures ANOVA was employed to analyze the impact of two independent variables: treatment group (control vs. experimental) and time (pre-test vs. post-test) on state anxiety scores (refer to Table 3). Assumptions for the validity of the ANOVA were carefully checked. State anxiety scores were continuous, allowing for precise comparisons. The study design ensured valid comparisons across all participants. Outlier detection led to the removal of two outliers, resulting in a final sample size of 48. The Shapiro-Wilk test confirmed approximate normality of state anxiety scores ($p > 0.05$). Mauchly’s Test of Sphericity was not applicable due to only two repeated measures levels. Addressing these assumptions laid a solid foundation for interpreting the ANOVA results, ensuring the reliability and generalizability of findings.

Post hoc pairwise comparisons were conducted to explore significant effects identified in the ANOVA (see Table 4). These comparisons directly contrasted mean state anxiety scores between control and experimental groups, assessing which group showed greater changes in anxiety levels post-intervention.

Additionally, paired-sample t-tests examined changes in state anxiety scores within each group (control and experimental) between pre-test and post-test measurements (see Table 5). This analysis isolated the intervention’s effects within each group, providing insight into whether the treatments had a measurable impact on state anxiety.

Collectively, these analyses illuminated the study's findings, revealing any statistically significant interactions between anxiety levels across groups and time points. The results contribute to understanding the effectiveness of 528 Hz sound waves in managing state anxiety, supported by rigorous statistical examination and theoretical framework.

Participants

Using G-power analysis, the study determined that a sample size of 36 participants was ideal, considering an effect size of 0.05 (see Figure 2, Appendix). The target population comprised adolescents aged 18-22 years, chosen for their

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susceptibility to anxiety. Purposive sampling was employed due to practical constraints in accessing a random sample within this age group. This method utilized existing social networks for recruitment, ensuring greater representativeness than convenience sampling. Ultimately, 48 participants were included in the study, which provided sufficient statistical power based on preliminary effect size estimates.
Initially, 79 students from Christ University expressed interest in participating. Following screening for health conditions such as auditory processing disorders and psychiatric diagnoses, 64 students met the criteria. However, a 28.12% attrition rate reduced the final sample size to 48 participants. After obtaining informed consent and basic demographic information (age and sex), participants were randomly assigned to either the experimental or control group. State anxiety levels were measured using the reliable and validated State-Trait Anxiety Inventory (STAI) - State anxiety subscale, administered both before and after the intervention.

Sample Characteristics

Table 1 Sex Characteristics

	Treatment Group			
	Control Group		Experimental Group	
Sex	n	%	N	%
Male	09	18.75	13	27.08
Female	15	32.25	11	22.91

Note. n = 48 (n = 24 for each group)

Table 2 Age Characteristics

	Treatment Group			
	Control Group		Experimental Group	
	SD	M	SD	M
Age	0.76	19.37	0.93	19.20

Note. N = 48 (n = 24 for each group); M, Mean; SD, Standard Deviation

Table 1 presents the sex distribution of participants in the study. There was a total of 48 participants, with 24 in each of the control and experimental groups. Among participants, 18.75% (n = 9) in the control group and 27.08% (n = 13) in the experimental group were male. Conversely, 32.25% (n = 15) in the control group and 22.91% (n = 11) in the experimental group were female.
Table 2 shows the age characteristics of the participants. Both the control and experimental groups had a sample size of 24, resulting in a total sample of 48 participants. The average age for the entire sample was 19.29 years old, with a standard deviation of .84 years. The control group had a mean age of 19.37 years (SD = .76), while the experimental group had a mean age of 19.20 years (SD = .93).

Assessment Tools and Apparatus

1. **State-Trait Anxiety Inventory (STAI):**

The STAI is a 40-item self-report questionnaire designed to measure two types of anxiety: trait anxiety and state anxiety. The State Anxiety (S-Anxiety) scale specifically assesses current feelings of apprehension, tension, uneasiness, worry, and autonomic nervous system activation. Participants rate each item on a five-point scale ranging from "almost never" (1) to "almost always" (4). For this study, the trait subscale (STAI-Y) was utilized. The STAI-Y has demonstrated strong test-retest reliability ($r = 0.70$, $p < 0.001$) and internal consistency (Cronbach's alpha = 0.90).

2. **528 Hz Pure Tone**

The 528 Hz pure tone was generated using MATLAB, a high-performance language and computing environment developed by MathWorks. MATLAB facilitates mathematical operations, data visualization, algorithm development, and model creation across various domains, including signal processing. Creating the pure tone involved specifying parameters such as sampling frequency (twice the desired tone frequency for accuracy), tone frequency, and duration. The

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tone was generated as a sinusoidal wave using MATLAB's sin function, ensuring precise amplitude representation at each time interval. The script was designed to produce an audio file that could be downloaded for experimental use.

Procedure and Method of Data Collection

The experiment adhered to protocols outlined by the National Academy of Sciences (2015) for scientific rigor. Both the experimental and control groups received identical scripted instructions before the experiment commenced. All procedures were conducted on the same day, in the same environment, and with uniform tools to ensure consistency.

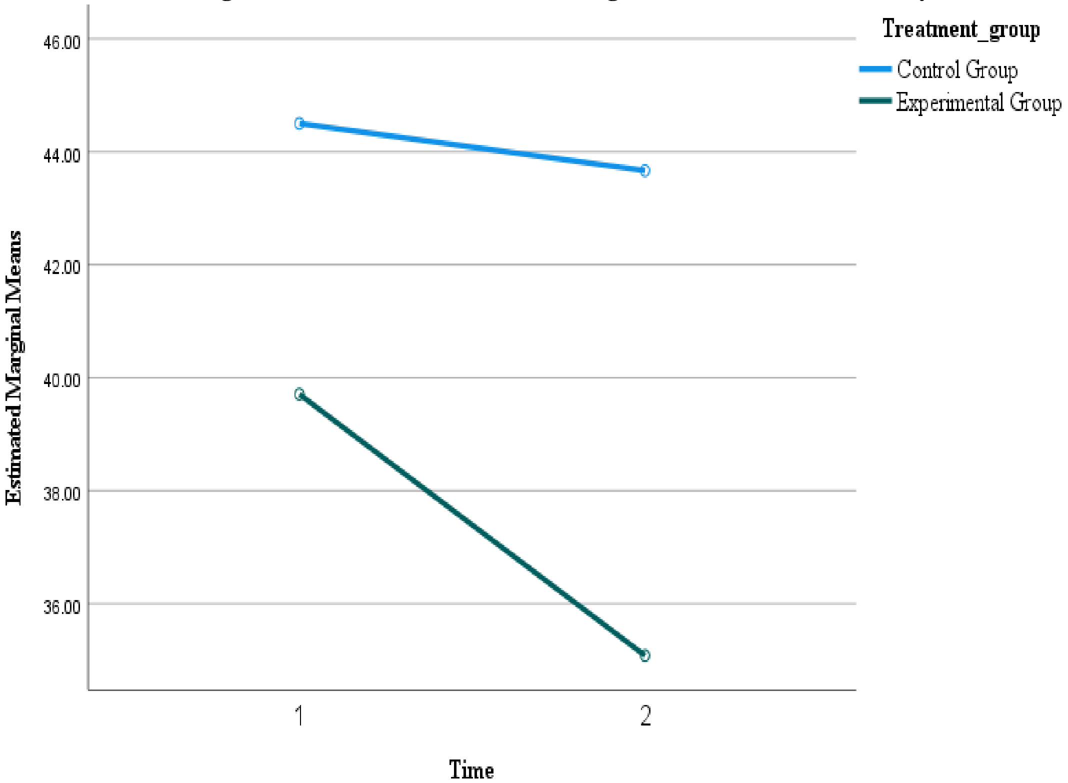
State Anxiety was assessed initially using the State-Trait Anxiety Inventory (STAI) as a pre-test to establish baseline anxiety levels for each participant. Next, the experimental group underwent a 3-minute exposure to 528 Hz frequency music played through lab speakers. To isolate the effects of the frequency itself from any potentially confounding musical elements, bass and treble were maintained flat.

In contrast, the control group engaged in a 3-minute neutral reading task devoid of specific sound or frequency exposure. This approach minimized potential placebo effects arising from the experimental setting. Following the intervention, the STAI was administered again to both groups to evaluate changes in state anxiety levels post-experiment.

The procedure concluded with debriefing participants, emphasizing confidentiality and the safety measures in place throughout the research process.

Results

Figure 1 Profile Plot Estimated Marginal Means of State Anxiety



Data was screened for outliers across all variables. Initially, participants 19 and 38 where seen as univariate outliers. Post removal of the two, no univariate or multivariate outliers (Mahalanobis distance; $p<.001$) were found. All the STAI-Y subscale scores were normally distributed ($p>.05$). Mauchly's test of sphericity was violated owing the presence of less than three groups.

Figure 1 provides an initial judgement of the data looks like and whether you might expect a statistically significant interaction term. The provided graph depicts estimated marginal means from the two-way ANOVA, investigating the effects of time and treatment group on a certain variable. While the plot shows the experimental group (green line) having a slightly decreasing trend across two time points(y-axis), confirmation from the ANOVA test is needed to solidify the presence of interaction.

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Table 3 State Anxiety Scores

Variable	Group	M	SD
Pre-test	Control	44.50	13.932
	Experimental	39.71	9.115
Post-test	Control	43.67	14.300
	Experimental	35.08	9.031

Note. M, mean; SD, standard deviation

Descriptive statistics revealed preliminary information about pre-test and post-test scores for the control and experimental groups. Both groups consisted of 24 participants (N = 24). On the pre-test, the control group had a mean score of 44.50 (SD = 13.932) compared to the experimental group's mean score of 39.71 (SD = 9.115). Following the intervention, the control group's mean score on the post-test was 43.67 (SD = 14.300), while the experimental group's mean score decreased to 35.08 (SD = 9.031). It is important to note that these results are purely descriptive and do not imply any statistically significant differences between the groups.

Repeated Measures ANOVA

Table 4 Two-way Repeated Measures ANOVA Main Effects

Effects	SS	df	F	p-value	$_{partial}\ \eta^2$
G	1073.344	1	6.002	.022*	.207
T	178.760	1	7.040	.014*	.234
T x G	86.260	1	4.954	.036*	.177

Note. ANOVA, analysis of variance; G, group; T, Time; SS. Sum of Squares; df, Degrees of Freedom

A repeated measures analysis of variance (ANOVA) was conducted to examine the effect of different treatments on the measured variable (State Anxiety). A Two-way Repeated Measures ANOVA was conducted to examine the effects of the treatment Group and Time on the dependent variable. There were significant main effects observed for Treatment Group, $F(1, 1) = 6.002$, $p = .022$, $\eta^2 = .207$, and Time, $F(1, 1) = 7.040$, $p = .014$, $\eta^2 = .234$. The interaction effect between the treatment Group and Time was also found to be significant, $F(1, 1) = 4.954$, $p = .036$, $\eta^2 = .177$.

Table 5 Pairwise Comparison of the Control and Experimental Group

					CI[b]	
(I) Group	(J) Group	M_Diff (I-J)	Std. Error	p-value[b]	LB	UB
Control	Experimental	6.888*	2.370	.022*	1.040	12.335

Note. M_Diff, Mean Difference; CI, 95% Confidence Interval for Difference; LB, Lower Bound; UB, Upper Bound; *p < 0.05; b, Adjustment for multiple comparisons: Bonferroni.

Pairwise comparisons revealed a statistically significant mean difference between the experimental group and control group (M_diff = 6.688, SE = 2.730, p = 0.022, 95% CI [1.040, 12.335]). Bonferroni correction was applied for multiple comparisons. Furthermore, multivariate tests already indicated a significant overall effect of Treatment on the dependent variable (Table 4) (Pillai's trace = 0.207, $F(1, 23) = 6.002$, $p = 0.022$, partial eta squared = 0.207). These findings suggest that the choice of treatment significantly impacts the measured variable.

T-Test
T-tests

Table 6 Paired Sample T-test

				CI[a]				
		M[b]	SD	Lower	Upper	t	df	p-value[a]
Pair 1	CONT_PRE - CONT_POST	.833	5.537	-1.541	2.791	.737	23	.501
Pair 2	EXP_PRE - EXP_POST	4.625	7.412	1.709	7.582	3.057	23	.009*

Note. M, mean; SD, standard deviation; a, bootstrap (=1000 samples) corrected values; CI, 95% Confidence Interval for Difference, *p < 0.05

Significant differences were observed between pre-test and post-test measurements for the experimental condition (M = 4.625, SD = 7.412, t(23) = 3.057, p = 0.006), indicating an increase in measurements following the intervention. Bootstrap analysis confirmed this significant increase (Bias = 4.625, p = 0.009). However, for the control condition, there was no significant change between pre-test and post-test measurements (M = 0.833, SD = 5.538, t(23) = 0.737, p = 0.468), as supported by bootstrap analysis (Bias = 0.834, p = 0.501). These findings suggest that the intervention significantly impacted the measured variable for the experimental group compared to the control group.

Discussion

This study investigated the effects of 528 Hz pure-tone frequency exposure on state anxiety in individuals diagnosed with anxiety disorders. The results of the two-way repeated measures ANOVA indicated significant main effects for both the treatment group and time, as well as a significant interaction effect between the two variables. Pairwise comparisons revealed a statistically significant mean difference between the experimental group and control group, suggesting that the choice of treatment significantly impacts the measured variable.

Furthermore, multivariate tests confirmed the significant overall effect of treatment on the dependent variable, thus rejecting the null hypothesis. The findings suggest that there were significant differences between pre-test and post-test measurements for the experimental condition, indicating an increase in measurements following the intervention. However, there were no significant changes between pre-test and post-test measurements for the control condition, as predicted. In summary, the results of this study suggest that the intervention significantly impacted the measured variable for the experimental group compared to the control group, thus supporting the hypothesis.

Building on existing research on the influence of sound frequencies on emotions (Joseph, 2019), this study provides initial evidence for the potential of 528 Hz as an anxiety management tool. The observed decrease in state anxiety scores in the experimental group (M = 4.625, p = 0.006) following the intervention suggests that 528 Hz exposure may activate relaxation pathways or promote emotional regulation. Potential mechanisms could be explained through a biopsychosocial model, involving physical (e.g., blood circulation, muscular relaxation) and neurological (e.g., cerebrospinal fluid flow) effects triggered by sound stimulation (Bartel & Mosabbir, 2021). The FDA approval of low-frequency sound vibration devices for improved blood flow (Campbell, 2019) aligns with this concept. While recent studies (Mosabbir et al., 2020; Vuong et al., 2020; etc.) suggest potential brain effects, further research is needed to elucidate the specific mechanisms of 528 Hz's anxiolytic effects.

The effects of sound stimulation on the auditory and vibrotactile systems are primarily due to physical and neurological mechanisms (Bartel & Mosabbir, 2021). Physical mechanisms involve activating muscles and cells, leading to increased fluid and cellular waste transport, cellular metabolism (Bartel & Mosabbir, 2021), blood circulation, and muscular relaxation through resonance. Neurologically, vibration may enhance cerebrospinal fluid flow and waste removal (Bartel & Mosabbir, 2021). The FDA approval of a low-frequency sound vibration device in 1996 for improved blood circulation, reduced discomfort, and enhanced mobility (Campbell, 2019) supports this concept. Recent studies (Mosabbir et al., 2020; Vuong et al., 2020; Iaccarino et al., 2016; Clements-Cortés et al., 2016; King et al., 2009) suggest potential brain effects of prolonged single-frequency exposure. However, further research is needed to elucidate the specific mechanisms by which 528 Hz exerts its anxiolytic effects.

From a psycho-social perspective, Jung's concept of collective unconsciousness (Jung, 2014) suggests that certain sounds might hold universal meaning. Ivonin et al. (2012) found that archetypal sounds, including 528 Hz, elicited stronger heart rate deceleration than negative sounds. This aligns with using archetypal sounds in meditation to focus attention and promote relaxation (Ivonin & Chang, 2013). Future research could explore the psycho-social aspects of 528 Hz's anxiolytic effects, including potential conditioning or cultural influences.

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Implications
This study suggests that 528 Hz sound waves may offer a promising non-invasive approach to managing state anxiety. If further validated through larger and more diverse studies, 528 Hz exposure could potentially complement existing anxiety treatments like cognitive-behavioral therapy. Its accessibility and affordability make it particularly appealing for widespread use.

Limitations
Several limitations affect the generalizability and scope of this study. The small sample size of 48 participants and the short duration of the intervention may limit broader applicability. Future research should address these limitations by conducting larger, randomized controlled trials with longer intervention periods.

Future Research Directions
Future studies should expand on this research by incorporating physiological measures of anxiety, such as heart rate variability or skin conductance, alongside self-reported scales. This holistic approach could provide a more comprehensive understanding of how 528 Hz affects anxiety levels. Additionally, investigating the underlying mechanisms of action through techniques like brain imaging or examining its impact on the autonomic nervous system could further elucidate its therapeutic potential.
If subsequent studies replicate these initial findings with larger and more diverse samples, 528 Hz exposure could potentially emerge as a significant intervention for managing anxiety disorders. Further research could explore integrating 528 Hz into comprehensive anxiety treatment protocols and evaluate its efficacy across different types of anxiety disorders, such as generalized anxiety disorder or social anxiety disorder.

References

1. Akimoto, K., Hu, A., Yamaguchi, T., & Kobayashi, H. (2018). Effect of 528 Hz music on the endocrine system and autonomic nervous system. Health, 10(09), 1159–1170. https://doi.org/10.4236/health.2018.109088
2. Anxiety. (n.d.). https://www.apa.org. https://www.apa.org/topics/anxiety
3. Anxiety disorders. (n.d.). National Institute of Mental Health (NIMH). https: //www.nimh.nih.gov /health/topics/anxiety-disorders
4. Baakek, Y. N. E. H., & Debbal, S. M. (2021). Digital drugs (binaural beats): how can it affect the brain/their impact on the brain. Journal of Medical Engineering & Technology, 45(7), 546–551. https: //doi.org /10.1080/03091902.2021.1936236
5. Babayi, T., & Riazi, G. H. (2017). The Effects of 528 Hz Sound Wave to Reduce Cell Death in Human Astrocyte Primary Cell Culture Treated with Ethanol. Journal of Addiction Research and Therapy, 08(04). https://doi.org/10.4172/2155-6105.1000335
6. Bartel, L., & Mosabbir, A. (2021). Possible mechanisms for the effects of sound vibration on human health. Healthcare (Basel), 9(5), 597. https://doi.org/10.3390/healthcare9050597
7. Beheshti, M. T. H., Emkani, M., Jebeli, M. B., Tajpoor, A., Chahack, A. F., Yarahmadi, G., Piramoon, H., Khoshehsahi, S., & Zobeidi, N. (2019). The effect of sound with different frequencies on men and women noise annoyance. Journal of Research & Health, 9(4), 355–362. https://doi.org/10.29252/jrh.9.4.355
8. Beri, K. (2018). A future perspective for regenerative medicine: understanding the concept of vibrational medicine. Future Science OA, 4(3), FSO274. https://doi.org/10.4155/fsoa-2017-0097
9. Campbell, E. M. (2019). Vibroacoustic treatment and self-care for managing the chronic pain experience: An operational model. JYU Dissertations. https://jyx.jyu.fi/handle/123456789/64286
10. Charcot, J. (2011). Vibratory Therapeutics.-The application of rapid and continuous vibrations to the treatment of certain diseases of the nervous system. The Journal of Nervous and Mental Disease, 199(11), 821–827. https://doi.org/10.1097/nmd.0b013e31823899bc
11. Clements-Cortés, A., Ahonen, H., Evans, M. A., Freedman, M., & Bartel, L. (2016). Short-Term effects of rhythmic sensory stimulation in Alzheimer's Disease: an exploratory pilot study. Journal of Alzheimer's Disease, 52(2), 651–660. https://doi.org/10.3233/jad-160081
12. Daly, I., Malik, A., Hwang, F., Roesch, E. B., Weaver, J., Kirke, A., Williams, D., Miranda, E. R., & Nasuto, S. J. (2014). Neural correlates of emotional responses to music: An EEG study. Neuroscience Letters, 573, 52–57. https://doi.org/10.1016/j.neulet.2014.05.003
13. Daylari, T. B., Riazi, G., Pooyan, S., Fathi, E., & Katouli, F. H. (2018). Influence of various intensities of 528 Hz sound-wave in production of testosterone in rat's brain and analysis of behavioral changes. Genes & Genomics, 41(2), 201–211. https://doi.org/10.1007/s13258-018-0753-6
14. Dependent T-Test in SPSS Statistics - The procedure for running the test, generating the output and understanding the output using a relevant example | Laerd Statistics. (n.d.). https://statistics.laerd.com/spss-tutorials/dependent-t-test-using-spss-statistics.php

15. Dunkel, J. (2018). Rolling sound waves. Nature Materials, 17(9), 759–760. https://doi.org/10.1038/s41563-018-0155-9
16. Egmond, R. (2004). Emotional experience of Frequency Modulated sounds: Implications for the design of alarm sounds. https://www.semanticscholar.org/paper/Emotional-experience-of-Frequency-Modulated-sounds%3A-Egmond /32c409370c4431c7cc9a70824580752d2a7a7cb6
17. Engel, G. L. (1977). The need for a new medical model: a challenge for biomedicine. Science (New York, N.Y.), 196(4286), 129–136. https://doi.org/10.1126/science.847460
18. Explorer of the Brain, Bodymind & Beyond – Candace Pert, PhD. (2023, November 9). Candace Pert, PhD. http://candacepert.com/?_ga=2.20536956.579992778.1705123482-174686485.1705123481
19. Fein, E. C. (2022, June 16). Section 6.3 Repeated Measures ANOVA Assumptions, Interpretation, and Write up. Pressbooks.https://usq.pressbooks.pub/statisticsforresearchstudents/chapter/repeated-measures-anova-ssumptions/
20. Goetz, C. G. (2009). Jean-Martin Charcot and his vibratory chair for Parkinson disease. Neurology, 73(6), 475–478. https://doi.org/10.1212/wnl.0b013e3181b1640b
21. Hart, R. C., & McMahon, C. (2006). Mood state and psychological adjustment to pregnancy. Archives of Women's Mental Health, 9(6), 329–337. https://doi.org/10.1007/s00737-006-0141-0
22. Horowitz, L. G. (2011). The Book of 528: Prosperity Key of Love. Medical Veritas International Incorporated.
23. How to perform a two-way repeated measures ANOVA in SPSS Statistics | Laerd Statistics. (n.d.). https://statistics.laerd.com/spss-tutorials/two-way-repeated-measures-anova-using-spss-statistics.php
24. Hutchins, B. E., & Young, S. G. (2018). State anxiety. In Springer eBooks (pp. 1–3). https://doi.org/10.1007/978-3-319-28099-8_1919-1
25. Iaccarino, H. F., Singer, A. C., Martorell, A. J., Rudenko, A., Gao, F., Gillingham, T. Z., Mathys, H., Seo, J., Kritskiy, O., Abdurrob, F., Adaikkan, C., Canter, R. G., Rueda, R., Brown, E. N., Boyden, E. S., & Tsai, L. (2016). Gamma frequency entrainment attenuates amyloid load and modifies microglia. Nature, 540(7632), 230–235. https://doi.org/10.1038/nature20587
26. Ivonin, L., Chang, H., Chen, W., & Rauterberg, M. (2012). Unconscious emotions: quantifying and logging something we are not aware of. Personal and Ubiquitous Computing (Print), 17(4), 663–673. https://doi.org/10.1007/s00779-012-0514-5
27. Joseph, S. (2019). Sound Healing using Solfeggio Frequencies. ResearchGate. https: //www.researchgate.net /publication/333852911_Sound_Healing_using_Solfeggio_Frequencies
28. Julián, L. (2011). Measures of anxiety: State-Trait Anxiety Inventory (STAI), Beck Anxiety Inventory (BAI), and Hospital Anxiety and Depression Scale-Anxiety (HADS-A). Arthritis Care & Research, 63(S11). https://doi.org/10.1002/acr.20561
29. Jung, C. G. (2014). The archetypes and the collective unconscious. In Routledge eBooks. https://doi.org/10.4324/9781315725642
30. Juslin, P., & Laukka, P. (2003). Communication of emotions in vocal expression and music performance: Different channels, same code? Psychological Bulletin, 129(5), 770–814. https://doi.org/10.1037/0033-2909.129.5.770
31. King, L., Almeida, Q. J., & Ahonen, H. (2009). Short-term effects of vibration therapy on motor impairments in Parkinson's disease. NeuroRehabilitation, 25(4), 297–306. https://doi.org/10.3233/nre-2009-0528
32. Koelsch, S. (2014). Brain correlates of music-evoked emotions. Nature Reviews Neuroscience, 15(3), 170–180. https://doi.org/10.1038/nrn3666
33. Levänen, S., & Hamdorf, D. (2001). Feeling vibrations: enhanced tactile sensitivity in congenitally deaf humans. Neuroscience Letters, 301(1), 75–77. https://doi.org/10.1016/s0304-3940(01)01597-x
34. Lima, C. F., & Castro, S. L. (2011). Speaking to the trained ear: Musical expertise enhances the recognition of emotions in speech prosody. Emotion, 11(5), 1021–1031. https://doi.org/10.1037/a0024521
35. Lolli, S. L., Lewenstein, A. D., Basurto, J., Winnik, S., & Loui, P. (2015). Sound frequency affects speech emotion perception: results from congenital amusia. Frontiers in Psychology, 6. https://doi.org/10.3389/fpsyg.2015.01340
36. Lowe, M., Loveland, K., & Krishna, A. (2018). A Quiet Disquiet: Anxiety and Risk Avoidance due to Nonconscious Auditory Priming. Journal of Consumer Research, 46(1), 159–179. https://doi.org/10.1093/jcr/ucy068
37. Ma, W., & Thompson, W. F. (2015). Human emotions track changes in the acoustic environment. Proceedings of the National Academy of Sciences of the United States of America, 112(47), 14563–14568. https://doi.org/10.1073/pnas.1515087112
38. Mallik, A., & Russo, F. A. (2021). The Effects of Music & Auditory Beat Stimulation on Anxiety: A Randomized Clinical Trial. Semantic Scholar. https://doi.org/10.31234/osf.io/qnhu4
39. Margolin, I., Msw, J. P., & Msw, A. W. (2011). Wellness through a creative lens: mediation and visualization. Journal of Religion & Spirituality in Social Work: Social Thought, 30(3), 234–252. https: //doi.org/10.1080 /15426432.2011.587385
40. Mauchly's test of sphericity - Why no results? | ResearchGate. (2012, August 7). ResearchGate. https://www.researchgate.net/post/Mauchlys-test-of-sphericity-Why-no-results

41. Mosabbir, A., Almeida, Q. J., & Ahonen, H. (2020). The effects of Long-Term 40-Hz physioacoustic vibrations on motor impairments in Parkinson's Disease: a Double-Blinded Randomized Control trial. Healthcare (Basel), 8(2), 113. https://doi.org/10.3390/healthcare8020113
42. Murtiani, Hasanah, H., Darvina, Y., & Yulkifli. (2019). Development of interactive teaching materials with scientific approach contains character values in learning matter about sounds wave, light wave, and optical devices in senior high school class XI. Journal of Physics: Conference Series, 1317, 012164. https://doi.org/10.1088/1742-6596/1317/1/012164
43. National Academy of Sciences. (2015). Psychological testing in the Service of Disability Determination.
44. Özseven, T., Düğenci, M., & Doruk, A. (2016). The effect of age and gender on the acoustic analysis of anxious sound. International Journal of Advanced and Applied Sciences, 3(12), 21–25. https://doi.org/10.21833/ijaas.2016.12.003
45. Pereira, C. (2016). Frequencies of the Buddhist Meditative Chant – Om Mani Padme Hum. International Journal of Science and Research (IJSR), 5(4), 2319–7064. http://scireprints.lu.lv/313/
46. Pert, C. B. (1997). Molecules of emotion: Why You Feel the Way You Feel. Simon and Schuster.
47. Picou, E. M. (2016). Acoustic factors related to emotional responses to sound. https://www.semanticscholar.org/paper/Acoustic-factors-related-to-emotional-responses-to-Picou/e05d98aac26a6c491aedb035f5ae449c8e2c0570
48. Protopapas, A., & Lieberman, P. (1997). Fundamental frequency of phonation and perceived emotional stress. Journal of the Acoustical Society of America, 101(4), 2267–2277. https://doi.org/10.1121/1.418247
49. Sachs, M. E., Habibi, A., Damásio, A. R., & Kaplan, J. (2018). Decoding the neural signatures of emotions expressed through sound. NeuroImage, 174, 1–10. https://doi.org/10.1016/j.neuroimage.2018.02.058
50. Santos, A. C. D., De Abreu, M. S., De Mello, G. P., Costella, V., Amaral, N. R. D., Zanella, A., Poletto, J., Petersen, E., Kalueff, A. V., & Giacomini, A. C. (2023). Solfeggio-frequency music exposure reverses cognitive and endocrine deficits evoked by a 24-h light exposure in adult zebrafish. Behavioural Brain Research, 450, 114461. https://doi.org/10.1016/j.bbr.2023.114461
51. Snyder, B. (2001). Music and Memory: An Introduction. http://ci.nii.ac.jp/ncid/BA50857291
52. Standing, L., & Stace, G. (1980). The effects of environmental noise on anxiety level. The Journal of General Psychology, 103(2), 263–272. https://doi.org/10.1080/00221309.1980.9921007
53. Steele, R. (2004). The theory and practical application of sounds in therapy. Psychotherapy in Australia, 11(1), 66. http://search.informit.com.au/fullText;dn=546772576404776;res=IELHEA
54. Stroebe, M., & Stroebe, W. (2012). Encyclopedia of Human Behavior (2nd Edition). In Elsevier eBooks. https://www.rug.nl/research/portal/publications/grief-and-bereavement(f82050d2-8e2b-4c62-87fb-89d8af6c4664).html
55. Thompson, W. F., Marin, M. M., & Stewart, L. (2012). Reduced sensitivity to emotional prosody in congenital amusia rekindles the musical protolanguage hypothesis. Proceedings of the National Academy of Sciences of the United States of America, 109(46), 19027–19032. https://doi.org/10.1073/pnas.1210344109
56. Thompson, W. F., Schellenberg, E. G., & Husain, G. (2004). Decoding speech prosody: Do music lessons help? Emotion, 4(1), 46–64. https://doi.org/10.1037/1528-3542.4.1.46
57. Van Steenhuyse, E., & Rhoads, M. (2021). Impact of Vibrational Frequencies on State Mood and Mindfulness. Metropolitan State University of Denver, 3. https://doi.org/10.25261/rowdyscholar_sum_2021_evs
58. Vuong, V., Mosabbir, A., Paneduro, D., Picard, L. M., Faghfoury, H., Evans, M. A., Gordon, A., & Bartel, L. (2020). Effects of rhythmic sensory stimulation on Ehlers–Danlos Syndrome: a pilot study. Pain Research & Management, 2020, 1–10. https://doi.org/10.1155/2020/3586767
59. Waddington, D., Woodcock, J., Peris, E., Condie, J., Sica, G., Moorhouse, A., & Steele, A. (2014). Human response to vibration in residential environments. Journal of the Acoustical Society of America, 135(1), 182–193. https://doi.org/10.1121/1.4836496
60. Whole-body vibration: An effective workout? (2024, January 19). Mayo Clinic. https: //www.mayoclinic.org/healthy-lifestyle/fitness/expert-answers/whole-body-vibration/faq-20057958#:~:text=Advocates%20say%20that%20as%20little,decrease%20the%20stress%20hormone%20cortisol.
61. Wiethoff, S., Wildgruber, D., Kreifelts, B., Becker, H. G. T., Herbert, C., Grodd, W., & Ethofer, T. (2008). Cerebral processing of emotional prosody—influence of acoustic parameters and arousal. NeuroImage, 39(2), 885–893. https://doi.org/10.1016/j.neuroimage.2007.09.028
62. Xia, S., Yan, M., Wu, M., Sheng, Z., Hao, Z., Huang, C., & Yang, W. (2015). Soliton frequency shifts in subwavelength structures. Journal of Optics, 17(5), 055503. https://doi.org/10.1088/2040-8978/17/5/055503