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Research Paper

Comparative Study on the Effects of White Noise and Western Classical Music on Perceived and Physiological Stress Levels in Healthy Young Female Adults

Agastya Rishi Bhardwaj[1]*

ABSTRACT

The present study compared the effects of white noise and western classical music on perceived and physiological stress levels in young, healthy female adults. Using a repeated-measures laboratory experiment, 30 women aged 20-30 from the Delhi NCR region were exposed to both auditory conditions across two sessions. Perceived stress was measured using the Subjective Units of Distress Scale (SUDS), while physiological stress was assessed through pulse rate, blood pressure, and galvanic skin response (GSR). The findings showed that both white noise and western classical music were associated with significant reductions in perceived stress. However, the physiological results were less consistent with the white noise condition producing a significant increase in pulse rate, suggesting that although participants reported feeling calmer, autonomic arousal may not have decreased. This may be attributed to perceived stress scores being influenced by demand characteristics. In contrast, western classical music produced a significant reduction in pulse rate and lower GSR increases than white noise at all times, indicating a more consistent calming effect on physiological stress responses. Overall, the study suggests that while both auditory stimuli may help reduce the subjective experience of stress, western classical music appears to be more effective in promoting measurable physiological relaxation. These findings highlight the importance of distinguishing between perceived and physiological stress reduction and support further research into how specific sound qualities and musical features influence stress regulation.

Keywords: *White Noise, Classical Music, Perceived Stress, Physiological Stress, Galvanic Skin Response*

In the years following the COVID-19 pandemic, stress has become an increasingly salient public health concern, because long-term changes to school, work, daily routines, and people's sense of safety and control have continued to affect how they cope. Population-level research conducted during the acute phase of the pandemic documented substantial psychological strain alongside social and financial stresses, underscoring how large-scale environmental uncertainty can amplify everyday stress experiences (Robillard et al., 2020). Beyond its immediate emotional burden, stress is clinically relevant because repeated or prolonged activation of stress response systems can contribute to health risks

[1]Student, The British School, New Delhi, India
*Corresponding Author

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ranging from insomnia (Dube & Babar, 2024) to mood disorders and metabolic vulnerability (Eggers, 2007). Young adults may be particularly susceptible due to concurrent academic demands, identity development, and changing social roles, making feasible, low-cost stress regulation strategies especially valuable. (Schwartz et al., 2015)

Sound-based interventions represent one such strategy. Auditory stimuli can be delivered easily, at low cost, and without medical supervision, making them practical for everyday stress management. Among these, classical music and white noise are commonly used in wellness and study environments, yet they differ fundamentally in acoustic structure (rhythmic and melodic predictability vs relatively uniform sound). These differences may engage distinct cognitive and neurophysiological pathways, producing measurably different effects on stress-related physiology. (Pascoe et al., 2022) Understanding how these auditory conditions modulate stress markers in real time can help refine evidence-informed recommendations for non-pharmacological stress regulation.

According to the American Psychological Association (2018), stress is "the physiological or psychological response to internal or external stressors. Stress involves changes affecting nearly every system of the body, influencing how people feel and behave." This framing is captured by Lazarus and Folkman's transactional model, which conceptualises stress not as an inherent property of events, but as the outcome of interactions between an individual and their surroundings. Central to this model are primary appraisal, secondary appraisal, coping and reappraisal. Primary appraisal is where an individual evaluates the situation's significance: "Is it a challenge or threat?". Then, secondary appraisal is where an individual assesses the resources to manage the stressor, where the individual's ability to handle the stressor in terms of personal resources and potential coping strategies are looked at. Then the coping stage is where actions to manage demands are implemented. These are also divided into two points: problem-focused and emotion-focused. Problem-focused coping mechanisms refer to changing the stressful situation through actions such as planning. Emotion-focused coping mechanisms refer to managing the emotional distress through actions such as relaxation and denial. Lastly, reappraisal refers to the continuous re-evaluation based on new information or outcomes, making the process dynamic and ever-changing. The core idea of the model, however, is that stress arises from the perceived imbalance between demands from the environment and perceived resources from the self. It is the interpretation, not just the event, that creates stress. This model is particularly relevant when studying interventions such as music and white noise because auditory inputs can influence both appraisal (shifting attention and emotional interpretation) and coping capacity (supporting relaxation, focus or perceived control over the situation/environment). (VandenBos & American Psychological Association, 2015)

Stress also varies in form and function. There are two main forms of stress: eustress and distress. Eustress refers to manageable challenges that can enhance motivation and performance, whereas distress refers to overwhelming demand linked to negative affect and physiological strain. (Gibbons et al., 2008) Complementing the cognitive appraisal view, Selye's General Adaptation Syndrome (GAS) describes a stereotypical pattern of bodily response to sustained stressors across three stages (alarm, resistance, and exhaustion) highlighting how prolonged activation can deplete adaptive capacity over time. The alarm stage refers to the mind's initial response to a stressful event, initiating a 'flight or fight' response, which is a way in which the mind protects an individual to either run away from the stressor or fight to protect itself from it. This stage is defined by an increased heart rate, the release of cortisol and a boost of adrenaline (Higuera, 2018). In the second stage, the resistance stage, the body begins to return to pre-alarm stage levels. However, if the stressor is mitigated, the body will lower its heart rate and reduce the secretion of cortisol and adrenaline. But, if the stressful situation persists, the body will never receive an indication to return to pre-alarm stage levels, leading to an increase in cortisol, adrenaline and an elevated heart rate. This has been seen to cause disturbances in digestion, immunity and reproduction (Mariotti, 2015). The exhaustion stage is a result of chronic stress, where the prolonged period of stress has depleted an individual's body's resources and they are no longer able to fight the stress. As the name suggests, one may experience fatigue, burnout, anxiety, and depression at this stage. (Selye, 1946)

When a stressor is detected, the brain recruits interconnected circuits involved in threat detection, salience, emotion regulation, and autonomic control. Two major biological pathways coordinate the acute stress response.

The sympathetic-adreno-medullary (SAM) system, which rapidly increases sympathetic activity and catecholamine release to support mobilisation (e.g. - heightened heart rate). The brain perceives a threat, activating the sympathetic nervous system (SNS). SNS nerve fibres directly stimulate the adrenal medulla (the inner part of the adrenal gland) and then the adrenal medullary cells release catecholamines directly into the blood. The SAM system aims to quickly mobilise resources to deal with acute threats and return the body to a stable state (homeostasis) (Chu et al., 2024b).

The hypothalamic-pituitary-adrenal (HPA) axis, which produces a slower endocrine response culminating in glucocorticoid release that helps allocate energy and modulate immune and metabolic function. First, the hypothalamus detects stress and releases corticotropin-releasing factor (CRF) which stimulates the pituitary to release adrenocorticotropic hormone (ACTH). ACTH then travels to the adrenal glands and triggers the release of cortisol and adrenaline. The cortisol increases blood sugar, boosts energy, sharpens focus, and suppresses non-essential functions for immediate survival (Chu et al., 2024b).

In acute stress, these symptoms are adaptive; however, repeated activation can shift the body toward persistent sympathetic dominance and altered endocrine regulation, which is one reason chronic stress is associated with downstream health risks. Physiological signals such as changes in heart rate, blood pressure, and skin conductance can be interpreted by the brain as evidence of threat or safety, shaping moment-to-moment subjective stress. (*Stress Effects on the Body*, 2018)

Because stress is multidimensional, research commonly distinguishes perceived stress and physiological arousal. The present study focuses on real-time physiological indices that map closely onto autonomic function along with perceived stress:

- Galvanic Skin Response (GSR): Skin conductance changes reflect sweat gland activity, which is primarily driven by the SNS. For this reason, GSR is frequently treated as a sensitive, non-invasive marker of autonomic arousal and emotional intensity (Pedersen, 2026).
- Heart Rate (HR): HR reflects the balance of sympathetic activation and parasympathetic (vagal) modulation. Stress typically biases this balance toward sympathetic predominance, elevating HR (Kim et al., 2018).

- Blood Pressure (BP): BP is shaped by cardiac output and vascular tone, both influenced by sympathetic activity. Stress related increases in vascular resistance can elevate BP, making it a widely used marker of cardiovascular arousal (Joyner et al., 2010).

The aim of the study was to compare the effects of white noise and western classical music on acute and perceived stress levels in healthy, young female adults. In line with the aim, the following hypotheses were formulated.

- **H1:** Exposure to both classical music and white noise will be associated with a reduction in physiological and perceived stress.
- **H2:** Exposure to both classical music and white noise will not be associated with a reduction in physiological and perceived stress.
- **H3:** Classical music will produce a greater reduction in physiological stress markers and perceived stress than white noise.
- **H4:** White noise will produce a greater reduction in physiological stress markers and perceived stress than classical music

LITERATURE REVIEW

Several studies show that music listening reduces physiological stress responses and supports cardiovascular regulation. Mir et al. (2020) conducted a study with 30 pre-hypertensive young adults (18-25 years) who were randomly divided into two groups: the experimental group listened to relaxing flute and piano music 30 minutes a day, 5 days a week over 4 weeks along with the DASH (Dietary Approaches to Stop Hypertension) eating plan, whereas the control group was only on the DASH eating plan. The experimental group showed a significant reduction in systolic blood pressure and heart rate, and the control group showed no significant changes in any of the three measures. These findings suggest that music therapy can be an effective tool to reduce systolic blood pressure and heart rate. While Mir et al. (2020) show longer term reductions in systolic blood pressure and heart rate through repeated music exposure, Lee et al. (2015) aimed to investigate the effect of music therapy on stress levels by assessing cardiovascular and autonomic nervous system responses in stress-induced university students. 64 participants were randomly assigned to either an experimental group, which received 20 minutes of music therapy using preferred songs, or a control group, which rested without music. After music therapy, the experimental group showed a significant reduction in systolic blood pressure, pulse rate, and subjective stress, as well as improved HRV indicators. The control group showed no significant improvements. These findings suggest that music therapy may help alleviate both physiological and psychological stress responses in young adults. Beyond changes in blood pressure and pulse, Trappe and Voit (2016) aimed to compare the effects of different musical genres (Mozart, Strauss and ABBA) on blood pressure, heart rate, and cortisol levels. 120 healthy adults were randomly assigned to either a music group or a silent control group. The results showed that Mozart and Strauss music significantly lowered blood pressure, heart rate, and cortisol levels, while ABBA had a smaller effect. The control group also showed slight decreases, but less than those exposed to classical music. The study concluded that classical music, especially pieces with calm structure and no lyrics, may have a stronger relaxing effect on the body than pop music or silence.

Building on genre differences, Darki et al. (2022) looked at how fast and slow classical music affected heart rate, blood pressure, and mood. 100 adults listened to two pieces by

Beethoven: Symphony of Fate (fast) and Moonlight Sonata (slow). Results showed that fast music raised heart rate and blood pressure, while slow music lowered both. Most people found the fast music uplifting and the slow music calming. Almost everyone said that both pieces helped them manage stress. The study suggests music, especially slow classical pieces, can help reduce physical signs of stress and improve mood.

However, stress is not only physiological; it is also experienced subjectively. In an applied academic context, Istadi (2018) aimed to investigate whether listening to classical music could reduce stress levels among medical students during an anatomical identification test. 148 first-year medical students participated in a post-test only control group design experiment, with equal numbers assigned to either a music group or a non-music group. The music group listened to Mozart's Concerto for Flute, Harp, and Orchestra in C Major throughout the test. Results showed that students who listened to classical music experienced significantly lower stress levels compared to those who did not. Most students in the music group reported mild stress, while the non-music group had higher percentages of moderate and severe stress responses. The findings suggest that classical music can effectively lower perceived stress during academic evaluations such as anatomical identification tests.

Moriya et al. (2018) investigated how different types of music during study breaks affect brain activity and parasympathetic nervous system activity. 11 students completed a concentration task and then took breaks using five relaxation methods: doing nothing, deep breathing, listening to a favorite uplifting song, a favorite relaxing song, or classical music (Vivaldi). All music types led to more prefrontal deactivation and slightly higher parasympathetic activity than rest or deep breathing. Uplifting music showed the strongest signs of both mental and physiological relaxation. The study concluded that music, especially personally enjoyable uplifting songs, can be effective for reducing stress and restoring focus during study breaks.

Although music shows relatively consistent calming effects across studies, the evidence for white noise is more mixed. Ganea et al. (2025) aimed to investigate whether white noise could reduce stress and improve cognitive performance in university students taking a timed test. Twelve students previously identified as highly stress-responsive were randomly assigned to either a white noise group or a control group exposed to ambient noise. Participants completed a cognitive task. The white noise group showed a significantly smaller increase in heart rate and a drop in subjective stress scores, while the control group's stress levels increased. However, there were no significant differences in blood pressure or test performance between the two groups. The findings suggest that white noise may help reduce stress during exams, but does not enhance cognitive performance. Ganea et al. (2025) suggests white noise can lower subjective stress during timed testing, but Awada et al. (2022) aimed to investigate the effects of different white noise levels on the cognitive performance, creativity, and stress levels of neurotypical young adults in an office setting. Forty graduate students completed a within-subject experiment involving three auditory conditions (45 dB white noise, 65 dB white noise, and ambient office noise). Participants performed a series of tasks measuring sustained attention, selective attention, inhibition, working memory, creativity, and typing performance, while physiological stress responses were monitored via electrodermal activity (EDA). Results showed that white noise at 45 dB significantly improved sustained attention, creativity, accuracy, and speed of performance, and was associated with lower stress levels. In contrast, white noise at 65 dB improved working memory but resulted in higher stress and more performance errors. The findings suggest that lower-level white noise can enhance overall task performance and reduce stress in neurotypical adults, whereas higher levels may be beneficial for memory-related tasks but carry a stress-related trade-off.

However, not all findings support a benefit: Fox et al. (2015) aimed to explore whether white noise could reduce stress and improve cognitive performance during tasks, offering a safer alternative to stimulant use among students. Researchers tested this by measuring physiological stress markers (heart rate, blood pressure, and electrodermal activity) while participants performed cognitive tasks under three sound conditions: ambient noise, white noise, and heavy metal music. Despite expectations, results showed no significant reduction in stress or improvement in performance with white noise. The study concluded that white noise is not a reliably effective tool for stress reduction or cognitive enhancement, though further research with better equipment is recommended.

Overall, the literature suggests music (especially slower, calming music and, in some studies, preferred music) tends to produce more consistent reductions in stress markers, including heart rate, systolic blood pressure and HRV based recovery measures. It also reduces perceived stress in exam-like settings. White noise, on the other hand, has mixed results: it may reduce subjective stress or heart rate reactivity in certain contexts, but its effects seem strongly dependent on intensity and task demands. This creates a clear gap for further research: fewer studies directly compare music and white noise under matched conditions, and many studies focus on either physiological or subjective outcomes rather than both together.

METHODOLOGY

Research Design

The present study made use of a lab experiment research design to examine whether exposure to classical music versus white noise produces different changes in stress. A lab experiment was chosen because it allows for high control over extraneous variables, helping isolate the effect of auditory condition on stress levels. Furthermore, a repeated measures design was employed where each participant was exposed to both conditions.

Music Selection

For the western classical music condition, a combination of 3 pieces was chosen: Mozart’s Clarinet Concerto in A Major, K. 622: II. Adagio; Mozart’s Piano Concerto No.23 in A Major, K. 488: II. Adagio; and Mozart’s Piano Sonata No.12 in F Major, K. 332: II. Adagio. These pieces were chosen due to their slow tempo, a feature discovered (during the literature review) to be helpful in stress reduction.

Sample

Data was collected from 30 women between the ages of 20 and 30 from the Delhi NCR region. The average age of the sample was 26. The study employed a convenience sampling technique, meaning participants were recruited based on availability and willingness to participate. This method was used because it is time-efficient, practical, and feasible.

Instrumentation
One standardised scale and three devices were used to measure the key variables of the study:

1. **Subjective Units of Distress Scale (SUDS)**: The Subjective Units of Distress Scale, developed by Wolpe (1969), was employed to assess participants' perceived stress/distress. The SUDS is a single-item self-report rating, where respondents indicate their current level of distress on a 0-100 scale, with 0 indicating being 'Totally relaxed' and 100 indicating 'Highest distress/fear/anxiety/discomfort that you have ever felt'.
2. **Mindfield® eSense Skin Response sensor**: The Mindfield® eSense Skin Response sensor was used to measure galvanic skin response (GSR) as an objective physiological indicator of stress-related arousal. GSR reflects changes in skin conductance, driven by eccrine sweat gland activity, which is primarily controlled by the sympathetic nervous system, making it sensitive to stress and cognitive/emotional arousal.
3. **Blood Pressure Monitor**: An automated blood pressure monitor was used to assess systolic blood pressure (SBP) and diastolic blood pressure (DBP) (mmHg), as well as pulse rate (beats per minute), as objective cardiovascular indicators of stress-related arousal.
4. **Pulse Oximeter**: A fingertip pulse oximeter was used to measure peripheral oxygen saturation (SpO_2%).

Procedure
Data collection took place on two days (Day 1 and Day 4) for each participant, following the same procedure. On arrival, participants were briefed on the study's aims and procedure (and on Day 1, informed consent was obtained), after which they were prepared for recording. Each session began with a 5-minute seated baseline rest in a controlled room, during which pulse rate, SpO_2, blood pressure, and perceived stress were recorded. Then, the GSR sensor was attached to participants' fingertips and an eyemask was worn to remove the influence of any visual stimuli. Participants were then exposed to either classical music or white noise for 20 minutes with the use of noise-cancelling earphones while GSR was recorded continuously throughout the 20 minutes. Immediately after the intervention ended, post-intervention measures were taken (pulse rate, SpO_2, blood pressure, and perceived stress). Finally, participants remained seated and a recovery assessment was conducted 5 minutes later, again recording pulse rate, SpO_2, and blood pressure.

Ethical Considerations
Informed consent was obtained from participants and they were debriefed on the study's aims and how the data will be used before the readings were taken. Participants were also given the option to withdraw their data at any point in time. Data was anonymised and will be destroyed after publication.

RESULTS

Table 1: The t-test values for pulse before and after exposure to white noise

	t	df	p	Cohen's d
Before-After	-4.77	29	<.001	0.87

The results indicate a statistically significant increase in pulse rate following exposure to white noise with $t=-4.77$ and $p<0.001$. Participants exhibited a lower mean pulse rate before exposure (M=80.7, SD=10.56) compared to after exposure (M=85.5, SD=10.94). The magnitude of this difference was large, as indicated by Cohen's d = 0.87.

Table 2: The ANOVA with repeated measures values of pulse before, after, and 5 minutes after exposure to white noise

	Type III Sum of Squares	**df**	**Mean Square**	**F**	**p**	**η2**
Treatment	345.69	2	172.84	8.00	.001	0.22
Error	1252.98	58	21.60			

The results indicate that there is a statistically significant difference in pulse rate across the three time points with F=8.00 and p=0.001. The mean pulse rate increased from before exposure (M = 80.7, SD = 10.56) to after exposure (M = 85.5, SD = 10.94) and slightly decreased 5 minutes after exposure (M = 83.03, SD = 10.7). The effect size was large, as indicated by η2 = 0.22.

Table 3: The ANOVA with repeated measures values for systolic blood pressure before, after, and 5 minutes after exposure to white noise

	Type III Sum of Squares	**df**	**Mean Square**	**F**	**p**	**η2**
Treatment	161.62	2	80.81	1.00	.373	0.03
Error	4667.71	58	80.48			

The results indicate that there was no statistically significant difference in systolic blood pressure across the three time points with F = 1.00 and p=0.373. The mean systolic blood pressure slightly decreased from before exposure (M = 99.67, SD = 12.89) to after exposure (M = 96.47, SD = 14.25) and slightly increased 5 minutes after exposure (M = 97.43, SD = 10.39). The effect size was small, as indicated by η2 = 0.03.

Table 4: The t-test for paired samples values for systolic blood pressure before and after exposure to white noise

	t	**df**	**p**	**Cohen's d**
Before-After	1.37	29	.18	0.25

The results indicate that there was no statistically significant difference between the two time points with t = 1.37 and p = 0.18. The effect size was small, as indicated by Cohen's d = 0.25.

Table 5: The t-test for paired samples values for diastolic blood pressure before and after exposure to white noise

	t	**df**	**p**	**Cohen's d**
Before-After	-1.68	29	.103	0.31

The results indicate that there was no statistically significant difference between the two time points with t = -1.68 and p = 0.103. Participants showed a lower mean diastolic blood pressure before exposure (M = 62.97, SD = 10.42) compared to after exposure (M = 65.87, SD = 10.77). The magnitude of this difference was small, as indicated by Cohen's d = 0.31.

Table 6: The ANOVA with repeated measures values for diastolic blood pressure before, after, and 5 minutes after exposure to white noise

	Type III Sum of Squares	df	Mean Square	F	p	η2
Treatment	312.20	2	156.10	2.75	.072	0.09
Error	3292.47	58	56.77			

The results indicate that there was no statistically significant difference in diastolic blood pressure across the three time points with F = 2.75 and p = 0.072. The mean diastolic blood pressure increased from before exposure (M = 62.97, SD = 10.42) to after exposure (M = 65.47, SD = 10.77) and increased further 5 minutes after exposure (M = 67.47, SD = 10.38). The effect size was moderate, as indicated by η2 = 0.09.

Table 7: The t-test for paired samples values for perceived stress scores before and after exposure to white noise

	t	df	p	Cohen's d
Before-After	7.55	29	<.001	1.38

The results indicate a statistically significant decrease in perceived stress scores following exposure to white noise with t = 7.55 and p < 0.001. Participants reported higher perceived stress scores before exposure (M = 25, SD = 15.26) compared to after exposure (M = 7.67, SD = 11.04). The magnitude of this difference was large, as indicated by Cohen's d = 1.38.

Table 8: The t-test for paired samples values for pulse before and after exposure to western classical music

	t	df	p	Cohen's d
Before-After	2.82	29	.009	0.51

The results indicate a statistically significant decrease in pulse rate following exposure to classical music with t = 2.82 and p = 0.009. Participants exhibited a higher mean pulse rate before exposure (M = 82.17, SD = 10.94) compared to after exposure (M = 78.40, SD = 11.67). The magnitude of this difference was moderate, as indicated by Cohen's d = 0.51.

Table 9: The ANOVA with repeated measures values for pulse before, after, and 5 minutes after exposure to western classical music

	Type III Sum of Squares	df	Mean Square	F	p	η2
Treatment	215.76	2	107.88	4.14	.021	0.13
Error	1509.58	58	26.03			

The results indicate a statistically significant difference in pulse rate across the three time points with F = 4.14 and p = 0.021. The mean pulse rate decreased from before exposure (M = 82.17, SD = 10.94) to after exposure (M = 78.40, SD = 11.67) and slightly increased 5 minutes after exposure (M = 80.67, SD = 11.35). The effect size was large, as indicated by η2 = 0.13.

Table 10: The t-test for paired samples values for perceived stress scores before and after exposure to western classical music

	t	df	p	Cohen's d
Before-After	5.25	29	<.001	0.96

The results indicate a statistically significant decrease in perceived stress scores following exposure to classical music with t = 5.25 and p<0.001. Participants reported higher perceived stress scores before exposure (M = 21.67, SD = 18.77) compared to after exposure (M = 8, SD = 9.61). The magnitude of this difference was large, as indicated by Cohen's d = 0.96.

Table 11: The ANOVA with repeated measures values for systolic blood pressure before, after, and 5 minutes after exposure to western classical music

	Type III Sum of Squares	df	Mean Square	F	p	η2
Treatment	287.02	2	143.51	2.08	.134	0.07
Error	4004.31	58	69.04			

The results indicate that there was no statistically significant difference in mean systolic blood pressure across the three time points with F = 2.08 and p = 0.134. The mean systolic blood pressure slightly decreased from before exposure (M = 101.93, SD = 11.31) to after exposure (M = 101.47, SD = 12.32) and further decreased 5 minutes after exposure (M = 97.93, SD = 12.09). The effect size was medium, as indicated by η2 = 0.07.

Table 12: The t-test for paired samples values for systolic blood pressure before and after exposure to western classical music

	t	df	p	Cohen's d
Before-After	0.22	29	0.827	0.04

The results indicate that there was no statistically significant difference between the two time points with t = 0.22 and p = 0.827. The effect size was very small, as indicated by Cohen's d = 0.04.

Table 13: The ANOVA with repeated measures values for diastolic blood pressure before, after, and 5 minutes after exposure to western classical music

	Type III Sum of Squares	df	Mean Square	F	p	η2
Treatment	18.16	2	9.08	0.21	.812	0.01
Error	2515.18	58	43.37			

The results indicate that there was no statistically significant difference in diastolic blood pressure across the three time points with F = 0.21 and p = 0.812. The mean diastolic blood pressure remained similar before exposure (M = 67.27, SD = 13.18), after exposure (M = 66.97, SD = 11.02), and 5 minutes after exposure (M = 66.20, SD = 10.93). The effect size was very small as indicated by η2 = 0.01.

Table 14: The t-test for paired samples values for diastolic blood pressure before and after exposure to western classical music

	t	df	p	Cohen's d
Before-After	0.16	29	.875	0.03

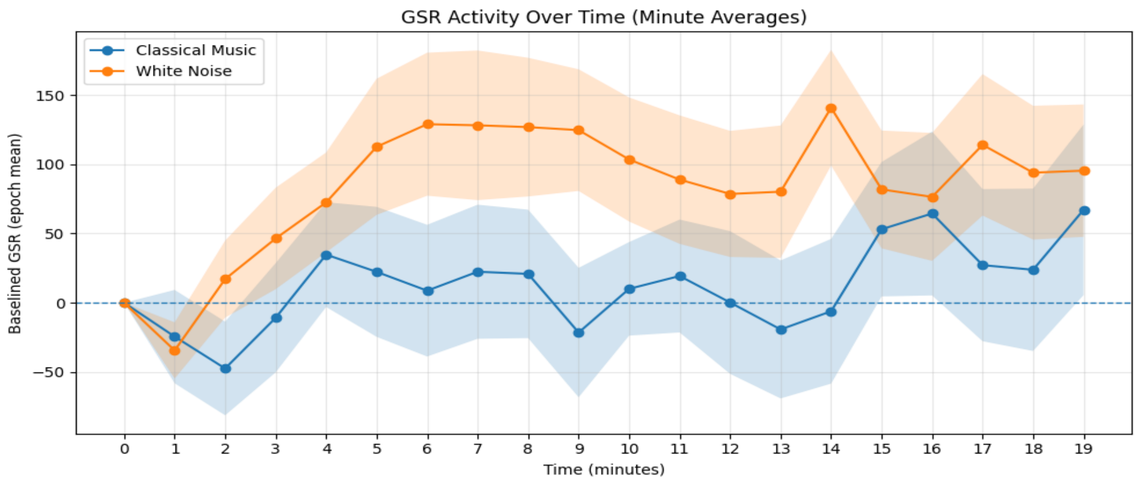
The results indicate that there was no statistically significant difference between the two time points with t = 0.16 and p = 0.875. The effect size was very small, as indicated by Cohen's d = 0.03.

Table 15: Paired Samples t-tests Comparing GSR Between Western Classical Music and White Noise Conditions by Minute

Minute	n	t	p	Cohen's d
0	30	-2.85	0.008	-0.52
1	30	0.26	0.80	0.05
2	30	-1.76	0.089	-0.32
3	30	-1.24	0.226	-0.23
4	30	-0.84	0.406	-0.15
5	30	-1.36	0.185	-0.25
6	30	-1.65	0.109	-0.30
7	30	-1.41	0.171	-0.26
8	30	-1.42	0.167	-0.26
9	30	-2.09	0.046	-0.38
10	30	-1.45	0.159	-0.26
11	30	-1.01	0.322	-0.18
12	30	-1.16	0.257	-0.21
13	30	-1.49	0.148	-0.27
14	30	-2.37	0.025	-0.43
15	30	-0.40	0.690	-0.07
16	30	-0.16	0.877	-0.03
17	30	-1.08	0.288	-0.20
18	30	-0.84	0.408	-0.15
19	30	-0.34	0.736	-0.06

Significant differences were observed at minute 0 ($t = -2.85$, $p = 0.008$, Cohen's $d = -0.52$), minute 9 ($t = -2.09$, $p = 0.046$, Cohen's $d = -0.38$), and minute 14 ($t = -2.37$, $p = 0.025$, Cohen's $d = -0.43$), with GSR being lower in the classical music condition compared to the white noise condition. No statistically significant differences were observed at the other time points ($p>0.05$). Overall, this suggests that western classical music produced a small-to-moderate reduction in GSR compared to white noise at select moments during the exposure, while differences were minimal at other times.

Figure 1: Minute-by-Minute Changes in Galvanic Skin Response (GSR) During Exposure to Western Classical Music and White Noise



GSR values are plotted as minute-by-minute averages.

At the beginning of the exposure (minutes 0-2), both conditions show an initial decrease in GSR. Following this, the white noise condition displays a rapid increase in GSR, reaching relatively high levels between approximately minutes 5 and 9. In contrast, the classical music condition remains comparatively lower and more stable during the same period, with smaller fluctuations around the baseline.

From approximately minutes 10-14, GSR under white noise remains elevated relative to the western classical music condition. The classical music condition shows moderate variability, including brief decreases below baseline around minutes 9 and 13. Toward the later part of the session (minutes 15 to 19), GSR in the western classical music condition rises.

Overall, the figure suggests that exposure to white noise was generally associated with higher GSR levels during much of the session, whereas western classical music showed lower and more variable GSR responses.

DISCUSSION

The present study investigated whether exposure to white noise and western classical music would reduce physiological and psychological perceived stress in young healthy females, and whether one auditory condition would be more effective than the other. Overall, the findings provide partial support for the hypothesis that sound-based interventions can reduce stress, but they suggest that western classical music was the more consistently calming condition, especially when physiological measures are considered.

First, both auditory conditions were associated with a significant reduction in perceived stress scores. After white noise exposure, perceived stress scores decreased. The $p<0.001$, with a large effect size ($d = 1.38$). Similarly, after western classical music exposure, perceived stress scores decreased. The $p < 0.001$, also with a large effect size ($d = 0.96$). This suggests that both sound conditions may have functioned as a form of emotion-focused coping and stress reduction. This is broadly consistent with Lazarus and Folkman's transactional model of stress (Lazarus and Folkman, 1984), in which coping strategies may reduce emotional experience of stress even if the stressor itself is unchanged. Sound may have helped participants shift attention away from stressful thoughts, created a sense of containment, or generated a temporary feeling of calm. In this respect, both white noise and classical music seem to have some subjective stress-relieving value.

However, the reduction in perceived stress in the white noise condition may be attributed to biases. Although participants reported feeling less stressed, the physiological findings do not strongly support the idea that white noise reduced stress at a physiological level. Some physiological measures showed no significant change, while others suggested an increase in arousal. Therefore, the decrease in self-reported stress in the white noise condition may partly reflect participant bias, particularly demand characteristics. Demand characteristics refers to when participants guess the aim of the study and thus alter their behavior accordingly. Because participants were informed of the study's aim when acquiring consent, they may have altered their behavior based on their prior knowledge of the ongoing inquiry into the effects of white noise on stress. (Orne, 1962)

This contradiction becomes especially clear in the pulse rate results. In the white noise condition, pulse rate significantly increased with $p<0.001$, with a large effect size ($d = 0.87$). The repeated measures ANOVA was also significant with $p = 0.001$, indicating that pulse changed significantly across the 20 minutes. This directly contradicts the claim that white noise is uniformly relaxing. If white noise had reduced stress consistently, a decrease in pulse rate would have been expected. Instead, the increase suggests that white noise may not have reduced autonomic arousal and may even have sustained or heightened it. This is consistent with the result of Ganea et al.'s (2025) study which showed that white noise, although reduced pulse rate in comparison to the control, still caused an increase in pulse rate. By contrast, the classical music condition showed a more coherent calming pattern in the context of pulse rate. Pulse rate significantly decreased with $p = 0.009$, with a moderate effect size ($d = 0.51$). The repeated-measures ANOVA was also significant with $p = 0.021$. Although pulse rate rose slightly again five minutes later, it still remained below baseline, suggesting at least partial physiological recovery. This provides stronger support for the conclusion that western classical music had a measurable calming effect on the autonomic nervous system. This is consistent with Trappe and Voit's (2016) findings, which showed that Mozart and Strauss music (part of the western classical tradition) created a reduction in heart rate.

A possible explanation for this difference lies in the structural properties of the two auditory stimuli. Western classical music is more dynamic and patterned, creating a sense of progression and predictability, helping the body shift away from a stress response. White noise, in contrast, is acoustically uniform and lacks meaningful variation. Although this uniformity may be useful for masking external distractions for some, it may not be sufficient to support deeper physiological relaxation. In fact, its repetitive and unchanging nature may have induced boredom, restlessness, or mind wandering, which could have led participants to dwell on stressful thoughts and thereby maintain physiological arousal. (Pascoe et al., 2022b)

For blood pressure, neither condition produced significant changes across the three time points. These null results imply that a 20-minute exposure may fall short of influencing blood pressure, a measure often slower to reflect acute autonomic shifts compared to pulse rate or skin conductance. Short-term auditory interventions like these might simply lack the duration needed to register on the vascular level.

Galvanic Skin Response (GSR), an index of sympathetic activation, further showed complex results. GSR levels were significantly lower in the classical condition at 0, 9, and 14 minutes after the audio started playing. This pattern aligns with the music's changing structure, with the opening being slow and having a sparse texture, thus dampening initial arousal. At 9 minutes, a lighter piano entry with a thinner texture reduced auditory density. At 14 minutes, a key modulation to major may have decreased stress levels. Thus, we further see how certain musical features affect stress levels. At the neurological level, such features could have engaged the prefrontal cortex to downregulate amygdala-driven stress signals via strengthened top-down inhibition, fostering parasympathetic dominance as pulse data also suggests (Rivera Segarra et al., 2015). White noise, by comparison, sustained higher GSR.

However, even classical music did not yield uniform GSR decline. For a majority of the time, the GSR values for participants in the classical music condition increased relative to the baseline. This could be attributed to participant unfamiliarity with the genre of music, limiting prefrontal cortex engagement, as familiar music more reliably boosts dopamine in the nucleus accumbens, indirectly calming the HPA axis output (Salimpoor et al., 2011).

Overall, the findings suggest an important distinction between subjective stress reduction and physiological stress reduction. Participants may report feeling calmer without showing corresponding reduction in autonomic arousal. This appears especially relevant in the white noise condition.

The study also had several limitations that need to be acknowledged. Firstly, the sample size was relatively small (n=30), which may have impacted the risk of error. The small sample size coupled with the opportunity sampling technique may have manifested in a sampling bias, as the participants were likely not fully representative of the wider population of young adults, limiting generalisability. Because opportunity sampling relies on individuals who are easily accessible, the sample may have been skewed toward participants with similar educational background, socioeconomic context, and familiarity with white noise and classical music. This reduced the generalisability of the findings for young women from different cultural, educational, or psychological backgrounds. The small sample size may have increased the likelihood of Type II errors (false negatives). At the same time, the multiple minute-by-minute GSR comparisons also raise the possibility of Type I errors (false positives), where some significant findings may have occurred by chance. Also, individual differences were not fully controlled. Variables such as baseline stress level, music preference, familiarity with western classical music, sensitivity to noise, and fatigue may all have influenced participants' responses to the auditory conditions. Finally, the intervention period was relatively brief and not sustained over a period of time, meaning the study only examined the short-term effects of white noise and western classical music on stress. It is therefore unclear whether repeated exposure over a longer period would produce stronger, weaker, or more stable effects.

Future research should use a larger and more diverse sample to improve generalisability and reduce sampling bias, and should ideally include a silence control group to determine whether the observed effects were due to the auditory stimuli themselves or simply to sitting quietly. It would also be useful to compare white noise with other sound conditions, such as nature sounds or self-selected music, to examine whether familiarity and personal preference influence stress reduction.

In addition, future studies should investigate the longer-term effects of auditory interventions, as the present study only measured short-term changes. Including more sensitive measures such as heart rate variability or salivary cortisol concentrations could provide a fuller understanding of physiological stress responses. Researchers could also examine specific musical features such as tempo, texture, and key to identify which elements of classical music are most effective at reducing stress.

CONCLUSION

The present study revealed that both white noise and western classical music were associated with reductions in perceived stress among young healthy females, suggesting that auditory interventions may have some value in helping individuals feel calmer in the short term. However, the physiological findings showed a more complex picture. While western classical music demonstrated a more consistent calming effect across measures such as pulse rate and GSR, white noise did not show the same pattern and in some cases appeared to maintain or even increase physiological arousal. These findings suggest that although both sound conditions may reduce the subjective experience of stress, western classical music may be more effective in producing measurable physiological relaxation. However, it is important to consider that participants' self-report of their perceived levels of stress may have been influenced by demand characteristics. Thus, if we look at results from a purely physiological lens, western classical music produces greater physiological relaxation than white noise. Although western classical music did produce increases in GSR, the increases were consistently less than that produced by white noise.

Furthermore, the study suggests that the structural qualities of sound may play an important role in how the body responds in the context of stress. The dynamic and patterned nature of western classical music may have supported greater autonomic recovery, whereas the repetitive and unchanging quality of white noise may have not been sufficient to produce relaxation by providing distraction. Overall, the study emphasises the potential of music-based interventions as accessible tools for stress reduction, while also showing that not all auditory stimuli are equally effective. It therefore provides support for further research into how different types of sound, as well as specific musical features, may influence both perceived and physiological stress responses.

REFERENCES

Awada, M., Becerik-Gerber, B., Lucas, G., & Roll, S. (2022). Cognitive performance, creativity and stress levels of neurotypical young adults under different white noise levels. *Scientific Reports, 12*(1). https://doi.org/10.1038/s41598-022-18862-w

Bigliassi, M., León-Domínguez, U., & Altimari, L. R. (2015). How does the prefrontal cortex “listen” to classical and techno music? A functional near-infrared spectroscopy (fNIRS) study. *Psychology & Neuroscience, 8*(2), 246–256. https://doi.org/10.1037/h0101064

Chennafi, M., Khan, M. A., Li, G., Lian, Y., & Wang, G. (2018). Study of Music Effect on Mental Stress Relief Based on Heart Rate Variability. *2018 IEEE Asia Pacific Conference on Circuits and Systems*, 131–134. https://doi.org/10.1109/apccas.2018.8605674

Chu, B., Marwaha, K., Sanvictores, T., Awosika, A. O., & Ayers, D. (2024, May 7). Physiology, stress reaction. *StatPearls - NCBI Bookshelf*. https://www.ncbi.nlm.nih.gov/books/NBK541120/

Darki, C., Riley, J., Dadabhoy, D. P., Darki, A., & Garetto, J. (2022). The effect of classical music on heart rate, blood pressure, and mood. *Cureus*. https://doi.org/10.7759/cureus.27348

Dube, S., & Babar, A. (2024). Stress and insomnia – A vicious circle. *Current Medicine Research and Practice, 14*(2), 73–77. https://doi.org/10.4103/cmrp.cmrp_130_23

Eggers, A. E. (2007). Redrawing Papez' circuit: A theory about how acute stress becomes chronic and causes disease. *Medical Hypotheses, 69*(4), 852–857. https://doi.org/10.1016/j.mehy.2007.01.074

Fox, D., Karic, B., Ash, A., Dietz, J., & Swiggum, A. (2022). The effect of white noise on psychological stress while performing cognitive tasks and its correlation to performance (p.2). https://minds.wisconsin.edu/bitstream/handle/1793/80211/The%20effect%20of%20white%20noise%20on%20psychological%20stress%20while%20performing%20cognitive%20tasks%20and%20its%20correlation%20to%20performance%20.pdf?sequence=1&isAllowed=y

Ganea, A., Kwan, W., Kwan, D., Subbiah, A., He, M., Xu, F., Al-Hasani, H., & Kim, G. (2025). Examining the Impact of White Noise on Stress and Cognitive Performance in University Students. *Queen's Science Undergraduate Research Journal, 8*. https://doi.org/10.71044/qsurjvol820257

Gibbons, C., Dempster, M., & Moutray, M. (2008). Stress and eustress in nursing students. *Journal of Advanced Nursing, 61*(3), 282–290. https://doi.org/10.1111/j.1365-2648.2007.04497.x

Higuera, V. (2018, October 6). What is General adaptation syndrome? *Healthline*. https://www.healthline.com/health/general-adaptation-syndrome

Istadi, Y. (2018). Students Who are Listening to Classical Music during Anatomic Identification Test Have Lower Stress Level. *Sains Medika Jurnal Kedokteran Dan Kesehatan, 9*(2), 78. https://doi.org/10.30659/sainsmed.v9i2.3144

Joyner, M. J., Charkoudian, N., & Wallin, B. G. (2010). Sympathetic nervous system and blood pressure in humans. *Hypertension, 56*(1), 10–16. https://doi.org/10.1161/hypertensionaha.109.140186

Kim, H., Cheon, E., Bai, D., Lee, Y. H., & Koo, B. (2018). Stress and Heart Rate Variability: A Meta-Analysis and Review of the Literature. *Psychiatry Investigation, 15*(3), 235–245. https://doi.org/10.30773/pi.2017.08.17

Lee, K. S., Jeong, H. C., Yim, J. E., & Jeon, M. Y. (2015). Effects of music therapy on the cardiovascular and autonomic nervous System in Stress-Induced University Students: a randomized controlled trial. *The Journal of Alternative and Complementary Medicine, 22*(1), 59–65. https://doi.org/10.1089/acm.2015.0079

Marina, M., Julia, H., Siagian, Y., & Wati, L. (2022). Pengaruh Terapi Musik Klasik Mozart Terhadap Tekanan Darah Penderita Hipertensi Di Kelurahan Sungai Enam Kijang. *Healthy Jurnal Inovasi Riset Ilmu Kesehatan, 1*(3), 148–157. https://doi.org/10.51878/healthy.v1i3.1487

Mariotti, A. (2015). The effects of chronic stress on health: new insights into the molecular mechanisms of brain-body communication. *Future Science OA, 1*(3). https://doi.org/10.4155/fso.15.21

Mir, I. A., Chowdhury, M., Islam, R. M., Ling, G. Y., Chowdhury, A. a. B. M., Hasan, Z. M., & Higashi, Y. (2020). Relaxing music reduces blood pressure and heart rate among pre-hypertensive young adults: A randomized control trial. *Journal of Clinical Hypertension, 23*(2), 317–322. https://doi.org/10.1111/jch.14126

Moriya, K., Kurimoto, I., Ezaki, N., & Nakagawa, M. (2018). Influences of listening to music in study break on brain activity and parasympathetic nervous system activity. *Journal of the Institute of Industrial Applications Engineers, 6*(1), 34–38. https://doi.org/10.12792/jiiae.6.34

Orne, M. T. (1962). On the social psychology of the psychological experiment: With particular reference to demand characteristics and their implications. *American Psychologist, 17*(11), 776–783. https://doi.org/10.1037/h0043424

Pascoe, A. J., Haque, Z. Z., Samandra, R., Fehring, D. J., & Mansouri, F. A. (2022). Dissociable effects of music and white noise on conflict-induced behavioral adjustments. *Frontiers in Neuroscience, 16*, 858576. https://doi.org/10.3389/fnins.2022.858576

Pedersen, M. (2026, March 19). Galvanic Skin Response (GSR): The complete pocket guide - iMotions. *iMotions*. https://imotions.com/blog/learning/research-fundamentals/galvanic-skin-response/

Robillard, R., Saad, M., Edwards, J., Solomonova, E., Pennestri, M., Daros, A., Veissière, S. P. L., Quilty, L., Dion, K., Nixon, A., Phillips, J., Bhatla, R., Spilg, E., Godbout, R., Yazji, B., Rushton, C., Gifford, W. A., Gautam, M., Boafo, A., . . . Kendzerska, T. (2020). Social, financial and psychological stress during an emerging pandemic: observations from a population survey in the acute phase of COVID-19. *BMJ Open, 10*(12), e043805. https://doi.org/10.1136/bmjopen-2020-043805

Salimpoor, V. N., Benovoy, M., Larcher, K., Dagher, A., & Zatorre, R. J. (2011). Anatomically distinct dopamine release during anticipation and experience of peak emotion to music. *Nature Neuroscience, 14*(2), 257–262. https://doi.org/10.1038/nn.2726

Schwartz, S. J., Hardy, S. A., Zamboanga, B. L., Meca, A., Waterman, A. S., Picariello, S., Luyckx, K., Crocetti, E., Kim, S. Y., Brittian, A. S., Roberts, S. E., Whitbourne, S. K., Ritchie, R. A., Brown, E. J., & Forthun, L. F. (2015). Identity in young adulthood: Links with mental health and risky behavior. *Journal of Applied Developmental Psychology, 36*, 39–52. https://doi.org/10.1016/j.appdev.2014.10.001

Selye, H. (1946). The General Adaptation Syndrome and the Diseases of Adaptation. *The Journal of Clinical Endocrinology & Metabolism, 6*(2), 117–230. https://doi.org/10.1210/jcem-6-2-117

Stress effects on the body. (2018, November 1). *American Psychological Association*. https://www.apa.org/topics/stress/body

Trappe, H., & Voit, G. (2016). The cardiovascular effect of musical genres. *Deutsches Ärzteblatt International*. https://doi.org/10.3238/arztebl.2016.0347

VandenBos, G. R., & American Psychological Association. (2015). *APA dictionary of psychology* (2nd ed.). American Psychological Association.

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Conflict of Interest

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