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The Effects of Different Types of Music on Perceived and Physiological Measures of Stress

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The effects of different types of music on perceived and physiological measures of stress were evaluated. Sixty undergraduate psychology students, 31 males and 29 females, rated their level of relaxation and completed the State-Trait Anxiety Inventory (STAI) after they were told that they would be taking a stressful, mental test. Participants were randomly assigned to listen to different types of music or silence while skin temperature, frontalis muscle activity, and heart rate were recorded. Participants rated their relaxation and anxiety levels after listening to music or silence and completed the Mental Rotations Task Test. MANOVA's resulted in significant differences between groups for trait anxiety, $F(57, 3) = 3.058$, $p = .036$, and postmusic phase heart rate, $F(57, 3) = 3.522$, $p = .021$. Significant differences were also found between groups on state anxiety when trait anxiety was used as a covariate, $F(57, 3) = 3.95$, $p = .024$. The results of the research suggest that music may have an effect on the cognitive component of the stress response.

Stress has become an increasingly popular subject of study due to the belief that stress is a causal factor in both physical and psychological illness (Pervin & John, 1997). A stress experience is an event that consists of three major elements: the external stimuli, the internal response, and the interaction between the two (Bernard & Krupat, 1994). The current research uses the word stress to describe the interaction element of a stress experience. The interaction element has been further described as a "complex reaction pattern that often has physiological, cognitive, and behavioral components" (Feuerstein, Labbé, & Kuczmierczyk, 1986, p. 99).

One strategy used for coping with stress is to promote relaxation through music (Miluk-Kolasa & Matejek, 1996). In one study of music therapy, music in conjunction with guided imagery was found to decrease self-reported state anxiety. Hammer (1996) used the State-Trait Anxiety Inventory (STAI) and individuals' self-reports to determine if guided imagery accompanied by music would decrease participants' perceived level of situational stress (measured as state anxiety). It was reported that those who received guided imagery treatment in conjunction with music reported significantly less stress after 10 sessions than did participants who did not receive therapy. The self-reported decrease in anxiety is evidence that music is helpful in dealing with the cognitive component of stress.

Miluk-Kolasa and Matejek (1996) reported that listening to music helped return presurgical patients to a state of calm, as measured by arterial pressure, heart rate, cardiac output, skin temperature, and glucose count, after being told about their surgical procedure. Those who were told about their procedure but not allowed to listen to music remained physiologically aroused. Allen and Blascovich (1994) conducted a study to evaluate the effects of music on physicians' stress level while operating. Skin conductance and blood pressure measures of 50 surgeons who listened to music while operating on patients suggested that they were less physically aroused when listening to music than when they operated in silence. The decreases in physiological arousal reported in both studies may be evidence of music's effect on the physiological component of stress.

In a study of 90 undergraduate college students, participants were given a mild stressor, being told they were participating in a psychological experiment, and their behavior was observed and recorded on videocassette. Some of the students sat in a hallway waiting for the experiment to begin in silence, while others sat in the hallway while soothing music was played. It was reported that those sitting in the hallway with music were less active and appeared less anxious or stressed (Stratton, 1992). These results suggest that music has an effect on the behavioral component of stress.

Standley's (1986) meta-analysis on music research in dental and medical treatment reviewed studies that demonstrated the effects of music on specific physiological processes. Standley found many studies that support the idea that music can cause physiological changes. In general, these studies have shown that slow relaxed music is usually correlated with lower physiological arousal and faster music is associated with increases in physiological responses. As early as 1929, Vincent and Thompson (see Standley, 1986) studied blood pressure responses of musical and nonmusical subjects. They concluded that the subject's interest in and appreciation of music was more important than the type of music listened to in eliciting physiological responses. The lack of current research on the effects of *different* types of music on stress is not surprising when considering these early conclusions found in the literature. A review of current literature reveals that only two studies have been conducted on the effects of different types of music on stress. One study examined the effects of Stravinsky's "Sacrifice Dance" from *The Rite of Spring,* an excitative piece, and the orchestral version of Satie's *Gymnopedie No. 1,* a relaxing one, on perceived arousal and measures of heart rate and respiration rate. Iwanaga, Ikeda, and Iwaki (1996) presented subjects with each of the selections four times at 5-minute intervals and found significant music by phase interactions for respiration rate. The interaction for music by phase was not significant for heart rate. The repetition of the music decreased the level of tension perceived in both experimental conditions. Although baseline measures were taken, during which no music was played, there was no control group. Also, the research did not control for participants' individual preferences; music that may seem sedative to some may be arousing to others and vice versa.

A study of 56 undergraduate college students conducted by Burns, Labbé, Williams, and McCall (1999) revealed that participants' physiological measures of stress before, during, and after listening to different types of music were not significantly different, however, their perceived levels of relaxation were significantly different. Specifically, hard rock music decreased participants' report of relaxation. The positive findings in both the Iwanga et al. (1996) and Burns et al. (1999) studies indicate that research evaluating the effects different types of music have on stress should continue. Of particular interest in the current study was to evaluate the differential effectiveness of music when the participants were allowed to bring music they thought was relaxing. This idea is consistent with Vincent's and Thompson's (1929) conclusion that the subject's interest in music may be a factor in eliciting physiological responses.

The current research evaluated the cognitive and physiological effects of listening to different types of music. The cognitive effect was measured by self-ratings of relaxation and the State-Trait Anxiety Inventory (STAI), and recordings of muscle tension, skin temperature, and heart rate measured physiological effect. A mild stressor was introduced in order to increase overall arousal. It was hypothesized that individuals who listened to classical music or music they believed was relaxing would perceive themselves to be more relaxed and less anxious than individuals who listened to hard rock music. It was also hypothesized that individuals who listened to classical music or music they believed was relaxing would experience lower levels of physiological arousal than those who listened to hard rock music.

Method

Participants

Participants were 60 undergraduate students recruited from psychology courses at a regional university in southern Alabama. Fifty-one percent were male ($n = 31$) and 48% female ($n = 29$). Participants ranged in age from 18 to 49 years ($M = 21.6$, $SD = 5.60$). There was a bimodal distribution with 26.7% of the sample being 18 years old and 26.7% of the sample being 19 years old ($n = 16$ for each age group). The sample was 85% Caucasian ($n = 51$), 7% African-American ($n = 4$), and 8% other ($n = 5$); other includes Indian, Asian, and Hispanic.

No exclusion criteria were used for the research. Informed consent was inferred through voluntary participation in the research for those over the age of 18; for those 18 years of age and younger a written consent form was signed by the participants and their parents. Participants received 5% grade credit in their psychology courses for participation in the study. The Institutional Review Board of the university approved the study and the ethical standards of the American Psychological Association were upheld in conducting the study.

Materials

A small testing room containing a recliner and two speakers was used. A 40-watt desk lamp softly lighted the room. A Toshiba lap top computer with a *Biotech Component 4.65* software package was used to record levels of muscle activity, skin temperature, and heart rate. Muscle activity was measured by a J&J EMG Module (*threshold* = 0.0, *scale* = .050) with silver-silver electrodes placed on the right frontalis muscle (just above the right eye), and a wide bandwidth (25 to 1,000 microvolts); temperature was measured by a J&J Model T-68 (*threshold* = 0.0, *scale* = .025) with a thermistor placed on the ventral side of the left index finger; and heart rate was measured by a J&J Module P-401 (*threshold* = 0.0, *scale* = .025) with a plethysmograph placed on the ventral side of the middle finger of the right hand. The plethysmograph was chosen over placing electrodes on the chest because it is less invasive and less uncomfortable for the participants. It is important to note that a plethysmograph estimates heart rate by measuring the tine interval between the peak of one pulse to the peak of the next. The measured interval is converted to a proportional direct current (D.C.) voltage. The plethysmograph is susceptible to motion artifact and may not detect blood flow changes in persons with cold hands. These problems make a plethysmograph a less reliable indicator of heart rate than electrodes placed directly on the chest.

Standard compact discs were used to present music to the participants. The *Serenata Notturna, KV239* by Wolfgang Mozart was used as the classical condition for the research. *So Close* by the alternative rock group Alice in Chains was used as the rock condition. Participants were also asked to bring their own 'relaxing' music as a third experimental condition.

An audiologist evaluated the testing room and set the sound at a moderate level, midrange on the volume dial, that would not cause discomfort or harm to participants. The temperature of the room was kept between 72 and 76 degrees Fahrenheit.

To ensure that standardization of instructions to participants was maintained the following script was used by the researchers:

"Today you will be asked to complete two questionnaires, and listen to music **or** sit in silence for approximately 30 minutes, complete two more questionnaires, and then take a difficult and stressful mental rotations task test. I cannot offer you any other information until you have completed the research. Please tell me which selection on your CD you would like to listen to before taking the mental rotations task test."

Test. The Mental Rotation Task Test (M.R.T.; Crawford & Christensen, 1995) was used as a mild stressor. While the test may not seem stressful to some it is assumed that the anticipation of taking a test would elicit mild performance anxiety. Instructions for taking the test were revised by the researcher; participants were given a total of 6 minutes to complete as many items as possible rather than 3 minutes for each of two sections.

Questionnaires

Participants were asked to complete a relaxation rating scale. The questionnaire asked them to rate their level of relaxation on a Likert-type scale with 1 being "Not relaxed at all" and 7 being "Totally relaxed" by circling the number that best described their level of relaxation. Higher scores indicated the participant was more relaxed.

The State-Trait Anxiety Inventory (STAI) Form Y is a 40-item self-report survey. Twenty of the items, which make up the State Anxiety Scale, require an individual to rate how they feel 'at this moment.' The other 20 items, which make up the Trait Anxiety Scale, require the individual to rate how they feel 'generally.' Higher scores indicate great levels of anxiety for both scales. Test-retest correlations for the State Anxiety Scale range from .16 to .62, and correlations for the Trait Anxiety Scale range from .73 to .86. The relatively low test-retest correlations found on the State Anxiety Scale are in keeping with the transitory nature of the construct being measured (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The use of the STAI to validate other measures of state and trait anxiety are anecdotal proof of its construct validity (Corr & Gray, 1996; Osman, Kopper, Barrios, Osman, & Wade, 1997; Sapp, Farrell, Johnson, & Ioannidis, 1997). The developer of the test also provides extensive documentation of the instruments validity in the STAI manual.

Procedure

All of the participants were asked to bring a compact disc with a music selection they considered 'relaxing.' Each participant signed up for a 1 hour time slot during which he/she came to the biofeedback laboratory. Sequential random assignment was used to place participants in one of the three music conditions (classical, hard rock, or self-selected) or the control group. When the participants arrived at the biofeedback laboratory they were informed that they would take a "stressful" mental rotations task after being hooked up to biofeedback instruments and listening to music or sitting in silence for about 30 minutes. The purpose of informing the participants that they would be taking a stressful test was to raise overall level of arousal. They were asked to complete the relaxation rating scale, and to complete the STAI-Y.

Each participant was then asked to sit in a recliner and the sensors were attached. Participants assigned to one of the three music groups (classical, hard rock, or self-selected) sat in silence for the first 10 minutes in order to obtain baseline physiological readings (prephase). Then the participants listened to music (classical, hard rock, or self-selected), for 10 minutes (music phase) followed by 10 minutes of silence (postphase). The control group sat in silence for 30 minutes while physiological measures were recorded. After listening to music or silence, each participant rated his/her level of relaxation again. The participant was asked to complete State-Anxiety Scale of the STAI-Y. The participant was detached from the sensors and administered the M.R.T.

Results

There were 13 participants in the hard rock music group (6 males & 7 females), 13 in the control group (6 males & 7 females), 18 in the self-selected music group (8 males & 10 females), and 16 in the classical music group (11 males & 5 females). Table 1 shows means and standard deviations for all variables by group.

A multivariate analysis of variance (MANOVA) was conducted to determine if any differences existed between groups on any of the variables being evaluated. Significant differences were found between groups for trait anxiety, $F(56, 3) = 3.058$, $p = .036$, and for postmusic heart rate, $F(56, 3) = 3.522$, $p = .021$ (see Table 2 for MANOVA results and significance levels for all variables by group). A series of univariate analyses of variance indicated that the self-selected music group had significantly higher trait anxiety scores than the hard rock group, $F(29, 1) = 6.406$, $p = .017$, and the classical group, $F(32, 1) = 4.632$, $p = .039$. A series of univariate analyses of variance also revealed that the classical music group's postmusic heart rates were significantly lower than the control group's, $F(27, 1) = 4.614$, and the self-selected music group's, $F(32, 1) = 10.572$, $p = .003$.

TABLE 1
Means and Standard Deviations by Group and Variables

Variables	Hard rock (n = 13)	Control (n = 13)	Self-selected (n = 18)	Classical (n = 16)	Total (N = 60)
Relaxation ratings					
Pre	4.54(1.39)	3.77(1.30)	4.06(1.11)	4.44(1.26)	4.20(1.26)
Post	5.54(1.39)	5.77(1.01)	5.94(0.73)	5.75(1.13)	5.77(1.05)
Trait-Anxiety	33.38(7.46)	37.38(6.79)	41.56(9.75)	35.06(7.54)	37.15(8.53)
State-Anxiety					
Pre	35.15(9.87)	39.46(7.48)	37.94(8.79)	33.38(6.98)	36.45(8.46)
Post	31.62(7.34)	29.38(6.69)	29.56(6.84)	26.25(6.55)	29.08(6.94)
EMG					
Pre	5.28(2.88)	4.68(2.20)	4.21(2.27)	4.27(2.20)	4.56(2.36)
Exp	5.45(2.79)	4.55(2.54)	4.06(2.52)	4.21(2.27)	4.51(2.52)
Post	5.20(2.17)	4.56(2.78)	4.06(3.25)	3.63(2.09)	4.30(2.65)
Heart rate					
Pre	63.30(32.86)	55.92(23.54)	58.53(26.56)	47.32(21.52)	56.00(26.22)
Exp	57.15(33.03)	62.03(23.39)	67.36(30.55)	49.79(31.15)	59.31(29.93)
Post	53.24(32.24)	58.90(27.99)	70.60(32.81)	37.80(24.87)	55.56(31.56)
Temperature					
Pre	86.89(7.44)	88.42(6.02)	87.19(6.47)	87.10(6.96)	87.43(6.62)
Exp	85.83(7.81)	89.33(5.72)	87.19(6.47)	87.62(6.79)	87.47(6.65)
Post	85.77(7.80)	88.72(5.29)	86.65(6.60)	87.40(6.93)	87.12(6.62)
Age	22.85(8.20)	20.39(2.22)	21.22(4.82)	21.81(6.02)	21.55(5.60)

Note. Pre = before music phase; Exp = during music phase; Post = after music phase.

In order to determine if ratings of relaxation increased significantly for any one of the groups, an analysis of variance with repeated measures was done for each group. Ratings of relaxation were significantly higher for the control group after sitting in silence for 30 minutes, $F(12, 1) = 19.500$, $p = 001$. The self-selected music group's ratings of relaxation were significantly higher after listening to music, $F(17, 1) = 55.239$, $p < .001$, as were the classical group's, $F(15, 1) = 19.286$, $p = .001$. In order to evaluate the clinical magnitude of these changes, a percent of increase was calculated by subtracting the premusic rating of relaxation from the postmusic rating of relaxation, dividing the result by the post-music rating, and multiplying the proportion by 100. The control group's scores increased by 34.66%, the self-selected music group's by 31.71%, the classical group's increased by 22.78% and the hard rock group increased by 18.05%.

Because significant differences between groups existed for trait anxiety, a multivariate analysis of variance, using trait anxiety scores

TABLE 2
Results of MANOVA and Significance Levels for All Variables by Group

Variables	*MS*	*F*(57,3)	*p*
Prerelaxation ratings	1.727	1.093	.359
Postrelaxation ratings	.417	.368	.777
Trait-Anxiety	201.371	3.058	.036*
Pre State-Anxiety	110.411	1.590	.202
Post State-Anxiety	72.238	1.544	.213
Pre EMG	3.542	.623	.603
Exp EMG	5.548	.871	.462
Post EMG	6.535	.929	.433
Pre heart rate	671.159	.975	.411
Exp heart rate	924.843	1.034	.384
Post heart rate	3109.972	3.522	.021*
Pre temperature	6.093	.133	.940
Exp temperature	27.193	.602	.616
Post temperature	20.663	.458	.713
Age	14.177	.440	.726
Gender	.213	.833	.482

Note. Pre = premusic phase; Exp = music phase; Post = postmusic phase.
*alpha = .05.

as a covariate (MANCOVA) was conducted. There were significant differences for postmusic state anxiety scores, $F(57, 3) = 3.395$, $p = .024$. A series of analyses of variance, using trait anxiety scores as a covariate, revealed that the hard rock group's postmusic scores were significantly higher than the self-selected music group's scores, $F(30, 1) = 5.701$, $p = .024$, and the classical group's scores, $F(28, 1) = 6.766$, $p = .015$.

Means for state anxiety scores indicated that state anxiety scores decreased over time for all groups. Scores for state anxiety were significantly lower for the control group, $F(12, 1) = 18.273$, $p = .001$, the self-selected music group, $F(17, 1) = 28.102$, $p < .001$, and the classical music group, $F(15, 1) = 34.057$, $p < .001$. The clinical magnitudes of these changes were calculated. The control group's score decreased by 25.54%, the self-selected music group's scores decreased by 22.09%, the classical music group's scores decreased by 21.36% and the hard rock group's scores decreased by 10.04%.

A multivariate analysis of variance was used to evaluate gender differences for all variables. Results indicated a significant difference between males and females for frontalis muscle activity during the music phase, $F(59, 1) = 4.66$, $p = .035$. Significant differences

TABLE 3

Means and Standard Deviations for All Variables by Gender

Variables	Male ($n = 31$)	Female ($n = 29$)	Total ($N = 60$)
Relaxation ratings			
Pre	4.23 (1.28)	4.14 (1.30)	4.18 (1.28)
Post	5.81 (0.95)	5.72 (1.16)	5.77 (1.05)
Trait-Anxiety	36.65 (7.42)	37.69 (9.68)	37.15 (8.53)
State-Anxiety			
Pre	36.03 (7.27)	36.90 (9.67)	36.45 (8.46)
Post	28.77 (6.78)	29.41 (7.21)	29.08 (6.94)
EMG			
Pre	4.03 (2.18)	5.12 (2.45)	4.56 (2.36)
Exp	3.85 (2.32)	5.21 (2.56)	4.51 (2.52)
Post	3.84 (2.11)	.80 (3.08)	4.30 (2.65)
Heart-Rate			
Pre	57.43 (28.43)	54.48 (24.04)	56.01 (26.22)
Exp	64.19 (29.18)	54.10 (30.34)	59.31 (29.93)
Post	57.33 (27.46)	53.66 (35.84)	55.56 (31.56)
Temperature			
Pre	88.90 (5.81)	85.85 (7.15)	87.43 (6.62)
Exp	89.78 (5.17)	85.00 (7.23)	87.47 (6.65)
Post	89.97 (4.62)	84.05 (7.13)	87.11 (6.62)
Age	21.39 (4.97)	21.72 (6.28)	21.55 (5.60)
MRT score	9.19 (4.46)	5.07 (2.99)	7.20 (4.32)

Note. Pre = before music phase; Exp = during music phase; Post = after music phase.

between males and females for temperature during the music phase, $F(59, 1) = 8.755$, $p = .004$, and differences in skin temperature during the postmusic phase, $F(59, 1) = 14.719$, $p < .001$ were found. Results indicated significant differences between genders for scores on the Mental Rotations Task Test $F(59, 1) = 17.461$, $p < .001$ (see Table 3 for means and standard deviations for all variables by gender and Table 4 for results of MANOVA and significance levels for all variables by group).

Discussion

It was hypothesized that individuals who listened to classical music or music they believed was relaxing would perceive themselves to be more relaxed and less anxious than individuals who listened to hard rock music. The results of the study support this hypothesis as participants who listened to hard rock music reported that they were not more relaxed after listening to the hard rock music. Par-

TABLE 4

Results of MANOVA and Significance Levels for All Variables by Gender

Variables	*MS*	*F*(59,1)	*p*
Group	1.592	1.308	.258
Prerelaxation ratings	.116	.069	.793
Postrelaxation ratings	.102	.091	.764
Trait-Anxiety	16.346	.222	.639
Pre State-Anxiety	11.193	.154	.696
Post State-Anxiety	6.129	.125	.725
Pre EMG	17.854	3.332	.073
Exp EMG	27.769	4.665	.053*
Post EMG	13.792	2.001	.163
Pre heart rate	130.798	.188	.666
Exp heart rate	1525.701	1.724	.194
Post heart rate	202.349	.200	.656
Pre temperature	139.130	3.297	.075
Exp temperature	342.215	8.755	.004*
Post temperature	523.688	14.719	<.001*
MRT scores	254.899	17.461	<.001*
Age	1.702	.053	.818

Note. Pre = Premusic phase; Exp = Music phase; Post = Postmusic phase.
*alpha = .05.

ticipants in the classical music group reported that they were more relaxed after listening to classical music. Participants in the self-selected or no music reported the greatest changes in relaxation 34.66% and 31.11 % respectively. Ratings of relaxation for these two groups increased more than the rating of relaxation for those who listened to hard rock, 18.05%, or classical music, 22.78%.

Means of the State Anxiety Scale of the STAI-Y revealed that scores decreased for all groups from before listening to music to after listening. Analyses of variance with repeated measures revealed that the control, self-selected music, and classical music groups' state anxiety scores all significantly decreased compared to the hard rock group. Evaluations of the clinical magnitude of the changes revealed that the classical music and self-selected music groups' state anxiety scores showed decreases of 22.09% and 21.36% respectively, and the control group's scores showed an even greater decrease of 25.54%. These findings complement the findings from other studies for self-ratings of anxiety.

While no significant differences existed between groups on scores of postmusic phase state anxiety, when trait-anxiety was controlled for, significant differences existed between postmusic phase scores for the hard rock and classical groups, and the hard rock and self-selected music groups. The differences between the hard rock and control groups' scores were not significant. Because trait-anxiety was not significantly different between the hard rock and control groups, the clinical magnitude of changes in scores may be the best indicator of reliable differences between the hard rock and control groups. If this is considered then the findings support the a priori hypotheses and complement the self-ratings of relaxation results.

Results of the study provided mixed support for the second hypothesis. The second hypothesis was that individuals who listened to classical music or music they believed was relaxing would experience lower levels of physiological arousal than those who listened to hard rock music would. There were no significant differences between groups in EMG and skin temperature recordings. Significant differences were found between groups for postmusic phase heart rates when baseline measures were held constant. These heart rate differences were between the self-selected music group and the classical music group. The means of the groups revealed that the classical group's heart rates were much lower than the self-selected music group's heart rate. These findings would suggest that listening to classical music would lower an individual's level of arousal more than listening to self-selected relaxing music. The means for heart rates for all groups followed no consistent pattern and problems with the reliability of plethysmograph readings, which were discussed in the methods section, suggest that these findings may be questionable. Means for skin temperature were relatively constant for all groups across all phases of the experiment. No differences in skin temperature over time may indicate it is not a sensitive enough measure of arousal.

While the focus of this research was to assess the effects of different types of music on perceived stress and physiological indicators of arousal, gender differences were significant for the sample. Statistical analyses conducted to assess gender differences for the variables being considered revealed that males' overall music phase EMG readings were significantly lower than females, but there were no group differences between males and females. The analyses also showed that overall skin temperatures for males were significantly higher than skin temperatures for females during the music phase and postmusic phases. Again, there were no group differences for genders. These findings complement the findings of Williams (1996) which indicated that males are more likely to experience less anxiety than females after being presented with a stressor. However, the fact that the EMG readings were lower during the music phase of the experiment and not during the postmusic phase suggests that males may be less anxious when the stressor is less imminent. This rationale might also be considered for the differences in skin temperatures as well. While the postmusic phase temperatures remained significantly higher for males, the longer time frame needed for temperature changes to be detected might have kept temperature readings from decreasing significantly before the postmusic phase ended.

The results of this study partially support the main hypothesis of the research, which is that different types of music have different effects on stress. The findings suggest that hard rock music has an effect on the cognitive component of stress. Individuals who listened to hard rock music did not perceive themselves to be significantly more relaxed after listening to music than before listening, and did not perceive themselves to be significantly less anxious. Individuals who sat in silence, listened to self-selected relaxing music, or listened to classical music perceived themselves to be more relaxed and less anxious. While these findings do not indicate that listening to classical music or self-selected relaxing music increases relaxation, or decreases anxiety, they do suggest that hard rock music may compromise an individual's ability to relax or become less anxious. An important point that should be considered is that the clinical magnitude of changes in relaxation and anxiety were greatest for those persons who sat in silence. This suggests that sitting quietly may be a better way to increase relaxation and reduce anxiety than listening to any type of music.

The findings of the research indicate that different types of music do not have differing effects on the physiological component of stress. All the indicators of physiological arousal appeared to be unaffected by the type of music being listened to and were also unaffected if a person sat in silence. This implies that the feelings of increased relaxation and decreased anxiety reported by the respondents were purely cognitive in nature. The results of the current research can be contrasted with other research indicating that listening to music during a task, such as performing surgery (Allen

& Blascovich, 1994), helps decrease individuals' physiological arousal. The results are also inconsistent with the study by Miluk-Kolasa and Matejek (1996) which indicated that listening to music helped return presurgical patients to a less physiologically aroused state after learning about their surgical procedure.

The findings of the research are consistent with the study conducted by Hammer (1996) which found that music in conjunction with guided imagery decreased self-reported state anxiety on the State-Trait Anxiety Inventory. The results are also consistent with those found by Burns et al. (1999) which indicated that different types of music have differing effects on perceived relaxation, but not on physiological indicators of arousal.

Limitations to the current study should be addressed. The use of a convenience sample of predominantly Caucasian college students makes the generalizability of the results beyond this population tenuous. Future research should use a community sample which is representative of the general population in terms of age, ethnicity, and socioeconomic status. Also, the sample size was relatively small for each of the four experimental groups. The small size of the groups made gender by age analyses between groups impossible. Gender by age differences should be assessed in future research.

Another weakness may be the brevity of the music exposure and the use of a single session on which to base conclusions about the effects of music on stress. The short time period during which the participants listened to music should be lengthened in future research, and a greater number of sessions should be used. Also, given the short-lived nature of some psychophysiological effects, future research should use a shorter postmusic comparison time or should break the time into smaller blocks. Another solution to the short-lived psychophysiological effects might be to compare the last 2 or 3 minutes of baseline measures to the first 2 or 3 minutes of the postmusic phase.

A notable strength of the study is the use of a control group that sat in silence as well as a group that listened to self-selected relaxing music. The self-selected relaxing music group helped control for differences in beliefs about what type of music is relaxing. The silence group allowed the researcher to determine if music had an effect that was greater than no intervention. Another strength of the study is the use of both instruments to measure perceptions of relaxation and anxiety, as well as physiological indicators of arousal. The major strengths of the research are that it addresses a question that is not sufficiently addressed in the literature and that it adds empirical data to the intuitive consideration of music as an appropriate intervention to increase relaxation and decrease stress. Future research should include greater sample size and inducement of greater levels of stress prior to the listening of music or silence. Greater levels of stress might allow for greater variability in reduction of self-reports and physiological indicators of stress.

References

Allen, K., & Blascovich, J. (1994). Effects of music on cardiovascular reactivity among surgeons. *Journal of the American Medical Association, 272,* 882–884.

Bernar, L. C., & Krupat, E. (1994.) *Health psychology: Biopsychosocial factors in health and illness.* Ft. Worth, TX: Harcourt Brace College Publishers.

Burns, J. L., Labbé, E., Williams, K., & McCall, J. (1999). Perceived and physiological indicators of relaxation: As different as Mozart and Alice in Chains. *Applied Psychophysiology and Biofeedback, 24,* 197–202.

Corr, P. J., & Gray, J. A. (1996). Structure and validity of the Attributional Style Questionnaire: A cross-sample comparison. *The Journal of Psychology, 130,* 645–657.

Crawford, H. J., & Christensen, L. B. (1995). *Developing research skills* (3rd ed.). Boston: Allyn and Bacon.

Feuerstein, M., Labbé, E. E., & Kuczmierczyk, A. R. (1986). *Health psychology: A psychological perspective.* New York: Plenum Press.

Hammer, S. E. (1996). The effects of guided imagery through music on state and trait anxiety. *Journal of Music Therapy, 33,* 47–70.

Iwanga, M., Ikeda, M., & Iwaki, T. (1996). The effects of repetitive exposure to music on subjective and physiological responses. *Journal of Music Therapy, 33,* 219–230.

Miluk-Kolasa, B., & Matejek, M. (1996). The effects of music listening on changes in selected physiological parameters in adult pre-surgical patients. *Journal of Music Therapy, 33,* 208–218.

Osman, A., Kopper, B. A., Barrios, F. X., Osman, J. R., & Wade, T. (1997). The Beck Anxiety Inventory: Reexamination of factor structure and psychometric properties. *Journal of Clinical Psychology, 53,* 7–14.

Pervin, L. A., & John, O. P. (1997). *Personality: Theory and research* (7th ed.). New York: John Wiley and Sons, Inc.

Sapp, M., Farrell, W. C., Johnson, J. H., Ioannidis, G. (1997). Utilizing the PK scale of the MMPI-2 to detect postraumatic stress disorder in college students. *Journal of Clinical Psychology, 53,* 841–846.

Spielberger, C. D., Gorsuch, R. L., Lushene, R., Vagg, P. R., & Jacobs, G. A. (1983). *Manual for the State-Trait Anxiety Inventory: Form Y.* Palo Alto, CA: Consulting Psychologists Press, Inc.

Standley, J. M. (1986). Music research in medical/dental treatment: Meta-analysis and clinical applications. *Journal of Music Therapy, 23,* 56–122.

Stratton, V. N. (1992). Influence of music and socializing on perceived stress while waiting. *Perceptual and Motor Skills, 75,* 334.

Vincent, S., & Thompson, J. H. (1929). The effects of music upon the human blood pressure. *The Lancet, 1,* 534–537.

Williams, J. E. (1996). Gender-related worry and emotionality test anxiety for high-achieving students. *Psychology in the Schools, 33,* 159–162.