Appl Psychophysiol Biofeedback (2007) 32:163–168
DOI 10.1007/s10484-007-9043-9

Coping with Stress: The Effectiveness of Different Types of Music

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Published online: 27 October 2007

Abstract Listening to classical and self-selected relaxing music after exposure to a stressor should result in significant reductions in anxiety, anger, and sympathetic nervous system arousal, and increased relaxation compared to those who sit in silence or listen to heavy metal music. Fifty-six college students, 15 males and 41 females, were exposed to different types of music genres after experiencing a stressful test. Several 4 × 2 mixed design analyses of variance were conducted to determine the effects of music and silence conditions (heavy metal, classical, or self-selected music and silence) and time (pre–post music) on emotional state and physiological arousal. Results indicate listening to self-select or classical music, after exposure to a stressor, significantly reduces negative emotional states and physiological arousal compared to listening to heavy metal music or sitting in silence.

Keywords Stress · Anger · SNS arousal · Music types

Music may be a medium to help young people reduce negative emotions. In reviewing the research literature one finds a lack of scientific studies on the psychophysiological effects of different types of music in young people. Music is an important aspect of youth culture and most young people listen to music for a variety of reasons (Trzcinski 1994). Young people report that music can help them relax and will often have a collection of favorite 'tunes' that they will listen to when they are feeling 'stressed out' (Knobloch and Zillman 2002). Burns et al. (1999, 2002) and Labbé et al. (2004) report findings that suggest listening to relaxing music, such as some selections of classical music, results in the listener experiencing positive emotions and increases in parasympathetic nervous system arousal. They observed participants' reaction to what is traditionally considered relaxing music and hypothesized that an individual's perception of whether they believed the music was relaxing may be an important factor in inducing relaxation. Self-selected music refers to music that the participants chose as relaxing.

In the current study we evaluated music the person believes is relaxing to determine whether listening to music that one is attracted to can be an effective coping response to negative emotion. Allowing the person to select music gives them control over some aspect of the experimental situation. Health psychology research indicates perceived control is an important factor in reducing the stress response (Brannon and Fiest 2007). Self-selected rather than prescribed music may be more effective in reducing stress as it allows the person to control some aspect of their environment by allowing them to choose music that they believe is relaxing.

In contrast to the effects of relaxing music, Anderson et al. (2003) report on five experiments involving over 500 college students that examined the effects of seven violent songs by seven artists and eight nonviolent songs by seven artists. After listening to a music selection the college student was given tasks to complete that measure aggressive thoughts and emotions. The results indicated that violent songs compared to nonviolent songs led to more aggressive thoughts and feelings of hostility even when not provoked. However, they did not measure physiological arousal. Listening to soothing and relaxing music may play an important role in reducing negative emotions and increasing positive emotions and parasympathetic arousal. However, some types of music may actually increase

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negative emotions and sympathetic nervous system arousal; this differential effect of music in young people has not been adequately tested.

In previous studies we found mixed results regarding changes in physiological responses, particularly with heart rate (Burns et al. 1999, 2002; and Labbé et al. 2004). In these previous studies we used a plethysmograph placed on the ventral side of the middle finger of the right hand to measure heart rate. The plethysmograph was chosen over placing electrodes on the chest because it was less invasive. We discovered that the plethysmograph is very susceptible to motion artifacts and is not as reliable a measure of heart rate as using EKG electrodes placed on the chest. In the current study we were able to measure heart rate using EKG electrodes placed on the chest, with the hopes that we would obtain more reliable heart rate data. A second problem addressed in the current study was to allow the participants to listen to music or sit in silence for a longer period of time, 20 min instead of 10. And finally instead of trying to increase arousal by telling the participants that they would be engaging in a stressful test after listening to music or sitting in silence, we actually administered the stressful test prior to listening to music.

We hypothesized that individuals who are exposed to classical music or self-selected relaxing music will demonstrate significant reductions in anxiety, anger, and sympathetic nervous system arousal, and an increase in feelings of relaxation as compared to those who sit in silence or listen to heavy metal music. Another hypothesis was there would be a significant positive relationship with ratings of a person's use of music for relaxation and relaxation experienced during the self-selected and classical music conditions.

Method

Participants

Fifty-six college students attending a southeastern university participated (X age = 22.54), 15 males and 41 females—11% of the participants were African American; 82% were Caucasian, 2% were Asian and 2% were 'other' ethnicity. 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.

Measures and Apparatus

Measures included a demographic questionnaire, Relaxation Rating Scale (RRS), Music Rating Scale (MRS), State-Trait Anger Expression Inventory-2 (STAIX-2), State-Trait Anxiety Inventory-Form Y (STAI-Y) and physiological assessment of heart rate, respiration and skin conductance. A cognitive speed test was used to elicit sympathetic nervous system arousal. Measures and apparatus are described below.

The Relaxation Rating Scale (RRS) requires the participant to rate his/her 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 his/her 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 require an individual to rate how they feel 'at this moment'; these items make up the State Anxiety Scale. The other 20 items require the individual to rate how they feel 'generally'; these items make up the Trait Anxiety Scale. 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 et al. 1983). The use of the STAI to validate other measures of state and trait anxiety supports its construct validity (Corr and Gray 1996; Osman et al. 1997; Sapp et al. 1997).

The State-Trait Anger Expression Inventory-2 (STAXI-2) was used to measure state and trait anger. The STAXI-2 is a self-report survey, which scores experience of anger along multiple axes: State and Trait Anger (S-Ang and T-Ang) as well as Anger Control and Anger Expression. The full STAXI-2 is a 57-item self-report instrument, with six scales and five subscales (Spielberger 1999). Scores for S-Ang and T-Ang are divided into S-Ang/F, S-Ang/V, and S-Ang/P, etc. for feelings of anger, expression of anger verbally, and physical expression of anger, respectively. Also included in the full STAXI-2 is an Anger Expression Index score, distinguishing Anger Expression In and Anger Expression Out. The STAX-I has been demonstrated to correlate "strongly" with the Buss-Durkee Hostility Inventory and Overt Hostility scales of the MMPI (Spielberger 1999) arguing for convergent validity.

A small testing room containing a recliner and two speakers was used. A 40-W desk lamp softly lighted the room. Heart rate was measured by placing EKG gel electrodes on the chest, providing the best signal quality. The negative lead was placed on the right shoulder, the positive lead at the xphoid process and the ground lead on the left shoulder. An abdominal placement for respiration was used by strapping the respiration sensor's Velcro fastener across the participant, at the belly-button level with the rubber

tube placed on the front. The strap was adjusted so that there was a slight tension when the participant fully breathed out. A second respiration sensor for thoracic breathing was wrapped around the participant just below the armpit level. Each electrode of the skin conductance sensor was strapped around the finger pads of the index and annular fingers. The electrodes were placed on the palm side of the finger. Heart rate, respiration and skin conductance were monitored using a Procomp+ encoder. Leads for each monitor were routed through a Procomp+ encoder, and data was processed, observed and recorded with the use of CardioPro 2.0 software. Please refer to the Cardiopro™, Version 2.0 Installation and User Manual for more detailed technical information.

Physiological data was averaged over 5-min periods. Data from the last 5 min of the 'stress test' was used to assess the stress/pre-music period in order to achieve a consistent baseline across participants. In order to achieve a more valid indicator of the effects of the experimental conditions, participants listened to music/silence for a longer period (10 versus 20 min) than we had done in previous studies and we used the data from the last 5 min. We did this because immediately after completing the 'stress test' all participants experienced some reduction in their physiological responses and we wanted to make sure that the data we used to assess the experimental conditions were not affected by just the relief from the stressor being removed.

A brief, "cognitive speed test" was administered to elicit sympathetic nervous system arousal, simulating a negative stressor. The test took about 10 min and contained 80 simple calculations and 16 difficult mathematical operations to be completed in 45 s, 8 number memory items (9–10 string of single digits), 12 difficult verbal analogies, and spelling 14 difficult words.

Two compact discs were used for the heavy metal and classical selections. Each music selection was 20 min long. A professor of music created the discs using music selections that met several parameters. For the classical CD, the majority of the selections were in the Baroque style with moderate to slow tempo markings, i.e. Andante, Adagio, Largo. The crescendo and accelerando are not characteristic to this style, so the tempo and dynamics remained relatively constant throughout each track. Also, the selections were entirely instrumental, with strings as the dominant musical timbre. In creating the Heavy Metal CD, it was difficult to find works without vocals, and it was her opinion that lyrics would divert the listener's attention from the task at hand, so the vocals on this CD are in German, which was not the native language of any of the subjects. Thus the listener is easily able to dismiss the lyrics as containing any relevant content and they become just another musical timbre. This CD also had consistent tempi from track to track, much faster and the general dynamic was much louder than that of the classical CD. In this case, any crescendi or acceleration within a track were allowable as the purpose of this collection was to agitate the listener. In addition to the angst filled German vocals, the instrumental timbres of electric guitar, heavy bass, drums and electronica also served to grate on the consciousness of the listener. The overall mix of each CD was to create a wash of sound in its particular style that would not contain any obvious climaxes or points of arrival.

Participants were instructed to bring a compact disc with 20 min of music that they believed was relaxing. Most participants brought country music, soft jazz and easy listening rock music selections. Music was heard through dynamic type stereo headphones and set at a volume level that was approved by an audiologist.

Procedure

Participants were randomly assigned to self-selected, classical, or heavy metal music conditions or silence. Participants completed the demographic questionnaire and trait scales and then physiological sensors were attached. Baseline physiological data was recorded for 10 min. Participants were administered a mentally challenging test and then completed the state anxiety and anger scales and Relaxation Rating Scale (RRS). They were told they would either sit in silence or listen to music for 20 min. After sitting in silence or listening to music they were again given the state anxiety and anger scales, RRS and Music Rating Scale. Physiological sensors were detached and then the participants were debriefed.

Results

Several 4×2 mixed design analyses of variance with repeated measures were conducted to determine the effects of the music and silence conditions (heavy metal, classical, or self-selected music and silence) and time (stress/pre music, post-last 5 min of music/silence) on state anxiety and anger scores, rating of relaxation, heart rate, respiration and skin conductance. See Table 1 for means and standard deviations for physiological variables. In order to test initial predictions, select *t*-tests were conducted even though only a significant main effect was found. Furthermore, we were interested in exploring not only statistically significant differences but clinically significant differences as well.

For state anxiety a significant Time × Music/Silence interaction was present ($F(3,50) = 3.74$, $p = .02$). In addition the main effect for time was significant ($F(1,50) = 7.93$,

Table 1 Means and standard deviations for heart rate, respiration and skin conductance for stress and music or silence conditions

Physiological measures	Stress *X* (SD)	Music/Silence *X* (SD)
Heart rate		
Silence	82.47 (8.24)	82.31 (19.24)
Heavy metal	86.12 (9.88)	84.32 (12.99)
Classical	89.66 (10.91)	82.61 (24.25)
Self-select	89.13 (11.35)	79.39 (11.94)
Respiration		
Silence	35.57 (7.84)	35.46 (9.99)
Heavy metal	36.10 (10.88)	33.49 (12.65)
Classical	30.05 (7.56)	27.52 (6.55)
Self-select	36.62 (9.58)	34.98 (11.19)
Skin-conductance		
Silence	3.84 (2.10)	2.92 (2.11)
Heavy metal	4.14 (1.73)	3.45 (1.55)
Classical	4.71 (2.57)	3.11 (2.15)
Self-select	5.23 (2.28)	3.16 (1.80)

p = .01). The main effect for music/silence condition was not significant ($F(3,50)$ = .93, p = .44). Post hoc paired-sample t tests indicate that the groups listening to heavy metal ($t(12)$ = –1.01, p = .33) or silence ($t(10)$ = 1.97, p = .07) did not experience a decrease in state anxiety; where as participants listening to classical ($t(15)$ = 3.07, p = .01) or self-selected music ($t(13)$ = 3.27, p = .01) experienced decreases in state anxiety, see Fig. 1.

For ratings of relaxation a significant Time × Music interaction was present ($F(3,46)$ = 3.52, p = .02). In addition the main effect for time was significant ($F(1,46)$ = 63.54, p = .00). The main effect for music/silence condition was not significant ($F(3,46)$ = 2.58, p = .06). Post hoc paired-sample t tests demonstrate the group listening to heavy metal did not have changes in ratings of relaxation ($t(10)$ = –1.00, p = .34) where as the groups listening to silence($t(9)$ = –5.07, p = .00), classical ($t(14)$ = –5.14, p = .00) or self-selected ($t(13)$ = –6.25, p = .00) music did have increases in ratings of relaxation, refer to Fig. 2.

For state anger a significant main effect for time was present ($F(1,49)$ = 6.95, p = .01). The Time × Music/Silence interaction was not significant ($F(3,49)$ = 1.99, p = .13). The main effect for music/silence condition was not significant ($F(3,49)$ = 1.94, p = .145). Post hoc paired-sample t tests indicates that the group listening to silence ($t(10)$ = 3.53, p = .00) or self-selected ($t(12)$ = 3.41, p = .00) music experienced more of a decrease in state anger than participants listening to heavy metal ($t(12)$ = –.43, p = .67) or classical ($t(15)$ = .60, p = .56), refer to Fig. 3.

For heart rate a significant main effect for time was present ($F(1,50)$ = 4.96, p = .03). The Time × Music/Silence interaction was not significant ($F(3,50)$ = 1.21, p = .35). The main effect for music/silence condition was not significant ($F(3,50)$ = .20, p = .98). Post hoc paired-sample t tests indicate the listening to self-selected music ($t(13)$ = 4.56, p = .00) experienced a decrease in heart rate where as participants listening to classical ($t(15)$ = 1.48, p = .16), heavy metal music ($t(12)$ = .48, p = .64) or silence ($t(10)$ = .03, p = .99) did not.

For respiration a significant main effect for time was present ($F(1,50)$ = 7.22, p = .01). The Time × Music/Silence interaction was not significant ($F(3,50)$ = .74, p = .53). The main effect for music/silence condition was not significant ($F(3,50)$ = 1.78, p = .16). Post hoc paired-sample t tests indicates the group listening to classical ($t(14)$ = 2.36, p = .03) and heavy metal ($t(13)$ = 2.42, p = .03) music experienced lower respiration rates than participants listening to self-selected ($t(13)$ = 1.25, p = .23) or silence ($t(10)$ = .06, p = .95).

For skin conductance a significant main effect for time was present ($F(1,46)$ = 46.85, p = .00). The Time × Music/

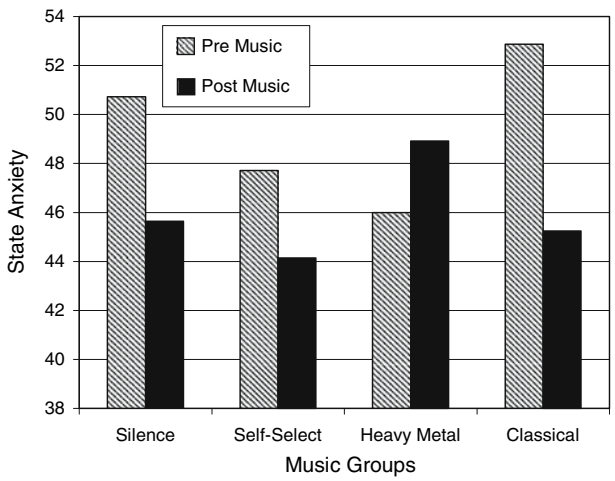

Fig. 1 State anxiety scores, pre music (stress) and post music or silence

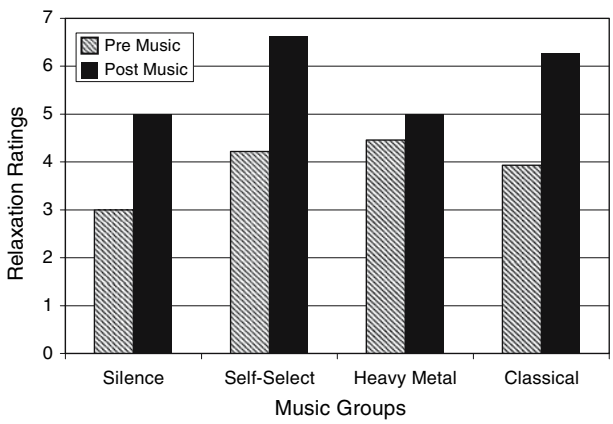

Fig. 2 Relaxation ratings of pre music (stress) and post music or silence

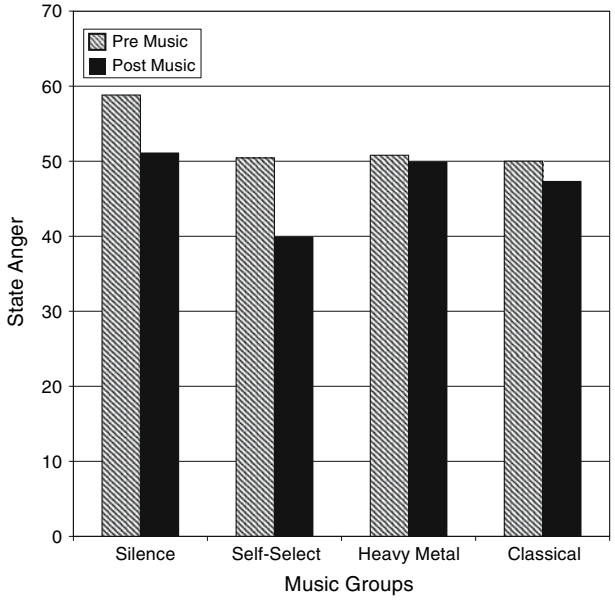

Fig. 3 State anger scores pre (stress) and post music or silence

Silence interaction was also significant ($F(3,46) = 2.84$, $p = .05$). The main effect for music/silence condition was not significant ($F(3,46) = .39$, $p = .76$). Post hoc paired-sample t tests indicated that all groups experienced a significant decrease in skin conductance: classical ($t(13) = 5.38$, $p = .00$), self-selected music ($t(11) = 3.61$, $p = .00$), heavy metal ($t(12) = 3.07$, $p = .01$) and silence ($t(10) = 2.15$, $p = .047$).

A significant Pearson Product Moment Correlation, $r = .52$, $p = .00$ with ratings of use of music for relaxation and how much they liked the self-selected or classical music was found, but not with relaxation experienced during the self-selected and classical music condition, $r = .24$, $p = .21$.

Discussion

The results of our study support the hypothesis that individuals who are exposed to classical music or self-selected relaxing music after exposure to a stressor will demonstrate significant reductions in state anxiety and an increase in feelings of relaxation as compared to those who sit in silence or listen to heavy metal music. Listening to self-selected and classical music produced increased feelings of relaxation as well as sitting in silence but not for the heavy metal condition. Listening to classical and self-selected music elicited reductions in state anxiety after exposure to a stressor. Interestingly, those participants who listened to heavy metal music not only experienced greater levels of state anxiety but were even more anxious after listening to the heavy metal music than when they were being stressed.

State anger scores decreased significantly over time for all participants. However, post hoc t tests indicated that listening to self-select music resulted in the lowest rating of state anger as compared to the other conditions. Noteworthy is that although all groups demonstrated some decrease in state anger scores the self-select group demonstrated the most 'clinical' change as scores decreased from a mean of 50 to a mean of 39 as compared to the high 40s for the other groups. The self-select condition may foster feelings of personal control as the individual is allowed to listen to music that they chose as relaxing. This finding is consistent with research on perceived control and its relationship to feelings of anger and irritability.

Heart rate and respiration decreased over time, regardless of the music/silence condition. Post hoc t tests suggest that participants in the self-select and classical music conditions experienced greater reductions in heart rate after being stressed than the other groups. Interestingly, respiration decreased the most for the classical and heavy metal music conditions. These results are consistent with previous studies that we have conducted in that although some changes in physiological arousal were found they were not as significantly altered compared to participants' report of their emotional state. For example, participants in the heavy metal condition reported increases in anxiety and anger and little change in their feelings of relaxation, however, their physiological arousal as measured by skin conductance and respiration did decrease over time, although not as much as the other groups. Listening to music may affect the emotional and cognitive experience of an individual more than their physiological arousal. However, participants listening to their own music demonstrated greater consistency in self-report of emotions and changes in physiological arousal as five out of the potential six responses (stage anger and anxiety, relaxation, heart rate, skin conductance and respiration) were significantly changed compared to the other groups. Those listening to classical music demonstrated changes in four of the six responses, sitting in silence resulted in changes of three responses and listening to heavy metal only resulted in reductions of two responses (skin conductance and respiration).

We did not find a significant positive relationship with ratings of a person's use of music for relaxation and relaxation experienced during the self-selected and classical music conditions. One reason that the correlation may have not been significant was the participants who listened to self-select and classical music had a mean relaxation rating of 6.45 ($SD = 1.05$) out of 7, indicating a very homogenous response. Therefore there was not enough variability in their ratings of relaxation for a significant correlation to occur. However, participants' report of how frequently they used music to relax was related to greater ratings of liking classical or select selected music.

A concern with this study is that the participants were college students and findings might not be appropriately generalized to other groups of individuals. We did find that measuring heart rate using EKG sensors placed on the chest provided a more reliable measure than using a plethysmograph on the finger. Thus we are more confident in the results of the current study. Actually stressing the participants prior to listening to the music created a better measure of the participants feeling stressed as it resulted in a greater range of emotional and physiological responses that could be potentially affected by the experimental conditions. Extending the time listening to music or sitting in silence allowed us to be more confident that changes over time was related to the experimental condition rather than just feeling less stressed because the stress test was over.

In conclusion, listening to some types of music genres elicit positive emotional and cognitive states, and reduces sympathetic nervous system arousal compared to sitting in silence or listening to heavy metal music. Therefore, listening to self-selected or classical music might be useful as a stress management strategy, especially if an individual is unwilling to sit in silence for a long enough time to achieve a relaxation response.

Acknowledgment This project was supported by Grant # 2001-SI-FX-0006 awarded by the Office of Juvenile Justice and Delinquency Prevention, Office of Justice Programs, U.S. Department of Justice.

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