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MUSIC AND PHYSICAL ACTIVITY IN PSYCHOLOGICAL WELL-BEING [1,2]

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Summary.—The present study was designed to examine the effects of listening to music during exercise of moderate intensity on mood, state anxiety, and time to exhaustion as well as to evaluate sex differences in 27 physically active (14 men, 13 women) subjects between the ages of 20 and 30 years. Participants completed the Profile of Mood States and the State Anxiety Inventory before and after treadmill running in Music and No music conditions. Music and No Music conditions were randomly assigned, and participants exercised at 75% of their Heart Rate Reserve until voluntary exhaustion. Analysis indicated participants reported statistically significant mean changes on Tension, Depression, Fatigue, Confusion, and State Anxiety. However, the findings for emotions yielded no significant effect of music, except findings suggested that women, but not men, reported greater mean Fatigue after exercising in the presence of music than in its absence. Also, there was a statistically significant finding suggesting that women exercised longer with music than without.

In the last decade, there has been a growing research interest on the contribution of physical exercise to the alleviation of mental discomfort and the psychological benefits of regular physical activity have been reported by many researchers (cf. U.S. Department of Health and Human Service, 1996; Morgan, 1997, for reviews). The findings indicate that regular physical activity and exercise have positive effects on mental health (e.g., anxiety, depression, stress), cognitive functions, subjective well-being, and mood (see Stephens, 1988; LaFontaine, DiLorenzo, Frensch, Stucky-Ropp, Bargman, & McDonald, 1992; Landers & Petruzzello, 1994; Karageorghis, Drew, & Terry, 1996; Karageorghis & Terry, 1997, for reviews; Craft & Landers, 1998; Tsutsumi, Don, Zaichkowsky, Takenaka, Oka, & Ohno, 1998; Kramer, Hahn, Cohen, Banich, McAuley, Harrison, Chason, Vakil, Bardell, Boileau, & Colombe, 1999; Salmon, 2000; Toskovic, 2001; Annesi, 2002).

For instance, Stephens (1988) analyzed data from 56,000 subjects and concluded that "the level of physical activity is positively associated with good mental health in the household populations of the USA and Canada, when mental health is defined as positive mood, general well-being, and rel-

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atively infrequent symptoms of anxiety and depression" (pp. 41-42). However, there also has been some controversy, as other studies have reported no significant effects of exercise and physical activity on mood (Mack, Huddleston, & Dutler, 2000; Naruse & Hirai, 2000).

Several studies also have investigated the influence of music on affect and state anxiety in healthful and clinical conditions (Luccacini & Kreit, 1972; Burns, Labbe, Arke, Capeless, Cooksey, Steadman, & Gonzales, 2002; Chan, Lee, Ng, Ngan, & Wong, 2003; Tornek, Field, Hernandez-Reif, Diego, & Jones, 2003). There is general agreement on the effect of music on mood states. In particular, exposure to music may induce change in mood. For example, Burns and colleagues (2002) showed that listening to different types of music during a stressful mental test induced significant and positive changes in state anxiety and heart rate, suggesting that music may have a beneficial effect on the cognitive components of stress responses.

Although many studies have examined the effects of either physical activity or music on mood, only a few studies have evaluated their effects on mood or state anxiety simultaneously (see Karageorghis & Terry, 1997, for a review). For instance, Hayakawa, Miky, Takada, and Tanaka (2000) studied the effects of music on mood states Tension, Depression, Anger, Vigor, Fatigue, Confusion) in 16 middle-age women during a bench-stepping exercise. In their study, these women listened to aerobic dance music, Japanese traditional folk song, or no music while exercising. Analyses suggested that the women reported significantly less fatigue when they listened to music than when they did not and that aerobic dance music was associated with higher rated vigor and lower rated confusion than other conditions.

More generally, researchers have rarely investigated how sex qualified the effects of physical exercise and music on psychological well-being, and the results of a few studies are yet controversial (O'Connors, Morgan, & Raglin, 1991; Berger & Owen, 1998; Bhui & Fletcher, 2000; Toskovic, 2001; Rocheleau, Webster, & Bryan, 2004). For instance, O'Connors and colleagues (1991) investigated the psychobiological effects of 72 hr. of increased training in female and male swimmers. Analysis showed no main effect for sex and no interaction with trial, suggesting that college-age female and male swimmers did not differ in psychological or physiological responses to a rapid increase in training volume. Likewise, Toskovic (2001) reported that Taekwondo practice may produce acute benefits on mood states independently of sex, which agreed with work by Berger and Owen (1998). In contrast, however, Bhui and Fletcher (2000) examined effects of the duration and intensity of physical activity on common anxiety and depressive states. These authors concluded that physical activity of long duration provides some protection against negative mood states and anxiety, but only for men. Similarly, Rocheleau, *et al.* (2004) examined the effect of sex, type of exercise, amount

of exertion, and duration of workout on the relation of exercise and mood in naturalistic settings. They reported participants improved their mood after exercise in both aerobic and anaerobic conditions and that women showed more improved mood in the domain of exhaustion than did men.

Thus, music and exercise may separately elicit benefits in mood and anxiety (Kennedy & Newton, 1997) and improve performance (Karageorghis, *et al.*, 1996; Szabo, Small, & Leigh, 1999). Furthermore, literature suggests that these effects may vary by sex. The present study addressed these possibilities within a single design and sampling to strengthen the comparability of findings. The first focus was how music and exercise together might affect mood and state anxiety compared to exercise alone. Moreover, the study also investigated the possible music-plus-exercise effects on time to exhaustion during moderate intensity treadmill running. Also investigated was the possible interaction of experimental effects with sex differences. Finally, the study evaluated these possibilities with a sample of Italian participants, thereby representing, to the best of our knowledge, the first Italian research of this sort and possibly an important element of comparison with international findings.

Method

Participants

Undergraduate students (16 men and 16 women) from the University of Motor Sciences in Rome who were of moderate fitness were recruited. During the study, five subjects (2 men and 3 women) were dropped for illness, injuries, or not having completed all the measurements. Therefore, the study relied on data from 14 men and 13 women. Participants ranged in age from 20 to 30 years (M age 22 ± 2.9 yr.) and were homogeneous in sociocultural status.

The selection criteria for participation were (a) age between 20 and 30 years, (b) previous experience in treadmill running, (c) no injury in the last six months, (d) no cardiovascular impairment, (e) no auditory impairment, and (f) no medical counter-indications for exercise. The physical characteristics of the women were 57.5 ± 5.7 kg for weight and 168 ± 5.1 cm for height, whereas 66.8 ± 4.5 kg and 175.2 ± 4.5 cm characterized the men.

Materials

A Technogym Treadmill (Model Runrace HC 1200) was used to perform the running test. A portable Sony stereo (Model No. CFD222L) with Sennheiser headphone (Model No. HD 433) was used to play music for the subjects during the test condition. A Polar Heart Rate Monitor (Model S610, Polar Electro Oy, Kempele, Finland) was used to assess resting heart rate and to monitor heart rate during exercise.

Measures

The Profile of Mood States, developed by McNair, Lorr, and Droppleman (1992), assessed six self-reported psychological states, namely, Tension, Depression, Anger, Vigor, Fatigue, and Confusion. The profile presented 58 separate adjectives, each of which belonged to one of the six mood states in the scale. For each adjective, participants were to rate on a 4-point scale (using anchors of 0: Not at all and 4: Extremely) to what extent the adjective characterized their mood state at that moment (right now). For each dimension, use of a software program permitted the computation of a *T* score subjected to analysis, with higher *T* scores indicating a greater mood state.

The State Anxiety Test, developed by Spielberger (1966), was used to assess state anxiety before and after the running performance. At each occasion, the test presented 20 items describing positive (10 items, e.g., "I feel relaxed") or negative (10 items, e.g., "I feel tense") statements. Subjects rated each item on a 4-point scale using anchors of 1: Not at all and 4: Extremely. The scale score was the sum of negative item scores and the positive item scores (after being reversed), so higher scores indicated greater anxiety.

Music Selection

The music was chosen according to two main criteria. First, to enhance possible positive effects of music on mood, an "up-beat" music within the range of 140–160 bpm (see Karageorghis & Terry, 1997, for review) was selected. Second, to avoid possible influence of semantic content on participants' mood, there were no lyrics. Moreover, participants were familiar with the selected music because it was widely used during an advertising campaign aired on television and radio. The selected music track was "Struggle for Pleasure" (piano, trumpet), by Wim Mertens (duration = 230 sec., tempo = 140 bpm).

Procedure

After written consent was obtained, participants were randomly assigned to the Music or No Music exercise condition in the first testing session. The opposite condition was assigned in the second test session which met approximately at the same time (9.00–12.00 a.m.) one or two weeks later.

After the procedure was explained, a participant entered the room (soundproof and visually sterile room), and resting heart rate was evaluated (Polar Heart Rate Monitor) while the subject sat quietly. Resting heart rate was used to calculate the heart rate corresponding to 75% of Heart Rate Reserve (HR Reserve) utilizing Karvonen's formula (Karvonen, Kentala, & Mustalo, 1957). Then, each subject responded to the Profile of Mood States and the State-Trait Anxiety Inventory-S to evaluate pre-exercise mood and state anxiety.

Experimental Task

Participants performed a treadmill running trial to volitional exhaustion at 75% of HR Reserve in both experimental sessions, i.e., with or without music. Volitional exhaustion was operationalized as the subject's voluntary interruption of the running trial. A secondary criterion of moderate exercise intensity was the Rating of Perceived Exertion at about 13 (Glass, Knowlton, & Becque, 1992) on Borg's Rating of Perceived Exertion of 6 to 20 points (Borg, 1998). As suggested by Dishman, Patton, Smith, Weinberg, and Jackson (1987) target heart rate plus feedback on perceived exertion are accurate in assessing target intensity. Rating of Perceived Exertion was measured every 5 min. during trials. As expected, imposing the same relative workload (75% HR Reserve) for men and women produced a significantly ($p < .01$) different workload expressed as running speed for women and men (10.9 ± 0.7 km/hr. and 12.8 ± 0.7 km/hr., respectively).

During the exercise condition, the music was started at the beginning of the running exercise and was repeated until subjects voluntarily interrupted the exercise. Music was played on a CD-player through headphones, with intensity (volume) self-selected by the subject. Headphones were also used in the No Music session. At the end of the exercise, subject sat on a chair and completed the two inventories again.

Results

For both baseline and posttask experimental sessions, the means and standard deviations for the Profile of Mood States scores (Tension, Depression, Anger, Vigor, Fatigue, and Confusion), and for State Anxiety, are summarized in Table 1. For the variables of mood states only, a baseline score reports the average of two pretest scores measured prior to the two physical exercise sessions. These data were analyzed in three separate repeated-measures analyses of variance.

TABLE 1

Means and Standard Deviations For Profile of Mood States Variables and State Anxiety For Baseline and Postexercise in Music and No Music Conditions

Variable	Baseline		No Music		Music	
	M	*SD*	*M*	*SD*	*M*	*SD*
Profile of Mood States						
Tension	45.1*	1.1	40.4	0.9	40.4	0.8
Depression	46.8*	1.1	43.2	0.5	44.7	1.1
Anger	45.5	1.0	58.1	15.0	43.5	1.1
Vigor	53.2	1.9	55.0	2.1	54.8	2.2
Fatigue	49.9*	1.5	46.1	1.2	47.7	1.2
Confusion	50.1*	1.6	46.5	1.6	45.2	1.5
State Anxiety	37.1*	1.7	33.2	1.5	32.4	1.4

*$p < .05$.

The first analysis was performed to examine whether the ratings of mood states obtained after the two physical exercise tasks, i.e., with or without music, changed significantly with respect to participants' initial baseline scores. In other words, this analysis examined the effects of physical exercise in the two experimental conditions on changes on several mood dimensions and state anxiety. Sex was included as a between-subject factor.

The second series of repeated-measure analyses of variance was performed to examine whether pre-post changes in these ratings obtained in the No music and Music conditions were significantly different. For each condition, separate mean difference scores were computed by subtracting posttest scores from baseline scores. Again, this analysis included sex as a between-subject factor.

Finally, a similar analysis was performed to see whether sex also qualified any difference in subjects' mean time of treadmill exercise for the two conditions.

Comparison of Baseline and Posttest Scores on Mood States

The first series of analyses yielded significant main effects for the within-subject factor on five dimensions of mood states, namely, Tension, Depression, Fatigue, Confusion, and State Anxiety but none for Anger or Vigor. Also, sex qualified no main effects detected for the above variables. Overall, compared to the initial mood baseline, the physical exercise tasks with and without music were associated with significant change in subjects' ratings on measures of mood and anxiety states. In particular, there was a significant decline on Tension ($F_{2,50}=7.93$, $p<.01$, $\eta^2=.24$, observed power = .94), Depression ($F_{2,50}=7.29$, $p<.01$, $\eta^2=.23$, observed power = .92), Confusion ($F_{2,50}=6.01$, $p<.01$, $\eta^2=.19$, observed power = .88), and State Anxiety ($F_{2,50}=4.07$, $p<.02$, $\eta^2=.14$, observed power = .69). Furthermore, the change on Fatigue fell just short of significance ($F_{2,50}=2.80$, $p<.07$, $\eta^2=.10$, observed power = .52). Since these analyses were performed controlling statistically for initial differences in mood states (i.e., by using baseline scores in the repeated-measures design), the statistically significant findings, and their related effect sizes and observed power, indicate that, especially for Tension, Depression, and Confusion, subjects experienced a significant decline in mood states and State Anxiety. This change was quite homogeneous across participants.

Emotional Changes in Relation to Music

With only the exception of Fatigue, the second series of analyses yielded no statistically significant differences between mean difference scores with and without music. As Fig. 1 shows, although for the women the change in Fatigue from baseline was significantly more pronounced without than with music (5.38 vs 1.23, $p<.01$), for the men the mean changes in Fatigue scores

were statistically equivalent (2.24 vs 3.14, ns). In other words, the women reported less fatigue after exercising without music than with music, whereas the men did not. As shown in the next section, this seemingly unexpected effect of sex could, however, be understood by analyzing participants' time to exhaustion across the experimental conditions.

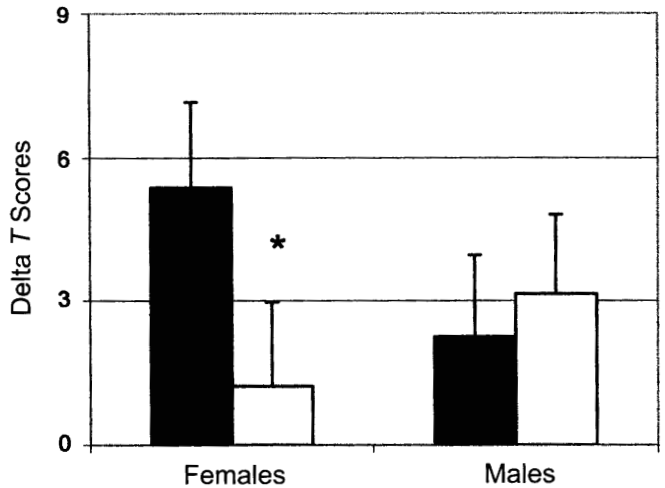

FIG. 1. Delta T scores (baseline minus after exercise) and standard deviations for fatigue in females and males after exercise in No Music (■) and Music (□) conditions ($p < .01$)

Time to Exhaustion in Relation to Music

A final repeated-measures analysis of variance examining whether participants' time to exhaustion on the treadmill varied across music conditions and by sex yielded significant main effects for music ($F_{1,25} = 4.70$, $p < .04$, $\eta^2 = .16$, observed power = .55) and sex ($F_{1,25} = 7.74$, $p < .01$, $\eta^2 = .24$, observed power = .77), and and significant interaction of sex by music conditions ($F_{1,25} = 5.45$, $p < .03$, $\eta^2 = .18$, observed power = .62).

On average, subjects spent significantly more time on the treadmill when they listened to music than when they did not (about 34 vs about 30 min.). Across tasks, the men spent about 40 min. on the treadmill, whereas the women spent about 25 min. exercising. However, as Fig. 2 also shows, subjects' sex significantly qualified these main effects. In particular, the men spent nearly the same time on the treadmill during both tasks (approximately 38 min.), but the women spent 29 min. in the Music and 21 min. in the No Music condition. This latter finding may explain the higher rated fatigue women reported with than without music. It is important to point out that an inspection of the effect sizes and observed power associated with

these effects suggests that, while the music main effect may be somewhat unstable given the high variability in time to exhaustion across subjects, the effects associated with sex appear to be more substantial and indicate a more adequate variance homogeneity across subjects.

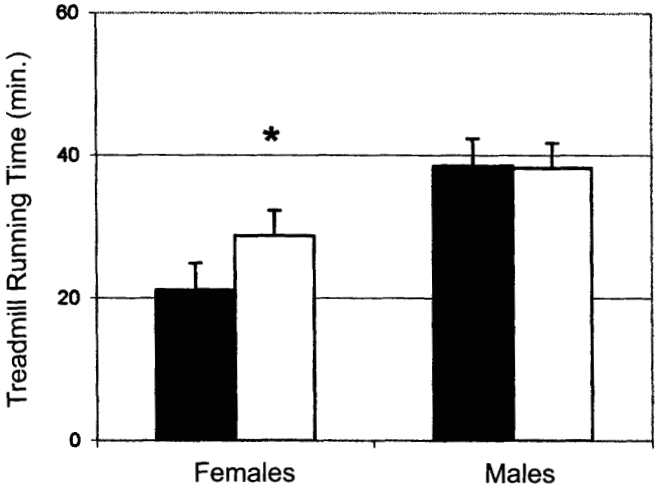

FIG. 2. Means and standard deviations for time to exhaustion of exercise for females and males in No Music (■) and Music (□) conditions ($p < .01$)

DISCUSSION

The purpose of this study was to evaluate the effects on a series of mood states, state anxiety, and time to exhaustion for moderate intensity treadmill running with exposure to music and no music in a group of Italian university students. Furthermore, there was an interest in examining whether effects would vary with sex.

The results support the general finding (LaFontaine, *et al.*, 1992; U.S. Department of Health and Human Services, 1996; Morgan, 1997; Guszkowska, 2004) that mood states are associated with participation in physical activity at moderate intensity. In particular, the main finding was that participants, compared to their baseline ratings of mood and anxiety, reported significantly lower Tension, Depression, Confusion, and State Anxiety after exercise on the treadmill both with and without music. There instead were no significant physical exercise effects on rated Anger and Vigor. Thus, the present findings overall are consistent with the notion that exercise and physical activity contribute to more positive mood. Finally, these findings characterized both men and women.

The findings of the present study can be integrated with international research quite well. For instance, as to the general effects of physical exer-

cise on mood states, the present findings replicate closely those reported by Berger and Owen (1983), who measured changes in rating of mood states on the Profile of Mood States by competitive swimmers when trained on a normal or an abbreviated training schedule. After a short-term swimming session, athletes reported a reduction in ratings of Tension, Depression, and Confusion, but not for Anger, Vigor, and Fatigue.

Despite our original expectations, the present study did not fully support the hypothesis that music was associated with positive effects on mood changes above and beyond physical exercise effects. This finding contrasts with Hayakawa, *et al.* (2000) who found that subjects rated more Vigor and less Fatigue after exercising with than without music. In the present study, instead, the women only reported significantly more fatigue after exercising with music. These differences could partly be due to the different physical task instructions used in the two studies. In particular, Hayakawa and colleagues applied a bench-stepping exercise (HR between 60–90% maximum) of a *fixed duration* (30 min.), whereas the present investigation tested effects associated with a treadmill running (75% HR Reserve) performed *until exhaustion*. This may explain the finding that the women exercised significantly longer in presence of music than in its absence, thereby showing a positive music effect on time to exhaustion. In other words, both studies yielded a positive effect of music, and their rated difference on Fatigue may plausibly be understood with respect to the different experimental instructions given during the physical exercise tasks.

Concerning the findings on time to exhaustion, the present study suggested further conclusions. Overall, the men exercised longer than did the women, but music was associated with longer exercise time on the treadmill only for women. Some authors (Copeland & Franks, 1991; Karageorghis & Terry, 1997; Potteiger, Schroeder, & Goff, 2000) suggested that music narrows the performers' attention and, as a consequence, diverts attention away from sensations of fatigue during exercise. Instead, performers may devote themselves to the movement (Hayakawa, *et al.*, 2000). This process may increase duration or intensity of work output (Szabo, *et al.*, 1999) and tend to promote a more positive mood state by distracting subjects from discomfort associated with fatigue, the net result being to prolong exercise.

Finally, the present findings also suggested that physical exercise was associated with self-reported state anxiety. As for both men and women, a lower state anxiety after physical activity appeared in both conditions relative to baseline. This general finding is consistent with prior research (Raglin & Morgan, 1987; Berger & Molt, 2001; Guszkowska, 2004).

As this is a preliminary study with limited characteristics, e.g., small sample size, only sport-involved university students, caution in the use of its findings is required. It is important as a replication of some international re-

search on the effects of physical exercise on mood and anxiety states, and, in part, it also is consistent with the literature suggesting that music has an additional effect on these domains above and beyond the effects associated with physical exercise.

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