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Effects of music during exercise in different training status

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***Aim*. This study examined the interaction of exercise and music to establish the impact of these factors on state-anxiety and time to exhaustion comparing trained and active participants.**
***Methods*. Twenty-six university students (13 trained, 13 active) completed the State-anxiety Inventory questionnaire before and after a submaximal treadmill running until volitional exhaustion in both music and no-music condition.**
***Results*. ANOVA showed that both trained and active groups significantly reduced their State-Anxiety scores after exercise tasks ($P<0.01$, partial $\eta^2=0.26$) independently by the presence of music. Finding also revealed that active group reported a higher significant reduction of their state anxiety score after exercise in music condition compared to no-music task ($P<0.05$, $d=0.80$), while this effect in trained group was not significant. Moreover, data showed that only active-subjects significantly prolonged their exercise experience in presence of music ($P<0.05$, $d=0.47$), while trained group did not.**
***Conclusions*. This study supports the general finding that exercise is associated with state-anxiety reduction, and suggests that music during exercise may improve this effect in active but not in trained participants. Further, listening to music during exercise may prolong the participants' exercise experience but different training status seems to qualify differently this response.**

KEY WORDS: Physical activity - Music - Anxiety -Time to exhaustion.

Scientific evidence shows that regular physical activity and exercise besides improving physical capacities and health, enhances psychological well-being.[1, 2] Researches concluded that exercise is positively related to several indices of mental health and may alleviate psychological discomfort, such as anxiety and depression.[3-5] These benefits were reported to be related to the participants' level of psychological discomfort, [6] and fitness levels.[7]

Within the past decade, researchers have begun to examine the properties of music during exercise and sport and it has been recommended as a technique to enhance the psychophysical state of participants during sport and exercise.[8] In particular, listening to music during exercise can produce ergogenic effects [9, 10] by improving exercise performance,[11] aerobic endurance,[12, 13] and enhancing the exercise experiences and adherence.[14]

Moreover, music is also used to help people relax and divert their attention from unpleasant and stressful situations.[15] Several studies have documented the positive effects of listening to music in order to manage mental discomfort, e.g. anxiety [16, 17] and to promote the client's health and well-being. On this regard, there is substantial evidence showing that music enhances psychological well-being, reduce stress, and distract patients from unpleasant symptoms.[18, 19]

Despite psychological benefit of exercise or music to reduce mental discomfort is adequately docu-

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mented by researchers, relatively few studies considered the effects of both music and exercise (exercise-plus-music) on psychological well-being. For instance, Hayakawa *et al.* [20] studied the effect of music on mood states (Tension, Depression, Anger, Vigor, Fatigue, Confusion) in 16 middle-aged women during a bench-stepping exercise. The authors reported that music was positively related to change on mood. Similar findings were also reported by Boutcher and Trenske [21] who examined the effects of sensory deprivation and music on perceived exertion and affect during exercise. Those analyses showed that subjects (24 untrained females) were feeling better during moderate and heavy exercise when accompanied by music than when exercising in the deprived condition, suggesting that music during exercise may enhance the participants' affective states. Brownley *et al.* [22] investigated the effects of music on affective responses in trained and untrained runners and concluded that listening to fast (up-beat) music during exercise may be beneficial for untrained runners but counterproductive for trained runners. On this issue Brownley *et al.*[22] claimed that participant's profile, (e.g. fitness status) has emerged as putative determinant of the direction and magnitude of music effects in exercise setting.

There has been also some controversy, as non-significant effects of music during moderate intensity exercise on mood and state-anxiety were reported.[23] Specifically, Macone *et al.*[23] reported that exercise was associated with positive mood and anxiety dimension but the authors also revealed that music did no add any significant effect on psychological dimension. Addressing this issue, it has been claimed that the discrepancy of results exists mainly because most of the investigations undertaken have suffered of methodological weaknesses [24, 25] (i.e., motivational qualities of music) and thus, research findings have been equivocal.[10] Further, responsible mechanisms remain unclear even though *dissociation* and physiological *arousal* seem involved in these processes.[26]

Hence, this study examined the interaction of exercise and music to establish the impact of these factors on state-anxiety. In particular this investigation focuses on the interaction of physical activity in two different conditions (with and without music) on state of anxiety comparing two different fitness status such as trained and active. This study also assessed the effect of listening to music during submaximal exercise on time to exhaustion of both the considered groups.

Therefore the aim of this study was to evaluate the effects of listening to music during submaximal exercise on state-anxiety and time to exhaustion comparing two different fitness level groups (trained vs. active).

Materials and methods

Participants

Thirty university students from the Faculty of Sport Sciences, homogenous in socio-cultural status, were initially enrolled in this study. Participants' ages ranged from 20 to 28 years (22 ± 1.9), were classified according to their training history and thus, distributed into two categories. Participants who had a recent 6-8 months history of regular physical activity for at least 3 to 5 training sessions per week were qualified as "trained"; participants, who had irregular physical activity (2 or less training sessions per week) in the same period, were classified as "active". Participants were engaged in different sport/physical activities (i.e., swimming, volley-ball, soccer, running).

During the study, four participants (2 trained, 2 active) did not complete the second session. Hence, this study included 13 participants classified as "trained" (7 women and 6 men) and 13 participants classified as "active" (6 women and 7 men). The selection criteria for participants were: 1) medical certificate of physio-psychological well-being status issued by the University Medical Center; 2) no auditory impairment; 3) no injury in the last six months; 4) previous experience in treadmill running; 5) aged between 20 and 30 years.

After receiving verbal and written description of the purpose, written consent was signed from participants in accordance with the University's Human Ethics Committee approved protocol.

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 participants during the experiment. A Polar Heart Rate Monitor (model S610, Polar Electro Oy, Kempele, Finland) was used to assess resting and exercise heart rate.

Instrumentation

State Anxiety questionnaire [27] was used to assess the participants' state-anxiety (STAI-S) before and after the running performance. At each occasion, the instrument presented the participants with 20 items describing positive (10 items, e.g., "I feel relaxed") or negative (10 items, e.g., "I feel tense") emotional statements at that moment ("right now"). For each item, subjects responded on a four-point scale ranging from 1 ("not at all") to 4 ("extremely") to express their emotional state at that moment. The scale score was calculated by summing the negative items' scores and the positive items' scores (after being reversed). Higher scores thus indicated higher anxiety levels. This tool has been extensively used to assess the anxiety level in exercise research.[28, 29]

Music selection

Studies on the effects of music during exercise have mainly focused upon the impact of synchronous, and asynchronous music.[30] Synchronous music has been reliably shown to produce an ergogenic effect while responses to asynchronous, or background, music are less predictable and beneficial effects are less reliable.[31]

Asynchronous music is a "background music" played without any conscious effort to keep in time with the music tempo.[31] Karageorghis *et al.*[32] investigating the asynchronous music reported that during treadmill task at 75% of Heart Rate Reserve (HRR) max, participants preferred the fast tempo (140 bpm). In the present investigation the music track was chosen according to the following main criteria: first, this study focuses on the effects of asynchronous music; second, to enhance the possible positive effects of music, a "fast music" (140 bpm) was chosen; third, to avoid possible influence of semantic content on participants' psychological conditions, the track did not contain lyrics; fourth, participants were familiar with the selected music because it was used during an ad campaign aired through both television and radio. The selected music track, according to these criteria, was "Struggle for pleasure" (piano, saxophone, violin, marimba), by Wim Mertens' (duration=230 s, tempo ~140 bpm). In this study, the treadmill speed (13.1±0.6 km/h and 10.8±1.2 km/h for trained and active participants respectively) induced a stepping tempo between 160-184 stride/min so that participants were not induced to synchronize their running with the 140 bpm music.

Procedure

Participants were randomly assigned to the Music or No-music exercise conditions in the first testing session. In the second testing session (a week later) participants were assigned the opposite condition approximately at the same time of the day (8.00-12.00 a.m.). After the procedure was explained, each participant entered the experimental room (soundproof and visually sterile room), and Rest HR was collected with subject quietly sitting. Rest HR was used to calculate HR corresponding to the 75% of HRR utilizing Karvonen's formula.[33] Then, each participant responded to the STAI-S to evaluate pre-exercise state anxiety.

Experimental task

Participants performed a treadmill running trial at 75% of their HRR in both experimental conditions (music, no-music) until volitional exhaustion. This heart rate level was achieved by increasing the speed of the treadmill (13.1±0.6 km/h. and 10.8±1.2 km/h. for trained and active participants respectively). Volitional exhaustion was considered as the subject's voluntary interruption of the running trial. A secondary criterion of moderate exercise intensity was the Rating of Perceived Exertion (RPE) at a level of about 13 on the Borg's RPE scale from 6 to 20 point (every 5 minutes from the 5th).[34] In this concern, it has been suggested that target HR plus RPE feedback are more accurate to produce the target intensity.[35] During the experimental condition, the music was started at the beginning of the running exercise and was repeated until subjects voluntarily interrupted the exercise. Music was played by using a CD-player through headphones, and the intensity (volume) was self-selected by the subject. Headphones were also used in the No-music session. At the end of the exercise, participants performed the cool-down (about 15 min) and then were asked to answer the STAI-S again.

Statistical analysis

Data are presented as mean and standard error. SPSS 15.0 for Windows software was used to perform on State-Anxiety score a 2×2×2 ANOVA with the between-groups factor Fitness Level (trained/active) and repeat-

ed measures factors Exercise (pre/post) and Music Condition (Music/No-music). Then, state-anxiety percentage change across events (pre-post exercise) was also compared by a 2×2 ANOVA the between-groups Fitness Level and Music Condition as within factor. A 2×2 ANOVA was also performed to assess running Time-to-Exhaustion between the two groups (trained/active) with Music Condition (Music/No-music) as repeated measure factor. Post-hoc analysis was performed when appropriate. Effect Size was also calculated using Cohen's definition of small, medium, and large effect size (as partial η^2=0.01, 0.06, 0.14 and as d=0.20, 0.50, 0.80, respectively).[36] Statistical significance was accepted at the P<0.05 level.

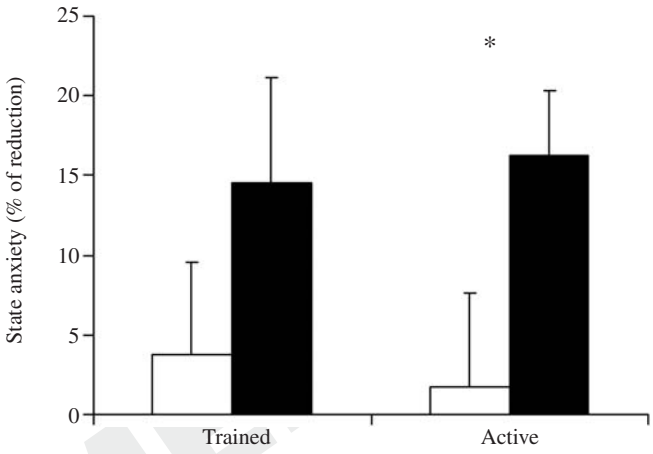

Figure 1.—Percentage of reduction and standard error for State-Anxiety after exercise for trained and active participants in No-Music (□) and Music (■) conditions. (*P<0.05 vs No-Music).

Results

State-anxiety

A three-way ANOVA for State-Anxiety resulted in a significant exercise main effect ($F_{1,24}$=8.46, P<0.01, partial η^2=0.26). Anxiety reduced significantly following exercise (from 37.4±3.0 to 32.7±1.2 respectively). A significant exercise by music interaction effect ($F_{1, 24}$=8.27, P<0.01, partial η^2=0.26) showed that, when controlling for the effect of training status, post-exercise anxiety score in music condition was more reduced than in post-exercise in no-music condition (from 39.7 ± 1.8 to 32.1 ± 2.0 and from 35.2 ± 2.5 to 33.3 ±2.2 in Music and No-Music conditions respectively). Further assessing state-anxiety as percentage of variation between post and pre-exercise scores (Figure 1), data revealed that this decline after the exercise-music task was more pronounced ($F_{1,24}$=6.94, P<0.05, partial η^2=0.22). Specifically, a statistically significant decline in Active-subjects' anxiety rating after exercise in music environment emerged (P<0.05, d=0.80), while a similar but not significant trend in Trained participants was observed (P=0.08, d=0.47) (Figure 1).

Time-to-exhaustion

A second series of analysis examined whether participants' Time-to-Exhaustion on treadmill varied across music conditions and training participants' status. This analysis yielded significant main effects for Music (F1,24=8.76, P<0.01, partial η^2=0.27), and for Training Status (F1,24=4.70, P<0.05, partial η^2=0.16). On average, trained group spent significantly more time on treadmill comparing to active-group in both exercise conditions (Music, No-Music). Moreover, data showed that both the groups (Trained, Active) experienced a longer time on the treadmill when music was present compared to the quiet condition. Specifically, data revealed that this change was statistically significant for Active-participants (P<0.01, d=0.47) while for Trained-participants the effect was not significant (Figure 2).

Discussion

This study examined the effects of listening to music during exercise on state-anxiety and time-to-exhaustion in trained and active participants. The main findings revealed that both trained and active participants decreased their state-anxiety level after the exercise, independently by the presence of music. From the data emerged that exercise was associated with a state-anxiety reduction in active as well as in trained participants, suggesting that different fitness status does not appear to have a different effect on emotional response (i.e., anxiety) to exercise. This first result supports and extends those studies which emphasized the role that physical activity may offer to protect and reduce psychological discomfort such as state-anxiety.[3-5]

Considering the effects of music during exercise on state anxiety, our study revealed that active-participants exhibited a more pronounced reduction of their

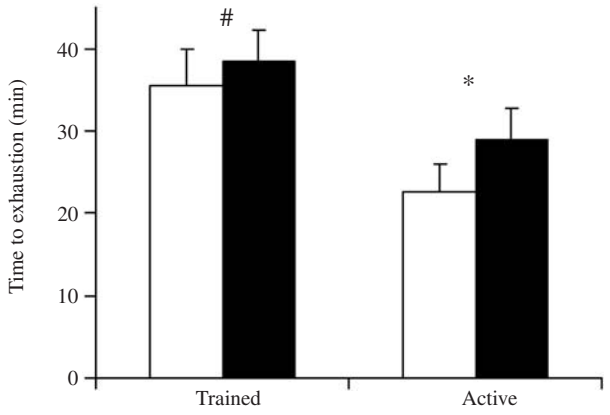

Figure 2.—Means and standard error for Time-to-exhaustion of exercise for trained and active participants in No-Music (□) and Music (■) conditions. (#P<0.05 vs Active; *P<0.05 vs No-Music).

anxiety level after exercising in presence of music than in its absence, whereas the trained-group demonstrated only a trend in the same direction. This result contrasts with previous investigation [23] who reported that music during exercise was not associated with state-anxiety reduction. The discrepancy of the results could partly be due to the different groups considered in the two studies. In the present study, participants were classified according to their fitness status while Macone *et al*.[23] investigated on gender differences. Thus, these different results could reflect differences of the investigation design. The present data support the hypothesis that music during exercise may enhance the *anxiolytic* effect induced by participation in physical activity (compared to silence) even though it seems that different fitness status may effect this outcome differently. This is in line with findings by Brownley *et al*.[22] who reported different result on affective dimension comparing trained and untrained subjects. Specifically, the authors could show that at low and high intensity exercise with music accompaniment, untrained reported more positive effects compared to trained subjects suggesting that fast/up-beat music tempo during exercise may be beneficial for untrained subjects but counterproductive for trained runners. In other investigations, elite sportsmen, compared with untrained controls showed higher levels of self-efficacy [37] and self-efficacy has been associated with lower anxiety and physiological stress reactivity.[38, 39] This might mean that active-subjects may have a higher psychological discomfort compared to trained-subjects and thus the benefit induced by listening to music during exercise was more evident because of more room for possible change, as suggested by Guszkowska.[6] Obviously this point awaits further research, but could have important implications for exercise prescription.

With respect to time-to-exhaustion, our finding indicated that trained and active participants have been differently affected by listening to music during exercise. Specifically, active-subjects substantially prolonged their treadmill running performance in presence of music whereas in trained participants this effect was absent. This result partially contrasts with Brownley *et al*.[22] and Mohammadzadeh *et al*.[40] In particular, Mohammadzadeh *et al*.[40] assessed the effects of music on RPE and Time to Exhaustion, measured during the Bruce test (incremental exhaustion trial) in trained and untrained subjects. The authors revealed that both trained and untrained groups increased their time of performance even though untrained participants reported a higher reduction in the RPE scores in presence of music compared to the trained group. On the other hand Brownley *et al*. [22] assessed the Total Time to Exhaustion (TTE) in trained and untrained subjects measured after three successive 10-min stages of low, moderate and high exercise intensity in different music conditions (no-music, sedative, and fast). On this concern Brownley *et al.*[22] revealed no-group or music effects on TTE. However the authors collected these data at the conclusion of the high intensity stage, asking the participants if they were able to continue exercising. Moreover during this voluntary fourth stage treadmill grade was increased 2% every 2 min increasing the participants' workload. On this concern researchers claimed that the cognitive strategies in exercise and physical effort were "load dependent".[21] Psychological factors may be salient at light and moderate exercise intensities, but during exercise of high intensity and long duration it is likely that attention is focused on overwhelming physiological sensations, which dominate focal awareness. [41] Hence, it could be plausible that the results reported by Brownley *et al.*[22] were related to the participants' higher exercise intensity and physical effort.

In the present investigation time-to-exhaustion was measured at constant exercise intensity and grade (respectively moderate and 0 degree) and music was associated with longer running time even though this effect was present only in active participants, while in trained it was not. Researchers argued that music may

narrow the performers' attention and, consequently, divert attention away from sensations of fatigue during exercise so that duration and/or intensity of work output are increased.[12, 14] This effect was also revealed by Elliott *et al*.[10] who found that untrained students significantly increased in distance traveled (exercise intensity) when they were listening to music during a 20 min cycling trial compared to the no-music condition task. The music's ability to induce a state of dissociation occurs when an individual focuses upon external stimuli thereby reducing the perception of internal bodily cues.[26, 42] As defined by Morgan and Pollock,[43] dissociation referred to any thought that served to divert attention away from internal sensations and toward external distracting stimulation. Collectively these data suggest that active participants have been positively affected by music during exercise whereas trained seems less sensible to this effect. In this context, it could be suggested that active participants may profit more from external cues while trained would focus on internal cues during exercise and therefore would not be responsive to the music stimuli.

These evidences suggest at least two considerations. First, it seems that different fitness status (i.e., active and trained) may have different responsiveness to music stimuli during exercise. In particular, low-to-moderate fitness level participants (active/untrained) may profit more from the effects induced by music during exercise, prolonging their physical exercise experiences; instead higher fitness level (trained) participants seem to be less sensible to this effect and therefore less responsive to the music benefits in exercise setting. Secondly, considering the listening to music effect on exercise, it may be reasonable to suggest that active subjects in their reaction to music stimuli during exercise are more similar to untrained than to trained-subjects.[10]

Overall, it seems appropriate to consider the present study as an important confirmation of previous experimental researches on the positive effects of physical exercise in the reduction of state-anxiety, thus supporting the general notion that physical activity participation is positively associated with psychological well-being. Moreover, the study confirmed what the literature suggests about the additional effects that music may have on these domains, at least when physically active participants are considered. Finally, the present findings suggest that music exposure may prolong the physical exercise experience, even though this contribution may not be generalized to all fitness levels and it could be speculated that training status may differently qualify this exercise performance enhancement.

Conclusions

From the obtained data the following conclusions can be established:

— participation in moderate physical activity can reduce anxiety level;

— listening to music during exercise may enhance the positive effect linked to participation in physical activity on state anxiety dimension in moderately fit subjects;

— asynchronous music stimuli may prolong time to exhaustion in active subjects.

Extension of the present investigation is needed analyzing larger samples, exercising under different music selections (including self-selected music) and workloads to establish the quantitative and qualitative accuracy of these findings.

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