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Investigate the Effects of Iranian Traditional Music and Western Classical Music on Physical Performance, the Normal Profile of Mood States and Rate of Perceived Exertion

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Abstract

Background: *The present study examines the effects of Iranian traditional music and Western classical music during 20 min of pedaling on an ergometer, along with the normal factors of profile of mood states and rate of perceived exertion.*
Methods: *Seventeen non-athlete participants (11 men and six women) with a mean age of 26±1.5 cycled in three conditions: exposure to Iranian traditional music; exposure to classical music; and control conditions (silence). Participant's normal mood states before and after each test, rate of perceived exertion and cycling speed during the test and distance traveled at the end of each test were recorded.*
Results: *The results showed that participants in exposure to classical music, and also in the face of Iranian traditional music, pedal a greater distance than the control condition (silence). Also, conditions of exposure to classical music and exposure to Iranian traditional music reduced rate of perceived exertion of participants compared to control conditions (silence). There was no significant difference in the speed of participant's cycling during exposure to music and in the control condition (silence).*
Conclusions: *Individual's mood during the physical test under the musical conditions was better than control condition, and classical music had a more prominent role in participant's mood.*

Keywords: Physical performance, Iranian traditional music, Rate of perceived exertion, Profile of mood states (POMS).
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Introduction

Music is a kind of art of which its field of performance is composition and sound making to create beauty in form and expression. Today, more than ever, technology has brought music to the mankind, so that its role can be seen every day in social and emotional life.[1] Music captures attention, increases morale, feelings, arousal, and changes mood, also, by promoting mobility and activity, it increases work efficiency.[2,3] One of the goals of ergonomics is improvement of individual performance when performing a certain task and adapting it to his/her physical and mental characteristics. Music is a positive intervention used to improve performance and today in some industries music is used to enhance performance of individuals for increasing work efficiency.[4] The effects of music on physical activity are investigated in three areas: ergogenic; psychological; and physiological. Ergogenic effects of music are reflected in improving work quality, fatigue delay or increasing work capacity, and they enhance physical performance. Usually, this effect leads to higher levels of endurance, strength, and efficiency.[5] Psychological effects of music on physical performance include ways that it effects on mood, emotion, cognition (mental processes), and on behavior affects. Psycho-physical effects are sub-branches of the psychological effects that are associated with the subjective perception of physical effort (i.e., psychological assessment of physiological processes), and fatigue. The term of psycho-physiological effects is related to psychological correlations of psychological effects of music such as relationship between changes in heart rate or blood pressure with music tempo.[6] Karageorghis (2012) named music as a legitimate medicine to improve performance. Some of the musical characteristics such as tempo, volume, and complexity influence the difference between original or generic (sad/happy) feel of the music. These acoustic characteristics are not only musical and may involve physical aspects of emotional behavior.[7-11] Music makes mood and feelings more positive during activity.[12,13] These positive effects will appear regardless of activity level or music sync. Some researchers have suggested that positive effects of music on emotions can lead to increased activity.[14] In the research of Yamashita et al., rate of perceived exertion during activity with 60% VO2 max compared to control conditions did not change; but during activity with 40% VO2 max, participants perceived less effort (2.3±9.63) compared to participants exposured to silence (2.6±12.38).[15] Szabo et al. studied the effects of classical music rhythm on physical performance by use of both fast and slow tempo pieces of Beethoven's Seventh Symphony and, by changing tempo of pieces, designed fast to slow and slow to fast conditions. They concluded that when the exercise intensity between conditions is the same, the music tempo changes may increase motivation and work efficiency.[16]

Szmedra et al. also examined the effects of Beethoven's Seventh Symphony during running at moderate intensity compared to control conditions (without music). Their findings showed that music reduces heart rate, blood pressure, and the rate of perceived exertion. Due to the possible mechanisms that have led to these benefits, the researchers concluded that music relaxes and reduces muscle tension in participants, and will thereby increase blood flow and muscle recovery. Rate of perceived exertion in musical conditions was 10% less than control condition.[17]

In a study by Bigliassi (2015), the results of mood factors (in six areas: anger; depression; tension; vigor; fatigue; and

confusion) and rate of perceived exertion, did not show significant difference between different musical situations.[18] By developing musical styles, people's tastes in music also increased. Researchers have stated that music which contacts a person culturally could have significant advantages in performance of individuals.[19] Today, the use of background music in order to increase productivity in the workplace is widespread and much research has been done in this area. According to the results of Huang and Shih, background music affects the attention of the workers and this effect is related to the level of workers' interest in the music which is playing.[20] Also, the results of a study by Lsyvk's showed the quality of work could be improved while listening to music.[21] Therefore, this study is formed with the aim to investigate the effects of Iranian traditional music and Western classical music on physical performance. For this purpose, profile of mood states (POMS), rate of perceived exertion, pedal speed, and distance traveled by the participants in each condition [exposure to Iranian traditional music, exposure to classical music, and control conditions (silence)], was evaluated.

Materials and Methods

The present study was performed among 17 (including 11 males and six females) Iranian students at the Tehran University of Medical Sciences. Students participating in this study ranged from age 23 to 28 years, with mean age of 26±1.5 years.

First, individual characteristics of participants which influence the test (sex, field of study, mental and physical health status) were investigated and were collected by self-designed questionnaire. Cardiovascular illness, mental illness, use of certain drugs, and smoking can cause interference in the test, so we used people who were free of these variables.

In order to monitoring perceived exertion of participants, the 15-point Borg scale was used.[22] Rated range of this scale is from 6 to 20, so that the perceived workload by semantic ranking ranks from very, very light to very, very heavy. Studies have shown that this scale is a reliable measure of perceived exertion.[23] In the study of Dehghan et al. (2011), the validity and reliability of this scale was evaluated in Iranian society.[24]

For assessing mood, the 65 questions profile of mood status questionnaire which was provided by McNair et al. in 1992, was used.[25] This questionnaire consists of six subtest scores related to the subscales of tension - anxiety, depression - dejection, anger- hostility, vigor - activity, fatigue-inertia, and confusion - bewilderment, the points of which were obtained from a set of questions assigned to a mood factor that were collected, and the score related to that index was obtained. Scoring method in this test is such that in front of each option is located a number from 0 to 4, which means: not at all; a little; moderately; quite a lot; and extremely, respectively. To obtain a total set of mood disorders, five negative factors including stress, depression, anger, fatigue, and confusion were collected together and score of vigor was subtracted from them. In this study, the score of total points of mood was for determining the effect of music on people's mood for their physical performance. This means that high score means a negative mood (that follows with behaviors such as anxiety, anger, aggression, and so on), and a lower score means a positive mood. The Persian version of this questionnaire was validated by Vaez Mousavi et al. in 2002,[26] and also by Shafizadeh et al. in 2007.[27]

The study focused on cardiorespiratory fitness, according to the parameters of intensity, duration, and method of study conducted based on the recommendations of the American College of Sports Medicine[28] (1998). To assess physical activity of participants, sub-maximal exercise test was selected. In this test, a person performed below the maximum level. Index of measurement in this test was a standard percentage of maximum heart rate with maximum oxygen consumption. Participants in three conditions of 20 min did the bicycle ergometer test with 60-80% of their maximum heart rate. To determine exercise intensity, distance cycled by participants at the end of 20 min was recorded.

To investigate the effects of music on physical performance, Western classical music and Iranian traditional music were used. Beethoven's music among classical Western music expressed storm and beam quality. Odd symphonies (Symphonies of numbers 7,5,3, and 9) often have powerful states and a higher tempo.[29] Since classical music selected in some studies yielded positive results (16,17), in the present study for evaluation of the effect of classical music on physical performance, Beethoven's Seventh Symphony was chosen with 120 bpm tempo. Schneider et al. (2010) reported that human movement and rhythm perception both have a frequency of 120 bpm.[30] High tempo melodies can rarely be found in Iranian traditional music. After searching Iranian Masters music performances, pieces of Master Faramarz Payvar Solo Santur were selected with a tempo of 120 bpm.

For measuring physical activity in this study, Tunturi TRAINER E 604 ergometer was used. This ergometer reports the pedaled distance parameter in meters and pedaling speed in terms of the number of rounds per minute. Sound pressure levels intensity of music were set at 70 dB. This level is high enough to prevent the perception of any external sound and also is not annoying. In order to prevent noise levels exceeding this value, a sound level meter device manufactured by TES, 1358TES model, was used to test and evaluate the balance. Participants in this study also reported that the intensity of the selected sound was good and not annoying. Music playback from the laptop device X42JY model ASUS laptop, and using portable stereo speakers of EMS-2015 model, was done. Test participants were asked to refrain from eating and drinking three hours before. Before starting the main test in order to bring heart rate to the required level, to find relative workload and to familiarize participants with the task, a pre-test was carried out. The test sequence is shown in Figure 1. First, using the formula HRmax=(220-Age), the maximum heart rate, was obtained. Since working at high intensity (more than 80% HR max) may reduce the effect of external stimuli,[31] the heart rate should not exceed 80% HR max or reach lower than 60% HR max. In order to monitor heart rate during physical performance, the Beurer companies pulse meter, PM70 model, was used. This device contains a sensor that is placed on the

Figure 1. The sequence of pre-test and main test

chest and a watch display which shows heart rate. After pre-test, the main test began, with participants pedaling in three sessions [exposure to Iranian traditional music, exposure to Western classical music and control conditions (silence)], each for 20 min, with self-selected speed. During the tests, continuous monitoring of heart rate was carried out in order to not exceed 80% HR max. At the end of 4, 8.12, 16, and 19 min, RPE and cycling speed of participants were recorded. Upon completion of the test, the participants again completed the questionnaire of POMS. Each test was done for the three conditions, with an interval of two weeks, and at the determined hour. To validate the results, selection of the test conditions (exposure to Iranian traditional music, exposure to classical music, and control conditions (silence)] was randomized.

Data analysis was performed by SPSS 18. After using Kolmogorov-Smirnov test, normal data distribution of responses to variables was observed. Thereby statistical difference between the dependent variables (distance traveled, RPE, the norm of POMS) was performed by one-way repeated measured analysis

Results

All descriptions of the three conditions [control condition (silence), exposure to Iranian traditional music, and exposure to classical music] are demonstrated in Table 1. These data show mean and standard deviation of the RPE, cycling speed and distance traveled. The RPE faced with classical music (11.83±2.65) compared to control conditions (12.16±2.83), was reduced, and in the face of Iranian traditional music (12.93±2.93) compared to the control condition (12.16±2.83), it was increased. This means that classical music has a more positive effect on the RPE. Participants cycling speed on exposure to both music conditions compared to control condition increased. The difference between the two musical conditions was 0. 23, which is not significant.

Participants in the current research in exposure to classical music cycled 7,994.11 meters, in exposure to Iranian traditional music they cycled 7,955.88 meters, and in control condition (silence) they cycled 7,200 meters.

By using repeated measured analysis (Wilk's Lambda=0.412, F(2,15)=10.7, P=0.001,Π^2= 0.588), significant difference between conditions was observed. As pairwise comparison revealed participants in exposure to Iranian traditional music had been cycling longer distances compared with control condition (silence) (P=0.019), and also in exposure of classical music, participants cycled longer distances compared with control conditions (silence) (P=0.01). There was no significant difference between exposure to classical music and exposure to Iranian traditional music (P=0.9). Total distance traveled by participants in the three different conditions is shown in Figure 1. As can be seen, the effects of various conditions on traveled distance were different.

Average RPE of participants was measured during 20 min. No significant difference was observed between the conditions (Wilk's Lambd a=0.764, F(2,15)=2.32, P=0.13,Π^2=0.23).

As is shown in Table 1, average RPE according to conditions did not significantly differ. According to Figure 2, by increasing time of the test, participants in all three conditions experienced more effort. So, in silent condition, the relation of time with RPE was linear and direct. Participants in terms of dealing with both music situations compared to silence situation, perceived less effort. Up to 14 min, exposure to Iranian traditional music caused perception of greater effort compared with exposure to classical music, but after 14 min, it was same for both groups. So in comparison with control condition (silence) musical condition were able to decreased perception of fatigue in participants.

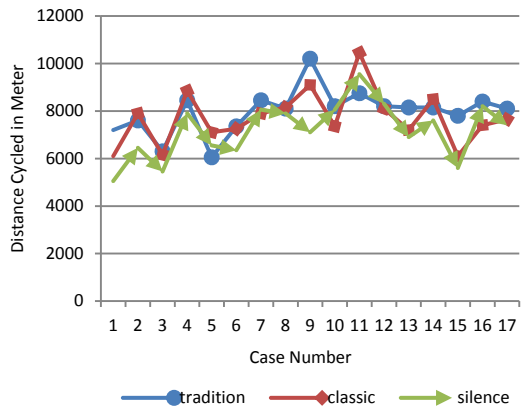

Figure 1. Linear graph of total distance traveled by participants in 3 musical sessions of the physical test

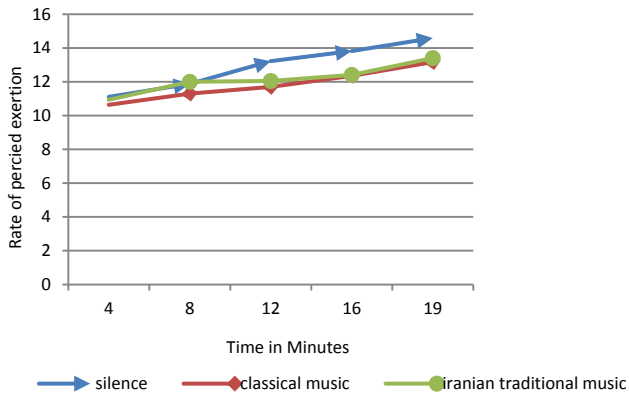

Figure 2. Rate of perceived exertion of participants in the recorded minutes

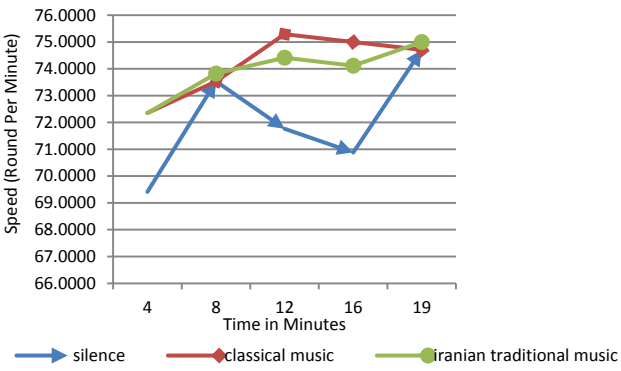

Figure 3. Participant pedaling speed in registered minutes

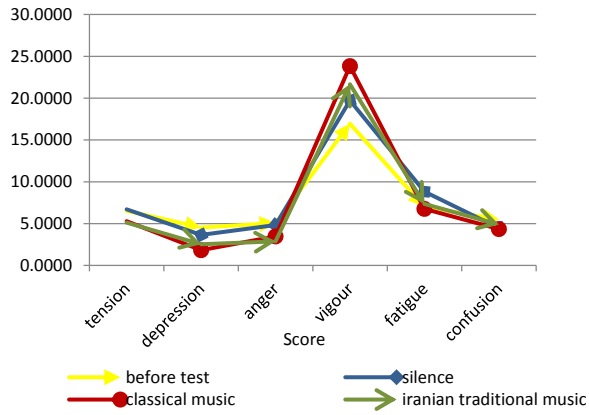

Figure 4. Comparison of the average profile of mood in different test conditions

Average cycling speed of participants during 20 min was measured. By doing repeated measure test, a significant difference was not observed between the different conditions (Wilk's Lambda=0.9, F(2,15)=0.748, P=0.49,η^2=0.091), hence the pedaling speed of participants in different situations had no statistically significant difference. As can be seen in Figure 3, participants between times of 8–16 min had compromising speed. In exposure to both Iranian traditional music and classical music, participants cycled faster than in the silent condition. So that in first 10 min of the test, participants in both musical conditions cycled equally, but exposure to classical music after the minute 10, increased speed of cycling**.**

Before and after each test, POMS questionnaire for the three conditions: control (silence); exposure to classical music; and exposure to Iranian traditional music, were investigated. In Table 2, the mean and standard deviation obtained from completion of the questionnaire is shown before and after each test.

Pre-test scores on the three conditions are listed in Table 2. By doing repeated measured comparison between each, factors of temperament were evaluated in three test conditions. For confusion factor, Wilk's Lambda=0.846, F(2,15)=1.36, p<0.01,η^2=0.15); tension factor (Wilk's Lambda=0.56, F(2,15)=5.77, P<0.01,η^2=0.435); depression factor (Wilk's Lambda=0.35, F(2,15)=13.9, P<0.01,η^2=0.65); anger factor (Wilk's Lambda=0.492, F(2,15)=7.75, P<0.01,η^2=0.508); vigor factor (Wilk's Lambda=0.35, F(2,15)=14.07, P<0.01,η^2=0.65); fatigue factor (Wilk's Lambda=0.55, F(2,15)=6.11, p< 0.01,η^2= 0.45), and the overall mood (Wilk's Lambda=0.203, F(2,15)=14.07, P<0.01,η^2=0.79, were obtained. For vigor factor and overall mood, significant difference between three conditions was seen. By applying pairwise comparison test, a significant difference between condition of exposure to classical music and control conditions for vigor factor was observed (P=0.01). As a result, classical music significantly increased vigor levels compared to the control condition. And for the overall mood, difference between control conditions (silence) with exposure to classical music (P=0.005) and the difference between control conditions (silence) with the face of Iranian traditional music (P=0.045), was significant. Therefore, presence of music, ranging from classical music to Iranian traditional music, could improve participants' positive mood.

Table 1. Descriptive results of distance traveled, cycling speed, and rate of perceived exertion while cycling in three different conditions

Conditions	RPE		Speed Pedaling (Rpm)		Traveled distance (M)	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Control (silence)	12.16	2.83	72.05	11.75	7200	1183.48
Exposure to Iranian traditional music	12.93	2.93	73.95	10.65	7955.88	946.52
Exposure to classical music	11.83	2.65	74.17	11.09	7994.11	927.25

Table 2. Table of description of confusion, tension, depression, anger, vigor, fatigue, and overall mood of the participants in three different conditions

Variable	Before the test		After exposure to silence		After exposure to classic music		After exposure to Iranian traditional music	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Confusion	5.47	2.8	4.47	2.37	4.35	2.76	4.88	2.17
Tension	6.53	3.08	6.7	3.44	5.3	2.68	5.11	2.02
Depression	4.53	3.45	3.64	2.66	1.82	2.00	2.53	1.87
Anger	5.05	2.27	4.82	2.62	3.47	2.37	2.88	2.34
Vigor	16.94	3.4	19.70	4.34	23.82	3.57	21.64	4.18
Fatigue	7	2.95	8.82	3.45	6.76	2.58	7.35	2.71
Moods	11.64	11.06	8.76	12.45	−2.11	10.48	1.11	9.4

Iceberg chart was created by Morgan and is a mood indicator when performing ordinary physical activity.[32] Morgan showed that for those who have more successful physical performance, more positive mental attributes, and less negative features of mental health, the psychological mood profile is like the iceberg. In this case, scores of people in the negative component of the mood (tension, depression, fatigue, anger, and confusion) are placed in the bottom of the chart, and positive components (vigor) are placed in the top of the chart and create a shape like an iceberg. Thus, according to Morgan's hypothesis, people who have better physical function will have a larger iceberg.[33] Each graph that is plotted in Figure 4, as can be seen, has a normal application. In both exposure to classical music and exposure to Iranian traditional music, mood values are better than the scores before the test or in tests in controlled conditions (silence).

Discussion

The results presented in Table 1 show that, compared to the control condition (silence), exposure to Iranian traditional music, and Western classical music significantly increased people's cycling distance. Significant differences in distance traveled between two musical conditions (exposure to classical music and exposure to Iranian traditional music), were not observed. Two distinct mechanisms are considered for similarity of individual's performance in the musical situation. In the first hypothesis, it is suggested that people tend to respond to musical rhythmic properties,[34] and rhythm is an important element. Based upon this assumption, Karageorghis and Terry[35] stated that during sub-maximal exercise, people are synchronized with music. If the music playing is asynchronous (no conscious sync between tempo and movements of the individual), a form of synchronization will occur. The second hypothesis suggests that people focus more on external stimuli than internal stimuli.[36] Therefore, it is assumed that external focus can reduce the onset of fatigue and improve mood. The music elected by Randi et al for their study was slow and fast versions of Beethoven's Seventh Symphony. They found exposure to fast tempo version increases the performance of participants . Also, in comparison with control conditions, slow tempo piece of symphony caused an increase in the performance.[37] So, when exercise intensity is similar, changes of music tempo may increase motivation and work efficiency. Wilson believes that there is a kind of beats making in the brain for coordinating the afferent nerve stimulus of music with a mutually distributed efferent stimulus (e.g., physical movement).[38] Exposure to classical music caused 8.51% reduction in the RPE, and exposure to Iranian traditional music caused 5.88% loss of perception of individual effort. Yamashita investigated influences of favorite music on RPE during pedaling on an ergometer bicycle at low and medium intensities. Compared to the control condition, music reduced RPE in the middle intensity and not much in the low intensity.[15] Part of this finding was predicted by the hypothesis of parallel processing of Rejeski; which states that by increasing exercise intensity, physiological variables (such as heart rate and respiratory rate) prevail.[39] So that in the middle of the test (when the intensity for participants still was not increased), participants reported lower RPE. By comparing the results of this study with other research, it can be concluded that at an average exercise intensity music could cause one to perceive less effort when doing physical activity. In research by Hayakawa et al. (2005), participants' mood was assessed by POMS questionnaire. Both conditions (Japanese traditional folk song and aerobic dance music) reduced the fatigue parameter compared to the non-music condition. Moreover, aerobic dance music was responsible for the sense of more vigor in comparison to Japanese traditional folk song or non-music conditions.[40] In a study by Brownley et al., participants in responding to music at high and low intensity experienced more positive feelings. Also, exposure to music was useful for non-athlete runners.[41] In a study of Dyer and Mckune, high tempo music increased overall mood disturbance and also increased feeling of tension in athletes.[42] The reason is that maybe athletes focus their attention only on the task they do and do not care for environmental conditions. In intense activity, physiological variables processing capacity is dominant, while in more moderate intensity, internal (kinematics) and external (music) placed variables processed in parallel. In other words, it is not possible to change person's sense of fatigue resulting from strenuous activity, but we could change perception of fatigue towards a more positive

assessment.[5] So classical music, according to this research, could make people less fatigued. In comparison with control condition (silence), speed of participants pedaling in exposure to classical music increased %2.85, and in exposure to Iranian traditional music increased %2.55. In a study by Lim et al., pedaling speed under three conditions (without music, music that was played at the beginning and then was cut between 5 and 10 kilometers, music that was played only between 5 and10 kilometers) changed. When music was playing at the beginning, participants rode 1–1/25 km/h faster than the two other[43] conditions. So perhaps the effect of music on speed of cycling is tangible when it involves combined conditions: silence and exposure to music.

The results of this study showed that participants with exposure of music cycled greater distance compared to control conditions (silence), and Iranian traditional music as well as classical music were involved in participants physical activity. The factor of perceived exertion during the physical test was measured several times. The results showed that exposure to classical music decreased by 8.51% the perception of effort compared to control conditions (silence), and exposure to Iranian traditional music decreased by 5.88% . Individuals' mood under musical conditions improves and classical music has a more prominent role in participants' moods than silence and Iranian traditional music.

One of the limitations of the present study is that it evaluated the physical performance of individuals in the laboratory. It is suggested that future studies are carried out in the workplace in order to create conditions for more realistic assessment.

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Conflict of Interest

The authors declare that they have no conflict of interests.

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