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The Relationship Between Motivational Music and Endurance Performance of College-Aged Individuals

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Abstract

Introduction: Music has shown beneficial ergogenic effects to exercise performance by increasing endorphins and catecholamines levels in the blood. However, the relationship between motivational lyrical music and endurance performance is still unclear. The purpose of this study is to examine the relationship between motivational music and endurance performance using the Sports-specific Endurance Plank Test.
Methods: 10 males and 26 females (age 21± 3 years) college-aged students were recruited to complete the study at Bethel University. All participants performed the Sports-specific Endurance Plank which assesses the trunk flexors and lumbar extensors in the same manner observed in sports performance movements. Participants performed the plank test under three different randomly assigned pre-selected conditions: no music (NM), instrumental music (IM), and motivational music (MM). During each trial, the set of seven plank positions was held until failure. Once failure was observed, duration was measured. Subjects were informed of their results after each completed session.
Results: Using the SPSS software, repeated analysis of variance measures was used to detect any differences between the three conditions during the Sports-specific Plank Tests. There was no significance noted between the three groups (p=.727).
Conclusion: Based on the results of the data, there is no direct correlation between motivational music and the endurance performance of college-aged individuals. From these results, it can be concluded that the lyrics of a song does not have a significant effect on performance when compared to other types of music. Further research is needed to determine what factors of music have a significant effect on endurance performance, such as tempo.

Keywords: music$_1$, training$_2$, endurance$_3$, plank$_4$, exercise$_5$, heart rate$_6$

1. INTRODUCTION

Research shows that music has ergogenic effects by enhancing physiological factors such as mood, emotion, and cognition (O'Keeffe, 2021). We can see music being used in various aspects of individuals' lives whether it's to help express their feelings, for its healing benefits, or for encouragement. Recently, it has been shown that individuals who exercise with music regularly indicate a positive influence rate of perceived exertion, an increase in running exhaustion time, and a positive impact on their psychological and physiological well-being (Bereket, 2018).

Listening to music has been shown to increase endorphins and catecholamines levels in the blood. Pain and music are processed by shared neural pathways of the brain (Jernigan, 2021). Music

stimulates the hypothalamus and pituitary gland releasing endorphins, in return giving us a heightened feeling of excitement. Therefore, individuals who listen to music while exercising experience a lower rate of perceived exertion. In endurance-type performance, the main source of energy comes from oxidative/aerobic metabolism (Alghannam, 2021). Catecholamines are released into the body in response to physical or emotional stress (MedlinePlus, 2020). Music was shown to increase physiological variables such as catecholamines and heart rate in a study that looked at fast-tempo pre-exercise music (Ballman, Favre, Phillips, 2021). Catecholamines enhance that rate of aerobic respiration resulting in increased ATP availability for muscles (Barth, Albuszies, Baumgart, 2007). The Sports-Specific Endurance plank test assesses the trunk flexors and lumbar extensors in the same manner observed in sports performance movements in which muscles are being recruited to give core stiffness to maximize these kinetic chains (Tong, Wu, Nie, 2014). The test consists of isometric measures of endurance that were originally developed for rehabilitation (Tong, Wu, Niw, 2014).

Music-related interventions can be used to create more positive exercise experiences (Stork, Karageorghis, Ginis, 2019). Listening to motivational music led to greater post-exercise enjoyment, elevated HR responses, and enhanced peak power output when compared to other audio controls such as podcast or no-audio (Stork, Karageorghis, Ginis, 2019). It is important to note that although participants achieved an elevated HR response and a greater power output during music conditions, participants perceived equal levels of physical exertion across conditions (Stork, Karageorghis, Ginis, 2019). The reason may be that music has also been considered a sensory distraction with the potential to increase adherence to physical activity (Bigliassi, Karageorghis, Bishop, et al., 2018). Additionally, exposure to environmental sensory cues can guide attentional focus toward task-irrelevant cues during exercise which results in a lower perceived exertion (Bigliassi, Karageorghis, Bishop, et al., 2018).

Music competes with bodily cues in afferent neural pathways and thus blocks unpleasant cues replacing them with more positive ones (Sanchez, Moss, Twist, et al., 2013). Additionally, benefits have been explained with references to the dissociation effect where music delays the onset of fatigue and allows individuals to increase work output/duration before internal negative sensations are perceived (Sanchez, Moss, Twist, et al., 2013). With the presence of music, the perception of effort and fatigue diminishes thus allowing participants to produce a greater work output (Sanchez, Moss, Twist, et al., 2013).

Compared to non-lyrical music, the lyrical content of music is known to influence people's behaviors (Sanchez, Moss, Twist, et al., 2013). It is found that the lyrics of the song had a greater capacity to alter mood than music without lyrics (Sanchez, Moss, Twist, et al., 2013). With that in mind, it may be plausible that lyrical music may alter a person's perception of effort and allows participants to experience a positive mood after exercise while listening to music.

Prior studies have looked at the correlation between music and athletic performance regarding tempo. The findings indicate that with faster-tempo music athletic performance was greater. This may be due to the innate tendency for humans to alter the frequency of their heart rate towards that of musical rhythms known as entertainment (Stork, 2019). Based on this concept, it is plausible that participants' HR increased in response to the fast-tempo music played (Stork, Karageorghis, Ginis, 2019). The increase in the heart's pace increases the blood flow to the working muscles providing it with nutrients and oxygen and in return producing more ATP for energy. The studies these investigators found pertaining to tempo provide a limited discussion of lyrics and performance. Another study looked at the preferential musical selection on endurance running performance and found that listening to preferred music had a larger effect on the endurance running performance of women than men (Cole, Maeda, 2015).

With respect to specific motivational lyrical music, there has not been a lot of research on this topic. Therefore, the purpose of this study is to examine the relationships between motivational music

and the endurance performance of college-aged students. It is hypothesized that motivational music will have a positive effect on an individual's performance resulting in an increase in endurance during exercise performance.

2. MATERIALS AND METHODS

2.1 Participants

Twenty-six female participants and ten male participants ranging from 18 to 26 years were enrolled in this study. All participants performed physical activity regularly according to ACSM guidelines. The following participants' information was collected: height (in), weight (lbs), and age. The participant's data are reported in Table 1. All participants gave written informed consent followed by a verbal and written explanation of the study. All procedures for this study were approved by Bethel University's Institutional Review Board for Research with Humans.

Table 1| Characteristics of Participants

	Height (in)	Weight (lbs)	Age
Participant 1	65.5	135.4	22
Participant 2	62.5	111.8	22
Participant 3	58.5	96.6	22
Participant 4	66.1	176.6	22
Participant 5	66.5	153	21
Participant 6	58.25	89.2	22
Participant 7	58.25	100.6	20
Participant 8	61	112.8	19
Participant 9	63	134.8	19
Participant 10	65.5	145.4	18
Participant 11	63.75	143	21
Participant 12	63	112	22
Participant 13	60	160	21
Participant 14	67	160	19
Participant 15	62	110	20
Participant 16	66	215	20
Participant 17	60	118	21
Participant 18	64	170	20
Participant 19	60	148	21
Participant 20	63	99	24
Participant 21	66.5	126	20
Participant 22	68	178 .9	23

Participant 23	61.25	111.8	21
Participant 24	67.25	148.8	19
Participant 25	69	165.6	21
Participant 26	71	189.6	18
Participant 27	61	170	20
Participant 28	62	114	23
Participant 29	63	125	21
Participant 30	69.5	167	20
Participant 31	62	164	23
Participant 32	64	125	23
Participant 33	66	131	21
Participant 34	68	186	20
Participant 35	67	149	22
Participant 36	68	179	22

2.2 Socio-Demographic Variables and Enrolment Process

Participants were enrolled in different colleges located in Saint Paul, Minnesota. The inclusion criteria are: (1) age between 18 to 26 years old; (2) relatively active according to ACSM guidelines (30 min of moderate-intensity activity on at least 3 days per week for the last 3 months); (3) not deemed high risk according to the Exercise Preparticipation Health Screening Questionnaire. To assure the safety of the procedures and the correct interpretation of the data the following exclusion criteria were followed: (1) pregnancy; (2) current lower back injuries or in the process of recovering from lower back injuries. The participants were asked to complete an informed consent and health history form. All participants voluntarily chose to partake in this study.

2.3 Experimental procedures

2.3.1 Pre-experimental phase

Participants were asked to complete three 10-15 minute sessions. Upon arrival at the first appointment, participants were given an overview of the entire study along with information sheets which included photos of proper plank form and the various plank positions held. Participants were then asked to provide written informed consent and complete the Exercise Pre-participation Health Screening Questionnaire. Subsequently, participants were asked to report their level and frequency of physical activity to determine if they were relatively active according to ACSM. Participants were informed about fasting and abstaining from vigorous exercise for at least 1 hr before arriving at any of the three appointments. Flexible clothing was highly encouraged for the participants. The participant's height (in), weight (lbs), and age were then collected. Following technical data collection, participants undertook a familiarization trial of the Sport-Specific Endurance Plank Test. Participants received verbal and physical demonstration instructions regarding the proper basic plank

position along with the 7 sequential plank positions. At the end of the pre-experimental phase, participants were afforded time to ask questions regarding the trials.

2.3.2 Main experimental phase

Each session assessed one of the three randomized conditions: no music (NM), instrumental music (IM), or motivational music (MM). At the beginning of the first trial, the participants were instructed to lie face down on a yoga mat. Four vertical standing poles were placed around the subject at the following locations: right elbow, left elbow, right calf, and left calf. Two cables were placed perpendicularly over the participant connecting the left and right poles. Participants were given a 10 in tolerance range for hip displacement. Participants performed the Sport-specific endurance plank test sequence referenced in section 2.3.2.2. Failure is described as when the participant is unable to keep their head, neck, back, or legs in the neutral spine position in which all 3 curves of the spine — cervical (neck), thoracic (middle), and lumbar (lower) — are present and in good alignment (Pilates Foundation, 2023), or when the hand or legs fall from the held positions of steps 2 to 7 in step 2 in which time will be recorded. After the session is completed, the participants were informed of their results. Participants scheduled a second appointment following the first. Consecutive appointments must have been 3 days apart from the prior one. The set of three appointments was required to be completed within a one-month span. Upon arrival at the second and third appointments, the participants completed the same Sports-specific Endurance plank Test but with one of the two remaining conditions. All sessions were conducted in the Biokinetics lab space. Music and headphones were provided. During all three sessions, only the participant and investigators were allowed to be in the room and all participants were prompted that the investigators would not speak after the timer started to avoid any distractions.

2.3.2.1 Auditory stimuli

As mentioned above, the three musical stimuli were pre-selected. *Believer* by Imagine Dragons was selected as the MM song of choice due to its motivational lyrics. The song always started at the 7-second mark and played on repeat. *Aggressive Hip Hop Motivation Music 2017 Playlist* by Vendetta Beats was selected as the IM of choice due to its motivational instrumental rhythm. The IM was always started at the 27-minute mark and played on repeat. The music was delivered via Beats by Dre at the participant's own preference of sound intensity.

2.3.2.2 Sports-specific plank test

This study aims to measure endurance via the Sports-specific plank test. The test consists of isometric measures of endurance and was originally designed for rehabilitation (Tong, Wu, Nie 2014). The plank maneuvers are thought to be similar to the movements in sports performance in which muscles are being recruited to maximize the upper and lower extremity kinetic chains (Tong, Wu, Nie 2014). The test engages the core muscles referring to the muscles between the knee and sternum with a focus on the abdominal region, low back, and hip making it the ideal and most convenient test to use for this study (Tong, Wu, Nie 2014). The plank test requires the athlete to maintain a prone bridge position with their arms and legs lifted alternatively for eight different positions (Tong, Wu, Nie 2014). The plank positions are held in the following sequences: (1) hold the basic plank position for 60 s; (2) lift the right arm off the ground and hold for 15s; (3) return the right arm to the ground and lift the left arm for 15s; (4) return the left arm to the ground and lift the right leg for 15s; (5) return the right leg to the ground and lift the left leg for 15s; (6) lift both the left leg and right arm from the ground and hold for 15s; (7) return the left leg and right arm to the ground,

and lift both the right leg and left arm off the ground for 15s; (8) repeat the steps from (1) to (7) until the maintenance of the prone bridge fails.

2.3.3 Statistical analysis

Repeated analysis of variance measures was used to detect any differences between the three conditions during the sports-specific plank tests. Endurance was the dependent variable and the following were considered the independent variables: NM, IM, and MM. The alpha test level for statistical significance was set at $p < 0.05$. The SPSS statistical software package (Version 28) was used for all statistical data.

3. RESULTS

There was no significance of endurance performance noted between no music (NM, 80.628286± 48.369403), Instrumental music (IM, 85.784857± 52.791531), and motivational music (MM, 90.794571± 55.519711) as seen in Figure 2 (p=.727).

Table 2| Multiple Comparisons

		Mean Difference			95% Confidence Interval	
(I) Music	(J) Music	(I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
1 (NM)	2	-7.49943	12.66733	0.825	-37.6275	22.6287
	3	-9.652	12.66733	0.727	-39.7801	20.4761
2 (IM)	1	7.49943	12.66733	0.825	-22.6287	37.6275
	3	-2.15257	12.66733	0.984	-32.2807	27.9755
3 (MM)	1	9.652	12.66733	0.727	-20.4761	39.7801
	2	2.15257	12.66733	0.984	-27.9755	32.2807

4. DISCUSSION

The results of this study shows that there is no significance in the three variables studied. What can be seen however is that there was a trend of an increase in endurance performance with the MM condition and NM condition but no observable effects on the other conditions. These findings of our study are similar to prior research that focused on athletic performance while listening to music. As other studies showed significant results of increased performance when listening to music compared to no music, our participants showed an improvement in endurance performance under MM condition compared to NM. This demonstrates that music does in fact allow the body to produce more ATP for energy. The pace of the music influences the rate of the heart. When the heart rate increases it allows for more oxygen and nutrients sent to the working muscles. Oxygen provided to the working muscles allows the muscle to convert glucose into ATP giving the individual more energy to perform the task (Ballmann, Favre, Phillips, et al., 2021). Although this may be the case, since our results indicate that there is no significance in endurance performance between the three variables we cannot deem the lyrics of a song to be a positive mediator.

Some participants contradicted the hypothesis that stated individuals would perform better with the MM as supposed to NM, and IM. With prior research, one would think that MM would increase endurance performance. An explanation for this result could be the participant's music preference. The MM that was selected could not have been considered motivational to all participants depending on music preferences. Research found that music selection and preference may largely mediate the ergogenic potential of music, suggests a principal importance in music choice when identifying the possible benefits of music (Ballmann, Favre, Phillips, et al., 2021). Another possible explanation for this result could have been the materials used. Some participants were taller than the length of the yoga mat causing the participant to slip while in the plank positions.

The study presents some limitations. First, the result only accounts for 18-26-year-olds (N= 36) rather than the population as a whole. The data may need to be compared to the inactive population, older individuals, or younger individuals to make a general conclusion. Secondly, the chosen music may not have been considered motivational for some of the participants based on musical preferences. Some participants reported that *Believer by Imagine Dragons* was distracting, rather than helpful. This may have affected the participant's performance in the sessions. Furthermore, this study did not consider other characteristics of music such as tempo, rhythm, and melody. All of the characteristics mentioned could have a profound effect on endurance performance.

In the special circumstances of follow-up research, there could be a few changes made to the study protocol to assure consistency and accuracy. During the sessions, height and equipment used played a role in how long the participants could hold the plank. The yoga mat that was provided was not compatible with every participant. For the participants that were too tall for the mat, their feet would slide on the concrete floor causing them to have to work harder to keep the plank position. If there is a chance for follow-up research, the size and length of the mat should be taken into consideration. Additionally, the test sessions allowed the participants the choice of either keeping their shoes on or off. Reflecting on this decision, it would have been best to keep it consistent that either everyone wears shoes or no one wears shoes. The reason for this is that the grip of the shoes could vary from brand to brand. Those with less grip on their shoes could be working harder to keep their plank position compared to those who have great friction on their shoes. This is another area of the study that could be improved. Another factor that could be taken into consideration is the volume at which each song was played. The study allowed participants to choose the volume of the songs, which in turn, may have an effect on performance.

The study found no significance between motivational music and the endurance performance of college-aged students. The motivational lyrics of a song do not increase endurance performance. This implies that the type of musical lyrics does not affect endurance performance. Overall listening to music is beneficial for decreasing RPE and increasing performance output. Music is seen being used in various aspects of individuals' lives whether it's to help express their feelings, for its healing benefits, or for encouragement. Recently, it has been shown that individuals who exercise with music regularly indicate a positive influence rate of perceived exertion, an increase in running exhaustion time, and a positive impact on their psychological and physiological well-being (Bereket, 2018). Athletes can use music as a beneficial factor to increase their performance. Additionally, sports teams may want to consider the use of music within practice and training sessions to increase psychological and physiological factors.

5. CONCLUSION

Based on the results of the data, there is no direct correlation between motivational music and the endurance performance of college-aged individuals. Prior studies demonstrate the beneficial ergogenic effects of listening to music during exercise performance by increasing exercise enjoyment, diminishing RPE, and increasing heart rate (HR). Music causes entertainment to occur in

which humans alter their HR frequency to match a musical rhythm. Music was shown to increase physiological variables such as catecholamines and heart rate in a study that looked at fast-tempo pre-exercise music. It is also considered a sensory distraction with the potential to increase adherence to physical activity. However, from the results of the study, it may be concluded that the lyrics of a song do not have a significant effect on endurance performance when compared to other types of music.

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