The Effects of Music

on the

Athletic Performance of Athletes

by

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Abstract

The purpose of this study was to determine if athletes would perform better in athletic performances when listening to music. The participants were measured during high intensity athletic workouts, across music tempo conditions. This design of this study was a with-in subjects design. Athletes showed no difference in athletic performance when listening to music and not listening to music. Continued research is recommended to explore the effects that music tempo has on athletic performance.

CHAPTER I

INTRODUCTION

Overview

With the growth of ever more sports competitions, athletes are looking for an edge in competition and in training because it takes more than just physical training to compete at peak performance. Athletes face a set of obstacles that can inhibit performance through an increase in stress and anxiety (Birrer & Morgan, 2010). There are many mental strategies that can help an athlete stay motivated and focused to push beyond typical performance levels. Athletes who perform at their peak have their anxiety and arousal controlled in an ideal zone for optimal performance (Tenenbaum, Edmonds, & Eccles, 2008). This allows the focus to be on the task, not distractions that might occur. To help control the factors that might affect an athletic performance, psychological skills training can be utilized (Peynircioglu, Thompson, & Tanielian, 2000).

Two of the commonly used techniques are imagery and self-talk. Imagery involves athletes going through step-by-step motions, in their mind, to help increase the likelihood of performing those tasks well (Cumming, Olphin, & Law, 2007). This is a common technique used by teams before a big game, or a basketball player before taking a free throw shot. Positive self-talk is a technique that can help to distract from negative thoughts that might affect a performance (Peynircioglu, Thompson, & Law, 2000). However, these techniques can be too cognitively demanding to do during an intense workout or athletic performance.

Another strategy is listening to music. Music is a training tool that is used everyday by all different types of people, from average Americans, attempting to lose weight with a brisk walk, to Olympic athletes training for a big event. Listening to music has been found to help a person stay focused on a physically demanding task by distracting the mind from the physical pain that could occur (Tenenbaum, Lidor, Lavyan, Morrow, Tonnel, & Gershgoren, 2004). It was banned from the New York City Marathon because it gave to much of an edge. Once an individual's body reaches a pain threshold, music cannot help the outcome of the performance. However, music can push back that pain threshold to distract from fatigue. Also, during high intense workouts, listening to music that correlates with the intensity of that workout can improve the outcome of the performance (Simpson & Karageorghis, 2006).

Statement of the Problem

To perform better in an athletic competition, different training strategies are utilized, depending on the type of competition. The purpose of this study was to explore one of those strategies, listening to music, and the effects on different athletic performances.

Hypothesis

The null hypothesis is that athletes, who listen to high tempo music, in a high intensity workout, will have no difference in performance than when listening to slow tempo music or no music.

Definition of Terms

The independent variable is the varying tempo, which is measured by beats per minute.

Fast tempo music- Music over 160 beats per minute (BPM) that was picked by the subjects to listen to with either an Iphone or Ipod and headphones, during the fitness tests.

Slow tempo music- Music under 80 BPM that was also picked by the subjects to listen to, during the fitness tests.

The dependent variable is the increase or decrease in performance. Performance will be defined as an individual's heart rate, rate of perceived exertion, minutes in the timed run, minutes in the 300 yard shuttle run, number of pushups, and number of sit-ups. The individual components of the dependent variables are described below.

Heart rate- The number of times that the heart beats to pump blood throughout the body, per minute. The participants will count the beats for 30 seconds, then that number will be multiplied by 2.

Rate of perceived exertion (RPE)- How the participants perceived the amount of exertion they put into the exercise. They circled a number on a scale with 6 representing hardly any exertion and 20 representing the maximum exertion during the exercise.

Mile run- Running a mile (1600 meters) as fast as possible.

300 yard shuttle run- Sprinting 50 yards from the baseline up and back 3 times to equal 300 yards. This is also run as fast as possible.

Push-up- An exercise that the subject does with a partner. The subject starts with only his/her feet and hands on the ground, with the body parallel to the ground. The partner then puts his/her fist directly below the subject's chin. The subject has to lower his/her body so his/her chin reaches his/her partner's fist, then push back up towards the starting position.

Sit-up- Starting with the back flat on the ground and feet on the ground with knees in a bent position towards the ceiling. The subjects have to put their hands behind their head, while lifting only the back and head off the ground, so that the chest meets the knees, then back down to the starting position.

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

Athletes are always looking for the best and most effective way to improve their athletic performance. Better athletic performance is more than just the physical result of a faster time or more points scored; it is also the psychological skills training that leads to enhanced performance (Birrer & Morgan, 2010). Research has found that athletes face a set of obstacles that prevent enhanced performance and they need to learn skills to focus and relax to overcome those obstacles. Section one provides a definition of athletic performance. Section two explores factors that affect performance. Section three discusses strategies that can help improve athletic performance, and in section five, a summary is provided.

Good Athletic Performance

When athletes reach their optimal zone for performance, they can perform at their peak. Optimal performance state is defined as the best internal conditions (cognitions and emotions) resulting in complete involvement in a task and effective use of coping strategies (Tenenbaum, et al., 2008). The Individual Zone of Optimal Functioning (IZOF), originally used anxiety as an indicator of performance, but now includes a range of emotional states. The IZOF links cognition and emotions to task performance; it also indicates that there is unlikely to be a single set of optimal levels of emotion resulting in better or worse performance for different athletes in the same sport realm. The IZOF grew into individual affect-related performance zones (IAPZ), which involves a reciprocal relationship between an individual's perceived intensity of affective state and

quality of the performance. According to the IAPZ, optimal performance occurs when perceived arousal is moderate, which is 5.2-6.5, on a scale of 1-9.

Just like arousal, there is no one level of anxiety that is good for everyone, and in every type of athletic performance because what is beneficial for one condition might be debilitating for another (Birrer & Morgan, 2010). Being aware of anxiety may make it possible for an individual to regulate his perceived anxiety (Hassmén, Raglin, & Lundqvist, 2004). If an individual's interpretation of his anxiety before an athletic event is facilitating, then that enables that athlete to reinterpret a negative sensation as a performance enhancer by having perceived control over the situation.

Highly motivated athletes can focus attention for the amount of effort needed to train harder (Johnson, Tenenbaum & Edmonds, 2006). Intrinsic motivation is the motivation to do an activity for one's own pleasure and satisfaction. It is associated with self-determined motivation, which has been shown to foster better athletic performance through concentration and persistence in an activity (Gillet, Berjot, & Gobance, 2009). Research has shown that there are three possible mediating factors between self-determined intrinsic motivation and athletic performance; the motivation to have freely chosen an activity, competence in that activity, and the need to be accepted by a group.

Research shows a positive correlation with self-confidence and athletic performance (Taylor, 1987). When an athlete feels confident rather than anxious before a competition, it will help achieve a confident mental state (Tenenbaum et al., 2008). Self-efficacy is the belief that as an athlete, one is competent and confident, which can lead to better performance. Self-confidence, levels of anxiety and motivation are all related and indicators of athletic performance.

Using the ability to focus on performance-relevant processes can reduce the distraction of performance obstacles and increase performance output (Birrer & Morgan, 2010). Research on endurance sport athletes found that associative strategies, which focus on bodily sensations, such as breathing, and performance-specific cues, such as stroke rate in rowing, can possibly lead to a faster performance. Dissociative strategies, having athletes focus on something outside of the actual performance, such as the surrounding landscape, can distract from the internal pain, which leads to lower perceived exertion and better endurance.

Attainment of flow is the optimal psychological state, where there is a perfect match between the challenge of a situation and the skills that an athlete has (Pates, Karegeorghis, Fryer, & Maynard, 2003). When athletes engage in flow, they are completely absorbed in the skills leading to optimal physical and mental functioning. During this state, the athletes are intrinsically motivated and performing a skill because they have the internal desire.

For high intensity sports, good recovery techniques are vital for training to be most beneficial. Proper recovery time will allow athletes to perform at their peak (Birrer & Morgan, 2010). Relaxation techniques are known to be helpful to hasten recovery time after training or competition. Along with good recovery techniques, developed habituation of pain can increase pain tolerance and dissociate from fatigue. This dissociation from fatigue can help an athlete train longer and harder as the pain tolerance increases.

Factors Affecting Athletic Performance

Perceived stress can have an impact on performance (Tenenbaum et al., 2008). A

lack of sleep can increase psychological stress from fatigue, which decreases performance (Halson, 2008). When athletes are in a stressful situation, they experience high pressure and anxiety, and cannot pay attention to the task. When they lose focus of self-regulatory mechanisms to reduce pressure, this can lead to the athletic term of "chocking". Increased stress appraisal can lead a performance to become ego relevant through the presence of an audience. An athletic performance that is complex and not mastered can hinder a performance by diverting attention to other sources. For athletes who have mastered a complex skill, performing in front of an audience can facilitate the performance because those athletes have learned how to remain in a preferable emotions-attentional state. However, when an athlete is not in this preferable state, chocking can occur. Along with stress, too high or low anxiety can lead to poorer performance. Athletes who view anxiety as out of their control allow the anxiety to be debilitative. Fear can also affect motivation to train and compete, self-confidence, pain levels, attention, and levels of anxiety. This can lead to increased muscle tension and loss of coordination (Birrer & Morgan, 2010).

In exhaustive activities, there are high psychological and physical obstacles to overcome (Birrer & Morgan, 2010). Pain interpreted as a threat to an individual's somatic integrity, and associated with increased arousal and anxiety, make it uncomfortable for the athlete. The body tightens, making physical effort less effective and more painful. Lack of sleep can increase pain perception and decrease emotional well-being (Halson, 2008). Once the pain threshold is reached, cognitive demands cannot be met (Waterhouse, Hudson, & Edwards, 2010).

To allow for optimal athletic performance, the body needs recovery time in

between workouts, and factors such as sleep disturbances and overtraining can shorten the required recovery time (Halson, 2008). Sleep disturbances can also lead to impairments in the immune and endocrine systems, and slow down recovery from injury.

Another obstacle in athletic performance is the level of fitness required for an activity or the amount of exposure to the activity. If an individual is participating in a sporting event that he or she is not used to (often a high intensity exercise) then he or she can suffer from DOMS (delayed onset muscle soreness) (Cheung, Hume, & Maxwell, 2003). DOMS can lead to a reduction in joint range of motion with severe muscle soreness or even damage to muscle fibers.

Research on genetics and distance running revealed that there was no known gene that influenced athletic ability, but an athletic performance had more to do with the environment (Scott & Pitsiladis, 2007). However, a 4-factor model posits an interaction of supportive environment, high effort, facilitative coping skills, and inherent talent to attain elite athletic performance (Johnson et al., 2006).

How Athletes Become Focused And Relaxed

There are skills that can help athletes reach his or her Individual Zone of Optimal Functioning (IZOF) (Tenenbaum et al., 2008). The skills include using emotional, psychological, and physical skills training to reach the optimal zone for an individual athlete.

Emotionally/Psychologically

Psychological skills training (PST) helps to attain optimal effective states by using psychological and emotional self-regulation strategies (Peynircioglu et al., 2000). Two of the widely used PST techniques are imagery and self-talk. An example of the use of

imagery is in free throw shooting. When athletes were primed for the motions of a free-throw shot, by going through exact motions in their mind, they increased the number of shots made. Mental imagery is good for high cognitive demanding tasks that require coordination of numerous motor skills, such as free-throw shooting. For tasks that are not cognitively demanding and require only a single gross motor task, increased arousal, instead of imagery, can help strengthen, focus, and concentrate an athlete. There are two different types of imagery techniques that help athletes regulate anxiety. Motivational general-mastery (MG-M) imagery is related to perceptions of control, self-confidence, and mental toughness (Cumming et al., 2007). Using MG-M can help athletes view anxiety symptoms as being under their control and help make the anxiety experienced before a competition facilitative. Motivational general-arousal (MG-A) is related to regulation of arousal and stress. MG-A can affect and control anxiety levels by imagining performing in a relaxed manner for reduced arousal or in a psyching-up manner for increased arousal.

The other psychological skills training (PST) technique that is commonly used is self-talk (Peynirioglu et al., 2000). This is when individuals talk to themselves internally or externally (Tenenbaum et al., 2008). Self-talk affects emotional states, and when athletes learn to control their self-talk, they can control their emotional states. Athletes who use positive-motivation self-talk, such as "I can do it", can increase their athletic performance by preventing negative thoughts from interfering with performance.

Another technique used to help athletes focus and relax before or during an athletic performance is listening to music. Music helps with attainment of flow; this is associated with intrinsic motivation and a positive perception of one's-self and controlled

emotions and cognitions (Waterhouse et al., 2010). Listening to music that is in sync with a short high intensity workout can increase the performance (Simpson & Karegeorghis, 2006). However, for longer workouts, once the pain threshold is reached, music cannot decrease the rate of perceived exertion and does not have an influence on output (Tenenbaum et al., 2004). Music can aid in can pushing the pain threshold by distracting from the internal fatigue, during low or moderate rates of workout intensity. During low or moderate workouts, music can lead to a lower rate of perceived exertion. Listening to motivational music can enhance task affect, moderating how an athlete feels during a workout, which could lower the negative impact effect of a high intensity workout (Yamamoto, Ohkuwa, Itoh, Kitoh, & Terasawa, 2003). However, music does not affect how an athlete feels after a workout.

Physically

Using the motivational general-arousal imagery technique can lead to an increase in heart-rate by psyching-up the athlete (Cumming et al., 2007). The change in heart rate represents the change in arousal states. Music has not found the same effect on heart rate. There is no significant difference in heart rate between listening to music and not listening to music (Yamamoto et al., 2003). When listening to faster tempo versus slower tempo music there was a difference in heart rate. Slow rhythmic music depresses the sympathetic activation, which lowers stress, while fast rhythm stimulates adrenaline.

Implications in sports and exercise settings

Music has been shown to generate positive affective states, which leads to the likelihood of staying with an exercise program when listening to music (Boutcher & Trenske, 1990). Selecting the most effective music for a workout involves picking music

with intensity that synchronizes with the intensity of the workout, and music that has personal or group associations (Bishop, Karageorghis, & Loizou, 2007). Asynchronous (background) music and MG-M imagery can help attain flow and perceived performance before an athletic event (Pain, Harwood, & Anderson, 2011). Music and psychological skills training can help in the rehabilitation of athletes by masking pain and blocking fatigue so athletes can push themselves further in the rehabilitation process (Saalfield, 2008). Before athletic performances, athletes are trying to attain emotional regulation to psych-up, relax or dissociate. Through experience and ability of the athlete to have control over his or her anxiety and arousal, optimal performance can be achieved and maintained. Once the focus to maintain the optimal zone is lost, the athlete is less likely to achieve improvement or success.

Summary

In order to increase athletic performance, an athlete needs to reach his or her optimal performance zone (Birrer & Morgan, 2010). In this zone, athletes have attainment of flow and control over arousal and anxiety. This optimal performance zone is not easy to reach, as it takes hard work over a long period of time to achieve and overcome many of the obstacles. There are several techniques that can be used to train athletes to perform at their peak, allowing focus and relaxation.

CHAPTER III

METHODS

Design

The purpose of this study was to examine the effects of music on athletic performance. The study used a quasi-experimental design to analyze the topic. Since the participants were at different fitness levels, a with-in subject design was used to test participants in three different conditions over four different tests. The experimental conditions were fast (about 170 beat per minute or higher) and slow (100 beats per minute or lower) music tempos, while the control condition was no music. The tests were different fitness tests requiring different strength and conditioning skills. The strength tests were number of sit-ups in one minute and number of push-ups in one minute. The conditioning tests were to run a mile as fast as possible, and to do a 300-yard shuttle run. The participants' times in each test, heart rate, and rate of perceived exertion (RPE) were recorded after every test. The design of the study was three groups with four measures.

Participants

Participants consisted of a convenience sample of members of a college varsity field hockey team, in the spring of 2012. There were seven female athletes between the ages of 18 and 21. These participants were on a team coached by the researcher. However, due to an ankle injury, one of the participants could only do the strength testing and one of the conditioning tests. Also, another participant joined the team after testing had begun, so she only participated in certain tests as well. The participants had prior experience with three of the four performance assessments before beginning the study.

Instrument

The four tests were a one minute push up test, one minute sit up test, timed 300 yard shuttle run, and timed mile. All four of the tests asked for the participants RPE and heart rate; however, only the two conditioning tests analyzed time as well. The other two tests were strength tests, and collected how many of a certain exercise the participant could complete in one minute. The heart rate was taken by the participants immediately following each test, by counting the number of pulses on the neck over 30 seconds and doubling that number. The RPE involved circling a number on a scale from 6-20 with 6 representing hardly any exertion during the exercise, and 20 representing the maximum exertion during the exercise.

Procedure

The participants were tested over a five-week period. The tests were physically demanding and the participants would have been too exhausted to get accurate results if there was too short of a break in between tests. However, due to the participants' schedules, the final mile run was not completed till the 5^{th} week. To record data, the participants used the sheet that had the rate of perceived exertion to record their heart rate and time or number from the test.

For the push-up and sit-up tests, the participants began when told to, "start", and counted how many they completed before a minute passed. As soon as the push-up or sit-up tests were completed, the participants took their heart rate. The heart rate and number of push-ups were recorded on the sheet with the RPE. The participants then circled the number correlating to their rates of perceived exertion.

For the 300 yard shuttle run, the participants began when told to "start". After the participants finished, their heart rates were taken, and the time, heart rate and RPE were recorded.

The participants began running the mile when told to, "start". As soon as the participants finished the mile, their heart rates were taken. Then their heart rate, time, and RPE were recorded.

Regarding the music that was used, there were no common songs that all of the participants had, as they were responsible for picking out fast and slow tempo songs during the tests. The participants listened to their Iphones or Ipods during the tests.

The testing of the participants had to be scheduled around their already limited spring schedule. The dates for the study were:

Week 1: (4/19)- push-up and sit-up test in the early morning (fast music). Mile run in the late afternoon (fast music).

Week 2: (4/24)-push-up and sit-up test in early morning (slow music).

Week 2: (4/26)- push-up and sit up test in early morning (no music). Mile run in early afternoon (slow music). 300 yard shuttle run in late afternoon tested three times (fast music, then slow music, then no music)

Week 5: (5/20)- Mile run (no music).

Before beginning any of the testing, the participants were told that they would be participants in a study to test music and athletic performance. The participants were informed that they would be asked to perform at their peak performance every time they were tested. The participants were shown the rate of perceived exertion and how to count their heart rate, and then they had a chance to ask questions.

The data was collected from all the tests and analyzed, comparing the experimental conditions to the control condition.

CHAPTER IV

RESULTS

In this section, the results of the music and athletic performance will be examined. This will include an analysis of the data, the tests that were used, and table to explain the results.

Analysis

For the analysis of the data, the different music tempos were measured for each performance measure. Multiple dependent t-tests were used to compare the different music tempos.

Table 1. Means and Standard Deviations of the Performance Measures by Music Condition.

Performance Measure	No Music	Slow Music	Fast Music
Push Ups	35.14 (10.49)	32.86 (9.94)	28.71 (11.25)
Sit Ups	25.71 (2.92)	30.86 (8.76)	29.14 (6.33)
Shuttle Run (in seconds)	76.33 (7.96)	78.33 (10.69)	76.50 (7.66)
Mile (in seconds)	434.33 (51.84)	431.50 (57.01)	440.17 (59.46)

Based on study design, a repeated measures ANOVA did not yield significant results. Therefore, multiple dependent t-test were used to examine differences between pairs of conditions. Of the dependent t-tests, results showed a significant difference in push ups when participants listened to fast music as compared to slower music, $t(6) = -3.190$, $p < .05$. Additionally, results showed a significant difference in push ups when participants listened to fast music as compared to no music, $t(6), = -2.56$, $p < .05$. Participants performed significantly fewer push ups when listening to fast music as

compared to when they listed to slow or no music. Therefore, the null hypothesis was accepted for the shuttle run test, timed mile, and sit up tests. No other significant differences between performance measures were found. However, the null hypothesis was rejected when athletes performed push-ups. In that instance, there was a significant difference in performance across music conditions. These results and their implications will be discussed in Chapter V.

CHAPTER V

DISCUSSION

The results supported the null hypothesis in all performance measures, except in one. The null hypothesis stated that there would be no performance differences in athletes listening to high tempo music in a high intensity workout than when listening to slow tempo or no music. The null hypothesis was rejected for the push-ups performance measure. The results found that listening to high tempo music, while performing push-ups, resulted in performing significantly fewer push-ups than when listening to slow music or no music. The shuttle run, timed mile, and sit-ups tests supported the null hypothesis with no difference between the three music conditions.

Comparisons to Previous Research

As a college coach of a high intensity sport, the researcher was intrigued by previous research that found better performance in athletes who listened to music that was in sync with a high intensity workout (Simpson & Keregeorghis, 2006). Based on these findings, the researcher believed that if athletes listened to high tempo music during a high intensity workout, the athletes would yield better results, compared to listening to slower tempo music or no music during the same workout.

According to Tenenbaum et al. (2008), an optimal zone of performance exists for athletes to overcome anxiety and stress for an athletic performance. However, once a pain threshold is reached there is very little that can be done to decrease the rate of perceived exertion and improve on the athletic performance (Tenenbaum et al., 2004). Music can help to push the pain threshold, allowing the athlete to stay in the optimal performance zone longer.

The results were not in line with previous research. Similar to the Simpson and Keregeorghis (2006) procedures, the participants listened to high tempo music, while performing high intensity workouts. The researcher's results did not find that the participants performed better. The results of the study found that there was either no difference in performance between the fast music tempo and the other conditions (slow tempo or no music) or that the fast music tempo performed worse in one performance measure.

Threats to Validity

There are some threats to validity in this study. The first is the number of subjects in the study. There were only seven subjects in the study, and all seven only completed two of the performance measures. The small sample size had an effect on the ability to find differences, and the design of having all subjects to all treatments made an ANOVA not possible. The sampling technique that was used was a convenience sample of athletes, therefore, it was hard to generalize the results without a random sampling. An older group of participants could have yielded different results. Another threat to validity was the practice effects over the period of testing. By the third testing condition, the participants were more familiar with the performance measure and testing conditions. Also, the testing period was over a couple weeks, where the participants were performing other physically demanding activities to increase strength and conditioning. Therefore, it was harder to discern whether it was listening to music or performing other physically demanding tasks that had a significant effect on the results.

Recommendations for Future Research

Continued research is recommended to explore the effects that music tempo has on athletic performances. First a suggestion would be to use a different sampling technique. It would be recommended to use a randomized sample, with more participants, from the college, not just one athletic team. Also, adjust the design of the study and have three separate groups of study participants for each treatment and controlling for differences in performance at the onset. The participants could not perform every condition of every test in a couple days due to the exhaustion that would occur. Therefore, there were some practice effects that occurred due to the amount of time between each condition of each performance measurement. Having three separate groups of participants for each treatment would eliminate the practice effects. Another recommendation for the future would be to control extraneous factors that might inhibit the performance in each test. The participants were performing other physically demanding activities during the testing period so the participants may have experienced muscle fatigue before one test and relaxation before another. A final recommendation would be to standardize the song choice for the fast and slow music tempo conditions. Although the participants listened to music with the appropriate beats per minute for the appropriate condition, the participants listened to different songs. A song could have a particular meaning for one participant, while another song could have had no connection to another participant.

Conclusion

In conclusion, this study retained the null hypothesis. Fast music did not lead to better results on high intensity performance measures. The only significant result was in

the push-ups measure, and the fast tempo music condition performed significantly fewer push-ups than the slow tempo music or no music conditions.

There were some threats to validity that could have hindered the results of the study. There were only seven participants in the study and the participants performed every test with each condition. Due to the high intensity of the performance measure, the participants could not complete the study in a shorter amount of time. Therefore, the participants were able to perform better over time due to factors other than music tempo. It is recommended that future research use more participants with three groups of study participants for each treatment and control for factors such as current physical fitness level.

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