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Non-Athlete High School Students' Music Usage During Exercise

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ABSTRACT

With the invention of technology devices such as wireless headphones and portable Bluetooth speakers, teenagers have gradually become heavily reliant on music during exercising/practicing. To find the underlying reason for this habit, an anonymous survey was sent out to 50 high school boarding students in America on 9th December 2022 regarding the purpose of listening to music during exercising/practicing, and their music preferences. Music supports both mental and physical aspects during athletic training. A slight correlation was found between music preferences specifically for the purpose of athletic training, and a slight correlation was found between preferences for genres of music and preference for each aspect of music.

Introduction

Exercising is important for both our physical and mental health (WHO, 2021; Penedo & Dahn, 2005; Fox, 1999). Music, which seems to be completely unrelated to physical work, actually connects deeply with exercising and athletic practices (Karageorghis & Terry, 1997, Karageorghis & Priest, 2012). Everyone at the gym has their earbuds stuck in their ears, which have grown even more prevalent after the invention of the wireless headphone; some run on treadmills with them, some lift heavy weights with them, some dribble across the courts with them, and some swing their rackets with them.

When people pick their favorite songs to accompany their exercises, they probably choose (perhaps unconsciously) based on the four aspects of music: melody, harmony, rhythm/tempo, and dynamics (Karageorghis, C.I., 2020; Levitan, D.J., 2006; Martineau, J., 2021). The four aspects can be understood as tune, mood, speed, and volume respectively according to C.I. Karageorghis. Different genres of music can be differentiated by the emphasis they put on each aspect, thus contributing to different feelings one might experience during their exercises/practices (Karageorghis, C.I., 2020; Levitan, D.J., 2006).

According to Karageorghis and Terry (1997), the three major connections between music and athletics are arousal, synchronization, and dissociation. Arousal is when one is aroused by the music, allowing further motivation and energy output. Synchronization is about coordinating the body with the beat of the music. Dissociation is about distracting one from fatigue during exercise. The application of music in exercising can be specifically divided based on the stages of exercising: Pre-task, In-task, and Post-task. Before exercising, music helps to regulate one's mood (Loizou & Karageorghis, 2015; Smirmaul, 2017). During exercises, music can interact with the exerciser synchronously and asynchronously. Synchronous interactions sync the movement of the athlete with the rhythm/tempo of the music (Moens et al., 2014). On the contrary, Asynchronous interactions usually use pre-chosen music based on the preference of the exerciser, therefore the tempo of the music does not sync with the movement of the exerciser (Karageorghis, C.I., 2020; Anshel & Marisi, 1978; Karageorghis & Terry,1997). After exercising, music can help one to relax.

There is much previous research surrounding topics of athletic training with music and music usage in professional athletes, and the psychophysical impacts of music surrounding athletics. However, there are no

studies specifically focused on music usage in high school students, who are not professional athletes, and how their music choices impacted their athletic performance. This paper analyzes the music usage phenomenon in high school students through an original online survey that was sent out to 50 students between the ages of 14 to 20 in private boarding high schools in the United States, allowing us to see a correlation between the usage of music before, during, and after exercising/practicing for both mental and physical reasons.

Overall, a weak correlation is observed between the preference for music genre and the purpose of listening to music at different stages of exercising. It seemed that for most private high school students, music was not chosen for the purpose of improving athletic abilities; it was chosen more based on each person's preferences.

Literature Review

Connection Between Music and Athletic Training

Exercising is a physically and mentally demanding process that many view as boring and unenjoyable, with the absence of companionship, social support, and, of course, physical discomfort accompanying every training session (Booth, Roberts, Thyfault, Ruegsegger & Toedebusch, 2017). In the 1970s, Jane Fonda investigated this issue. She proposed the idea of connecting music, a more enjoyable matter, to exercising. Fonda coordinated music with different exercises and released 24 tapes over the next two decades. Fonda's invention set the foundation for many modern music exercise videos such as Aqua (Karageorghis, C.I., 2020; Woitas, M., 2018). As the music exercise industry continues to develop, inventions such as Sony's Walkman and Apple's AirPods surfaced, allowing the transition from Fonda's group-based style to an individual style (Karageorghis, C.I., 2020). People can enjoy running, fast walking, and skiing as the music plays in their ears. Studies in this field have backed up the notion that music can enhance athletic performance (Boutcher & Trenske, 1990; Elliott et al., 2005; Karageorghis & Terry, 1997; Karageorghis et al., 2006; Mertesdorf, 1994).

Components of Music

All music includes four major components: melody, harmony, rhythm/speed, and dynamics. Melody is the order of the notes in a music piece that defines the tune of the piece (Karageorghis, C.I., 2020). It is the part you sing along with and the notes that you remember a piece by (Levitan, D.J., 2006). Harmony is the combination of tones in music that shapes the mood and emotions of the music, which set up the succeeding notes that a listener might expect to hear (Levitan, D.J., 2006; Karageorghis, C.I., 2020). The rhythm and tempo are slightly different in the sense that rhythm refers to the duration of a series of notes and their grouping (Levitan, D.J., 2006), while tempo entails the speed of a piece of music, which often is the element that prompts immediate physical reactions. For this study, rhythm, and tempo are grouped together for discussion. Karageorghis et al. (2008) studied the preference for the different tempos of music in people walking on treadmills. The results show that there was a preference for fast-tempo music as it leads to physiological arousal (Karageorghis, C.I. et al. 2008), specifically, an increase in power output and heart rate (Schwartzmiller, 2003). The dynamics of a piece of music is the volume of the piece that changes based on the energy emitted by the musician. Music productions and inventions are in essence innovations of different ways to combine and arrange these four components (Karageorghis, C.I., 2020).

Different Genres of Music

Different genres of music can be characterized by their unique qualities. For example, classical music is reflective and complex, rock is intense and rebellious, pop is upbeat and conventional, and rap is energetic and rhythmic (Rentfrow & Gosling, 2003). Rap is considered to be high arousal due to its offbeat style and dominant vocal part (Schäfer & Sedlmeier, 2009; Kostek & Plewa, 2016; Levitin, 2008). In a study done by Kostek & Plewa (2016), moods correlating to pop are mainly "energetic", and at times calm or relaxing; rap is considered to be energetic and aggressive, and R&B ranges from energetic to relaxing (Kostek & Plewa, 2016); metal is usually aggressive.

Listening to Music VS Not Listening to Music

Music has four types of effects on exercise and physical activities. Psychological, psychophysical, psychophysiological, and ergogenic. The psychological effect of music refers to the effect music has on one's mood. Studies of the psychological effects of music often focused on the long-term behavior of people, and it was discovered that music can help overcome barriers to exercise (Hallett & Lamont, 2019). The psychophysical effect of music refers to the effect music has on one's perception of physical presence. The psychophysical effects of music are measured using a Rating of Perceived Exertion (RPE) (Terry & Karageorghis, 2011). Research shows that music can decrease RPE during exercise (Boutcher & Trenske, 1990; Gordon, 2007; Karageorghis & Terry, 1997). The psychophysiological effect of music refers to the effect music has on one's physiological functioning, which can be determined using different measures such as heart rate or oxygen uptake. Lastly, the ergogenic effect of music refers to the effect music has on the outputs and results of one's physical activities (Terry & Karageorghis, 2011).

How Music Can Be Used in Exercise

Music has three primary applications in exercises: pre-task, in-task, and post-task (Terry & Karageorghis, 2011). Pre-task usage of music focuses on elevating/regulating an exerciser's mood before exercises. Pre-task usage of music is believed to trigger higher levels of activation during exercises by using music's priming effect to levitate the psychophysiological demands of exercising (Loizou & Karageorghis, 2015; Smirmaul, 2017). In-task usage of music is applied either synchronously, where exercisers sync their movement to the rhythm/tempo of the music, or asynchronously, where exercises do not sync their movement to the music. While synchronous application focuses on using rhythm to help exercisers with their movements, the asynchronous application uses the dissociative (distracting) effect of music to make the exercise process more enjoyable. Synchronous application has a further division of active synchronization and passive synchronization. Active synchronization requires exercisers to consciously match their movement to the rhythm of the music, while passive synchronization uses technology that matches the music to the exerciser's movements (Moens et al., 2014). Lastly, post-task usage of music is applied either as respite music or as recuperative music. Respite music is applied to positively influence the hemodynamic and cardiovascular recovery processes between high-intensity intervals. Recuperative music, on the other hand, is applied to expedite both active and static post-exercise recovery processes. Characterized by descending slow tempos, recuperative music is associated with the recovering heart rates of most adults (Karageorghis et al., 2018).

Method

This project included a literature section and an original research section. Research referenced in this paper was found in publications, databases, and websites, such as Google Scholar and PubMed. When searching for sources, no initial date was set, but an end date was set to June 30th, 2022 to ensure that the papers have been validated enough. Keywords that were entered to search for literature included: music and exercise, musical impact on athletes, music and athletic performance, and neurological effects of music. For the research section, an anonymous survey addressing athletes in private boarding high schools in the United States. The survey was distributed via Wechat to students between the ages of 14 to 20 at private boarding high schools in America with the link to the survey, information about the study, and an offer to participate. The survey was sent out on the 9th Dec 2022 to 50 individuals; out of the 50, 31 responded within the next two days. A reminder was sent out to the fifty individuals on 19th Dec 2022; an additional 7 people responded before the closing of the survey on 20th Dec 2022. The participants were notified that their responses would be anonymous and provided informed consent at the end of the survey for their submissions to be used in this study.

Participants

To begin research 50 surveys were sent out, 30 were sent to males and 20 to females. A total of 38 responses were received, 37 of the respondents listen to music at some point before, during, or after exercising/practicing. Table 1 shows the specific breakdown of gender and age of respondents.

Table 1. Representation of gender and age in the target population addressed with the online survey and in respondents.

Athletes addressed with survey directly through WeChat (N), (n%)	Respondents (N), (n%)	14 yrs of age (N), (n%)	15 yrs of age (N), (n%)	16 yrs of age (N), (n%)	17 yrs of age (N), (n%)	18 yrs of age (N), (n%)	19 yrs of age (N), (n%)
50	38	1 (2.7)	9 (24.3)	11 (29.7)	11 (29.7)	4(10.8)	1 (2.7)

N = Exact number of individuals, n% = percentage of all respondents.

All questions were originally made based on previous research conducted in the areas of music usage during different stages of exercise, the characteristics of different kinds of music, and the role of different elements of music in athletic performances (Karageorghis, C.I., 2020). The survey was divided into five parts.

The first part includes questions regarding basic demographic and music preference information. Aside from age, gender, and sports they participate in, the respondents were asked to respond to 'When do you actively listen to music? Before, during, and/or after exercising/practicing.' This allows for a separate analysis of the three different stages of exercising/practicing when respondents specifically listen to music to exercise. Based on the answers provided for this question, respondents were asked to fill out the corresponding parts: before, during, and after exercising/practicing. Lastly, a question was asked to get a general idea of the importance of music to exercising/practicing for the respondent.

The second, third, and fourth parts go through the same set of questions but apply to the three different stages: before, during, and after exercising/practicing. Firstly, respondents were asked to provide their reasons for listening to music. This was the only question that contained different options for the different parts. Next,

respondents were asked to pick the genre of music they listen to. For the next four questions, respondents were asked to indicate their preference for each of the four aspects of Melody, Harmony, Rhythm, and Dynamics. Then respondents were asked to rate the four aspects based on their importance when choosing the music they prefer. Lastly, a question was asked about whether they listen to the same kind of music when they are exercising and when they are not. This is to determine whether their preference for music is only based on their regular music taste or specifically to exercise.

The last part of the survey includes an acknowledgment that if the survey was completed and submitted, the data would be used in this research. The full survey is provided in Appendix 2.

Results

38 respondents reported gender and age; among them, 14 were female (36.8%), and 24 were male (63.2%). 1 (2.7%) of the respondents indicated that they do not listen to music before/during/after exercise. More than half of the respondents indicated a fairly high importance of music for their athletic training. Full data table provided in Appendix 1, Table 2.

Music Before Exercising/Practicing

32 respondents filled out the 'Music Before Exercising' section. 30 (93.8%) of respondents indicated that they listen to music to 'Get into the mood', and 8(25%) to 'Calm down'. The popular music genres were Pop (20, 60.5%), R&B (15, 46.9%), and Rap (21, 65.6%). (Full data table provided in Appendix 1, Table 3).

Respondents rated their preference for different aspects of music on a scale of 5. Firstly, for Melody (1= Sing along, 5 = Can't sing along), the choices leaned toward music that one can sing a long, and most ratings fall in between. Secondly, for Harmony (1= Heavy Emotions, 5 = Light Emotions), the choices leaned toward light-emotion music, and most ratings fall in between. Thirdly, for Tempo (1= Slow Tempo, 5 = Fast Tempo), the numbers leaned toward music that had a fast tempo, and the most popular option was 4, indicating a preference for a fast tempo. Lastly, for Dynamics (1= Soft, 5 = Loud), the most popular option was 3, however, options 4 and 5 also had sizable results, and no respondents chose 1. (Full data table provided in Appendix 1, Table 3).

Respondents indicated the importance of each aspect when choosing music (1= most important, 4 = least important). For Melody, most respondents voted 1 (most important); for Harmony, most respondents voted 4 (least important); for Rhythm, most respondents voted 3; for Dynamics, a tie appeared between 1 and 4. (Graph 1)

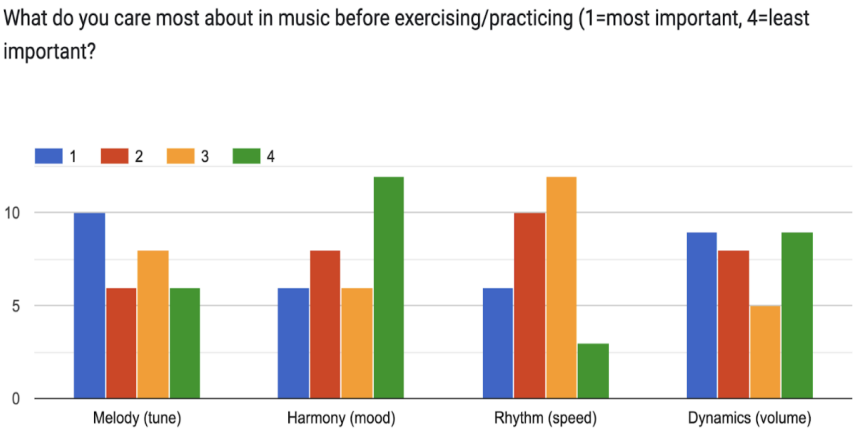

Figure 1. Importance of each aspect of music before exercising/practicing

Lastly, 16 (50%) of respondents indicated that they listen to the same kind of music before exercising and when they do not exercise. 12 (37.5%) indicated that they sometimes do, and 4 (12.5 %) indicated that they do not. (Full data table provided in Appendix 1, Table 3).

Music During Exercising/Practicing

37 respondents filled out the 'Music During Exercising' section. During exercise, most respondents listen to music because it 'makes the repetitiveness of exercising/practicing less boring' (31, 83.8%), 'increase[s] focus/productivity' (24, 64.9%), and 'enhance[s] power/ability/skills' (25, 67.6%). The popular genres of music are Pop (26, 72.2%), R&B (11, 30.6%), and Rap (24, 66.7%). (Full data table provided in Appendix 1, Table 4).

Respondents rated their preferences on a scale of 5. Firstly, for Melody, most ratings fall between can and cannot sing along (3). Secondly, for Harmony, the numbers lean towards light emotions, and most ratings fall between light and heavy emotions (3). Thirdly, when asked to indicate a preference for Tempo, the numbers leaned significantly toward music that had a fast tempo, and the most popular option was 4. Lastly, when asked to indicate a preference for Dynamics, the numbers leaned toward loud dynamics, the most popular option was 3 and 4. (Full data table provided in Appendix 1, Table 4).

Respondents indicated the importance of each aspect when choosing music (1= most important, 4 = least important). For Melody, respondents voted evenly for 1, 2, and 4; for Harmony, most respondents voted for 3; for Rhythm, most respondents voted for 2; for Dynamics, most people voted as most important (1) (Graph 2).

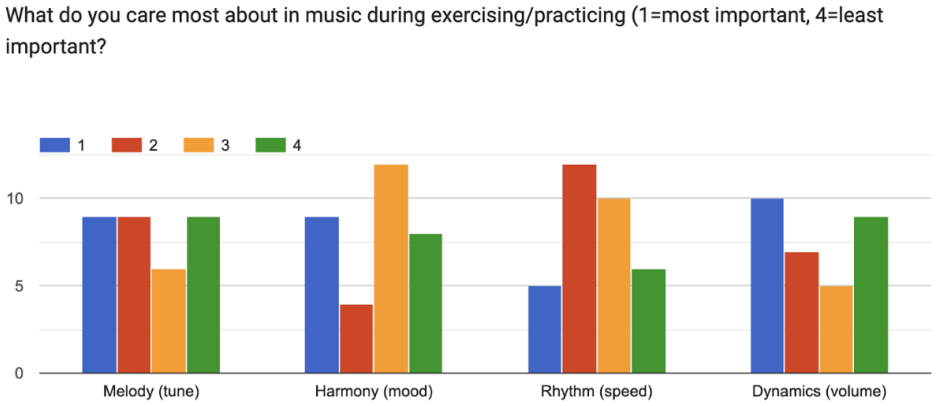

Figure 2. Importance of each aspect of music during exercising/practicing

Lastly, 15 (44.1%) respondents indicated that they listen to the same kind of music during exercising and when they do not exercise. 14 (41.2%) indicated that they sometimes do, and 5 (14.7%) indicated that they do not. (Full data table provided in Appendix 1, Table 4).

Music After Exercising/Practicing

25 respondents filled out the 'Music after Exercising' section. After exercise/practice, respondents listen to music because it helps with 'Mental relaxation' (21, 80.8%), 'Physical relaxation' (17, 65.4%), and ' Reduction of fatigue' (11, 42.3%). For the genres of music respondents listen to after exercising/practicing, the popular choices were Pop (18, 72%), R%B (14, 56%), and Rap (12, 48%). (Full data table provided in Appendix 1, Table 4).

Respondents rated their preference for each aspect of music on a scale of 5. Firstly, for Melody, the numbers leaned slightly toward music that one can sing along to, the most popular options were 2 and 4. Secondly, for Harmony, the numbers leaned towards light emotions, indicating a fairly strong preference for 'Heavy Emotions''. Thirdly, for Rhythm, the numbers leaned toward music that had a slow tempo, and the most popular option was 2, indicating a fairly strong preference for 'Slow Tempo'. Lastly, for Dynamics, the numbers leaned toward soft, the most popular option was 2, indicating a preference for fairly quiet music. (Full data table provided in Appendix 1, Table 4).

Respondents ranked the importance of each aspect when choosing music. For Melody, most respondents voted it as least important; for Harmony, most respondents voted it as most important; for Rhythm, most respondents voted 3; for Dynamics, a tie appeared between 1 and 4 (Graph 3).

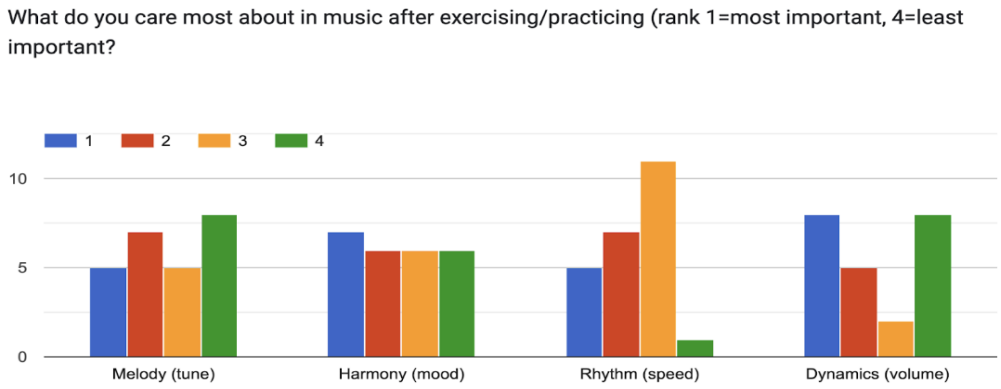

Figure 3. Importance of each aspect of music after exercising/practicing

Lastly, 13 (52%) indicated that they listen to the same kind of music after exercising and when they do not exercise. 10 (40%) indicated that they sometimes do, and 2 (8%) indicated that they do not. (Full data table provided in Appendix 1, Table 4).

Discussion

Based on the results of the survey, music is widely used at different stages during exercise as stated in past research (Karageorghis, C.I., 2020).

As shown in the survey, music provides emotional preparation for students by allowing them to 'get into the mood' (30, 93.8%) , which Loizou & Karageorghis (2015) and Smirmaul (2017) described as elevating/regulating the exerciser's mood and triggering activation during exercise.

During exercise, music is applied asynchronously and has psychophysical and ergogenic effects on the respondents, as it is mostly used to dissociate the uncomfort of these physical activities and affect the physical output. These were similar to previous findings (Boutcher & Trenske, 1990; Gordon, 2007; Karageorghis & Terry, 1997).

After exercise, music has both physical and mental relaxation effects on the respondents, similar to previous findings (Karageorghis & Terry, 2011). High school students use music before/during/after exercise for similar reasons as stated in previous research (Hallet & Lamont 2019, Karageorghis & Terry, 2011,Moens et al, 2014).

During the three stages, there was a change in music taste. In the 'before practice' phase most people preferred pop, R&B, and Rap, once the respondents entered the 'during practice' phase R&B dropped significantly, and the number of people listening to Heavy Metal increased from one to four. In the 'after practice' phase, Heavy Metal dropped to 0, whereas R&B increased and Rap decreased. R&B is usually calmer, slower, and more melodic, whereas Heavy Metal and Pop are more hyper, intense, and exciting (Levitan, 2018, Kostek & Plewa, 2016). This trend corresponds to the preference for fairly fast tempos and fairly loud dynamics in the 'before practice' phase, fast tempos and loud dynamics in the 'during practice' phase, and slow tempos and soft dynamics in the 'after practice' phase.

In all three stages, the rating of the importance of the different aspects yielded interesting results. For dynamics, the most chosen options were always 1 and 4, which meant that in general, the preferences are very polarized. On the other side of the spectrum, in all three stages, 2 and 3 were chosen the most for Rhythm but it is also the least amount of people choosing 4. This meant that most people were fairly neutral about it, yet did not consider it absolutely unimportant, this match previous research by Kostek & Plewa, 2016 , in which they stated that mood is largely affected by the rhythmic patterns in music. Overall the ratings for each aspect were pretty spread out and followed no specific trend where one is always important or one is always not unimportant.

As for the choices of music during all three stages of exercise and when not exercising, nearly half of the respondents said that they listen to the same kind of music. In the 'during practice' phase, less than half of the respondents indicated that they listen to the same kind of music during their practices as to their regular preference of music. It is also in the 'during practice' phase that the largest number of respondents indicated that they do not listen to the same kind of music during and on a regular basis. In general, however, it seems like most students listen to music based on their preferences for music.

Strengths and Limitations

The present study has limitations associated mainly with the size of the data collected. Assumptions made based on 38 responses cannot represent a major trend in a phenomenon, in addition, the majority of the respondents were Chinese students, thus cultural differences could have played a big role in preference for music, sports involvement, music listening habits, etc. Therefore, the data cannot represent the diverse population found in private boarding high schools. In addition, the quantitative survey format of the study limited the possibilities for open-ended responses and detailed expression of thoughts and feelings. Another limitation is the surveys were anonymous thus preventing further follow up which prevented clarifications with issues. For example, respondents filled out the 'before' practice section when they initially only indicated that they listen to music during practice.

Further statistical analysis would allow for stronger findings. In this iteration of research, only demographic analysis and univariable analysis were applied to the data, therefore, the correlation between different characteristics and behaviors lacks analytical tools to back it up.

The strength of this study includes a detailed dive into each stage of exercise separately and each aspect of music. It addresses the music listening phenomenon specifically for non-athlete high school students.

Conclusion

To examine the music usage habits of students in private boarding high schools, a self-reported anonymous survey had been conducted. The results seemed to be that music supports both the mental and physical well-being of exercisers. Music genre preferences correlates to the preferences for each aspect of music, which also correlates to the purpose of using music at different stages. However, the high percentage of repetition between

usual music preferences and specifically for exercise undermines the correlation. The music usage phenomenon should be further addressed and more research on a physiological aspect is needed, including in-depth study design for a larger and more diverse population.

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