

## PEER-REVIEWED ARTICLE

### The Effect of Upbeat Music on PACER Performance of Middle School Students

Grant Hill, Ph.D.  
Department of Kinesiology  
California State University, Long Beach

Mr. Elias Lopez  
Physical Education Department  
Acacia Middle School  
Hemet Unified School District

#### ABSTRACT

This study measured middle school student achievement on the Fitnessgram test for aerobic capacity (PACER) five times during a 3 week period. Participants were middle school aged students from one school in three separate physical education classes: sixth grade (N=47) and seventh grade (N=34) and eighth grade (N=51). One class took the PACER test with just the PACER cadence and with no background music each time, another group had the PACER cadence with upbeat background music each time, and the third group alternated trials with just the PACER cadence with those that also included the upbeat background music. A one-way repeated measures ANOVA was calculated comparing the PACER tests scores of participants for the five trials. The No Music group experienced a significant decrease in PACER laps from the 1<sup>st</sup> to the 5<sup>th</sup> trial whereas the Music Every Time group had a significant increase in PACER laps. The Alternating No Music/Music group performed significantly higher PACER laps when the background music was present than when it was not present. The results suggest incorporating music can increase student performance in aerobic capacity testing. These findings are consistent with those of previous research involving elementary and high school student performance on the PACER test.

Stimulating background music has been shown to enhance exercise intensity and duration in various physical activities including in cycling, interval training, and treadmill walking (Karageorghis, Priest, Williams, Hirani, Lannon, & Bates, 2010); Karageorghis & Priest, 2008). Exercise trials accompanied by music have been shown to not only increase levels of participation, but also result in greater enjoyment and other psychological and psychophysical benefits (Bharani, Sahu, & Mathew, 2004; Elliott, Carr, Elliott & Orme, 2005; Karageorghis, Mouzourides, Priest, Sasso, Morrish, & Walley, 2009;). Manire, Robert & Tiev, (2010) found that any music choice accompanying the exercise was significantly preferable to participants rather than exercising with no music. Nethery (2002) found that music listening during exercise can reduce perceptions of effort and fatigue by up to 12%. Music also appears to narrow attention and reduce the awareness of bodily sensations of fatigue (Rejeski, 1985). There is also evidence music is most effective in stimulating movement when there is synchronicity between the movement patterns required by running and tempo. This may be due to a reduction in energy cost of exercise because of enhanced neuromuscular metabolic efficiency (Simpson and Karageorghis, 2006) or because it allows runners to adjust tolerance through the diversion of attention from uncomfortable physical sensations to the various features of the music (i.e., rhythm, melody, and lyrics). These studies and others provide strong evidence that music has measurable and relatively positive effects on their stride rate to the tempo of the music using the supplementary motor area of the brain. Others have speculated that music enhances arousal, particularly when the music has personal value to the participant (Blumenstein, 1992; Karageorghis & Terry, 1997). In a qualitative research study, Gfeller (1988) concluded that music enhances exertion both behavioral and psychological states on people

when exercising (Hirani, Lannon, & Bates, 2010; Karageorghis, Terry, Lane, Bishop, & Priest, 2012).

To estimate cardiovascular endurance and VO<sub>2</sub> max, K-12 children in public schools complete the PACER test, which is part of the required Fitnessgram test. The results are measured against the Healthy Fitness Zone Standards, a criterion-referenced standard that indicates the level students should achieve to reach the Healthy Fitness zone for their age and gender. In 2015, over 80% of the students in California failed to reach the healthy zone in the PACER test. Deutsch & Hetland (2010) found the performance of elementary school students on the PACER test could be positively enhanced by the playing of concurrent high or moderate tempo music beat in the background. Dunaway and Ward (1995) found in their study of high school students, significantly more running laps were completed when stimulating music was present because students perceived the presence of the music was dependent upon strong effort. Interestingly, there appears to be no comparable research regarding the effect of music on the aerobic activity performance of middle school students. Since stimulating background music has been shown to result in higher PACER test scores with other age groups, it appears important to also determine whether the PACER performance of middle school aged students can also be enhanced by supplementing the PACER Beep test with upbeat tempo background music. Given the unique characteristics of middle school students in regards to their growth and development stage and emotional and maturity level, the results of this study may be very important to those who teach physical education at that level.

## Methods

Students in three different middle school physical education classes (N=132) with the same teacher in one school completed the PACER five times within a three week period. The three week time frame for the five trials was selected to minimize any effects of growth and development or increases in outside-of-class aerobic capacity. The students ranged from 10-13 years of age. The ethnic composition of the students was 57.8% Latino, 26.7% White, 8.9% Black or African American, 4.5% mixed ethnicity, and less than 1% of any other ethnic group. Approximately 89% of the students in this school were classified as socioeconomically disadvantaged. Permission to conduct the study was granted in accordance with district Institutional Review Board policies regarding research studies involving children. Each class was randomly assigned to one of the three research groups. Students in the 6th grade class (males =24 and females =23) performed every PACER test, other than the pre-test, with music incorporated into the background during the "beeps" (ABBBB treatment schedule). Students in the 7th grade class (males = 21 and females = 21) performed the PACER test alternating between the no music and music incorporated into the background with the following weekly sequence: no music, music, no music, music, no music (ABABA treatment schedule). Students in the 8th grade class (males=24 and females=27) performed every PACER test with the original format (no music, only beeps (AAAAA treatment schedule). During all "music" tests, A Block Rocker stereo system was used to play pop music from iTunes Top 20 that was selected by the researchers within a high tempo band of 125- 140 beats

per minute (Karageorghis, et., al., 2012). Songs were switched approximately once per minute to add variety and increase the chances it would be enjoyable for the majority of the students. A specific music fading android application called "Garage Band" pre-set the songs in accordance with the exact time of the PACER "Beeps" so the music automatically faded down before each beep and increased in volume after every beep. Students were encouraged to give their full effort both when music and non-music trials were performed. Scores were recorded for each student for each of the five trials by the instructor, with the help of a student assistant in each class. Each group performed the PACER test in the original format (without music, only beeps) on the first week of the study to attain baseline scores. After the initial test during the first week, each group tested twice during each of the next two weeks (*See Table 1, p.11*). All five tests were completed, scores were entered into Microsoft Excel and SPSS for further analysis. Descriptive statistics were used to analyze the data. A one-way repeated measures ANOVA was used to compare the music vs non music differences on the PACER tests. In addition, the instructor subjectively assessed two behaviors for each group for each of the five PACER trials: 1) Frequency of negative facial expression and complaining, and 2) Frequency of dancing or singing during the PACER testing period.

## Results

In the No Music group, a significant effect was found between the five trial means ( $F(4,200) = 2.73, p = .003$ ). Mean scores decreased from Test 1 ( $m = 27.02, sd = 13.07$ ) to Test 2 ( $m = 26.45, sd = 16.52$ ) to Test 3 ( $m = 23.16, sd = 13.38$ ), increased

in Test 4 ( $m = 26.84$ ,  $sd = 15.25$ ) and then decreased in Test 5 ( $m = 24.29$ ,  $sd = 12.96$ ). In the Music/No Music Alternating group, a significant effect was found between the five trial means ( $F(4, 184) = 13.84$ ,  $p < .000$ ). Mean scores increased from Test 1 (No Music) ( $m = 20.91$ ,  $sd = 9.75$ ) to Test 2 (Music) ( $m = 25.32$ ,  $sd = 12.46$ ) then decreased in Test 3 (No Music) ( $m = 24.23$ ,  $sd = 11.86$ ), increased in Test 4 (Music) ( $m = 28.30$ ,  $sd = 14.46$ ) and then decreased in Test 5 (No Music) ( $m = 23.13$ ,  $sd = 12.17$ ) (See Table 1, p.11). In the All Music group, a significant effect was found between the five trial means ( $F(4, 132) = 6.83$ ,  $p < .000$ ). Mean scores increased from Test 1 ( $m = 25.59$ ,  $sd = 13.46$ ) to Test 2 ( $m = 27.21$ ,  $sd = 14.20$ ) to Test 3 ( $m = 28.68$ ,  $sd = 15.98$ ), to Test 4 ( $m = 30.38$ ,  $sd = 18.64$ ) and then to Test 5 ( $m = 31.56$ ,  $sd = 16.78$ ) (see Table 1, p.11). The primary researcher also subjectively assessed two class behaviors during each of the five PACER trials: 1) Frequency of negative facial expressions and complaining, and 2) Frequency of dancing or singing during the PACER testing period. Groups were assigned a 1-5 nominal rating for each behavior for all five trials utilizing the ordinal scale: 1 = no occurrence and 5 = high frequency of occurrence. The primary value of using a scale of this type was to show changes from one trial to another; a ratio or interval relationship cannot be assumed (Betram, 2007). For the ALL MUSIC group, there was a low incidence of negative facial expressions or complaining and a high percentage of students were observed singing and dancing along with the music during Trials 2-5. For the Music/No Music Alternating group, there was no incidence of negative facial expressions and complaining on the days when there no music was incorporated, however the frequency of negative facial expres-

sions and comments increased dramatically when the music was not present. There was also a high frequency of singing, dancing and smiles on faces each time the test was administered with music, whereas there were many more expressions of dissatisfaction and complaints from members of the class when the music was absent. For the No Music group, the frequency of student negative facial expressions and complaints increased steadily from the first to the fifth trial and, predictably, there was no evidence of singing or dancing during any of the trials (see Tables 2, p.11 & 3, p.12).

### Discussion

These findings are consistent with previous research demonstrating the positive effects of upbeat background music on an aerobic capacity task. The significantly higher number of PACER laps completed when background music was played is consistent with Deutsch & Hetland (2010), who reported similar results with elementary school aged students. The results are also consistent with studies involving older participants which found that participant output was greatest when exercising while listening to the motivational music in the background (Bates, et al, 2010; Karageorghis & Priest, 2008; Karageorghis et al., 2009; and Dunaway 1995). The results for the MUSIC/NO MUSIC ALTERNATING group are particularly compelling because the average number of PACER laps performance was about 18% higher when the music was added (26.8 vs. 22.8). This is consistent with Nethery's (2002) findings that physical exertion is increased dramatically when upbeat music is present. The verbal and physical expressions of students, that were consistently observed by the researcher when music

was present, are consistent with Gfeller (1988), who found that upbeat music enhances mood and stimulates students to synchronize mood and stimulates students to synchronize their movements with the rhythm of the music.

Since upbeat music increased PACER scores, it is very likely it would also facilitate an increase in student exercise intensity during other activities in physical education classes (Hirani, Lannon, & Bates (2010). If students learn to enjoy being physically active during physical education classes, they may be more likely to incorporate physical activity into their daily lives. Future research involving middle school students could compare arousal and performance levels during, 1) continuous tasks and discrete tasks with music of different tempos, and 2) upbeat music that is familiar vs. unfamiliar. In addition, having middle students complete a self-report measure of student mood, such as the Profile of Modes State for Adolescents (POMS-A) (Terry, Lane, Lane, & Keohane, 1999) after exercising, both with and without music, might provide more insight regarding affective benefits of incorporating various types of music into physical activities.

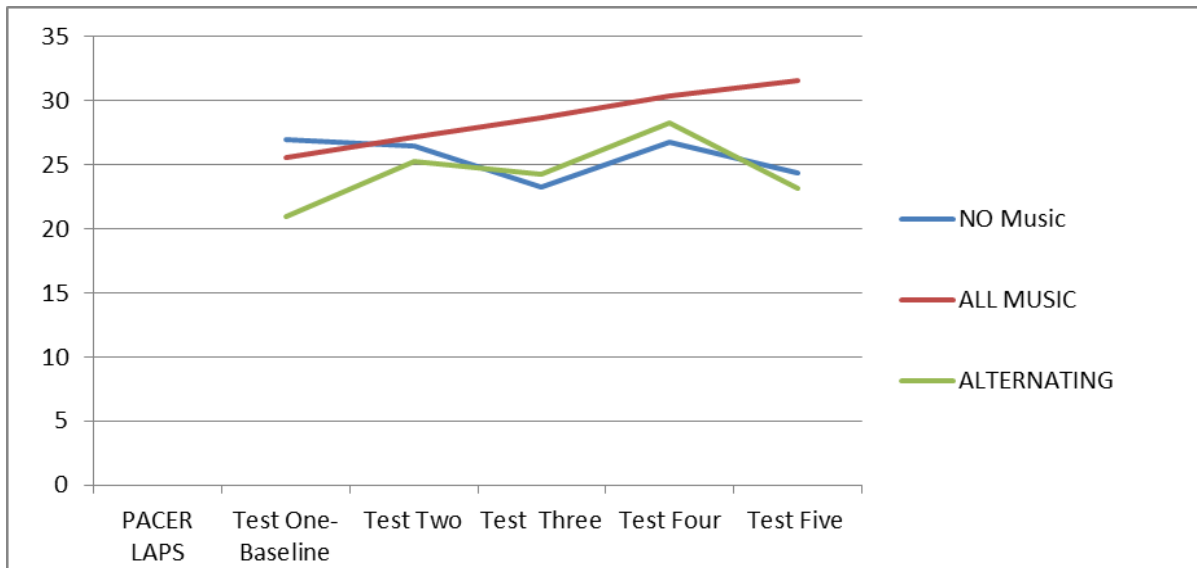
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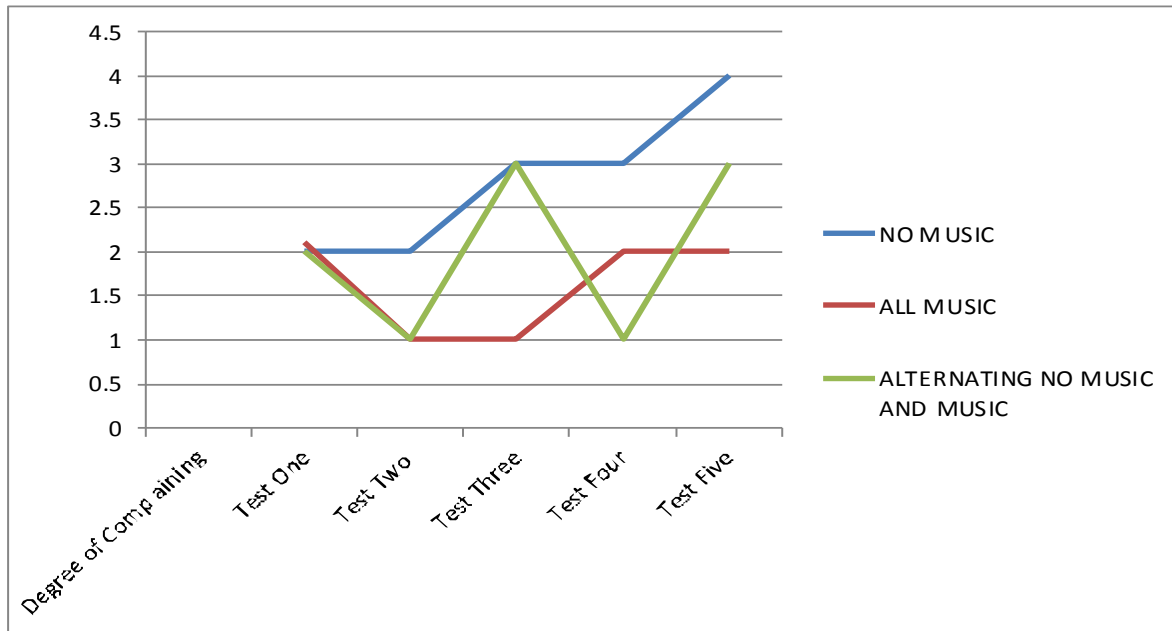
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# TABLES

**Table 1. Number of PACER Laps Completed by Middle School Students in No Music, All Music, and Alternating No Music/Music Groups**



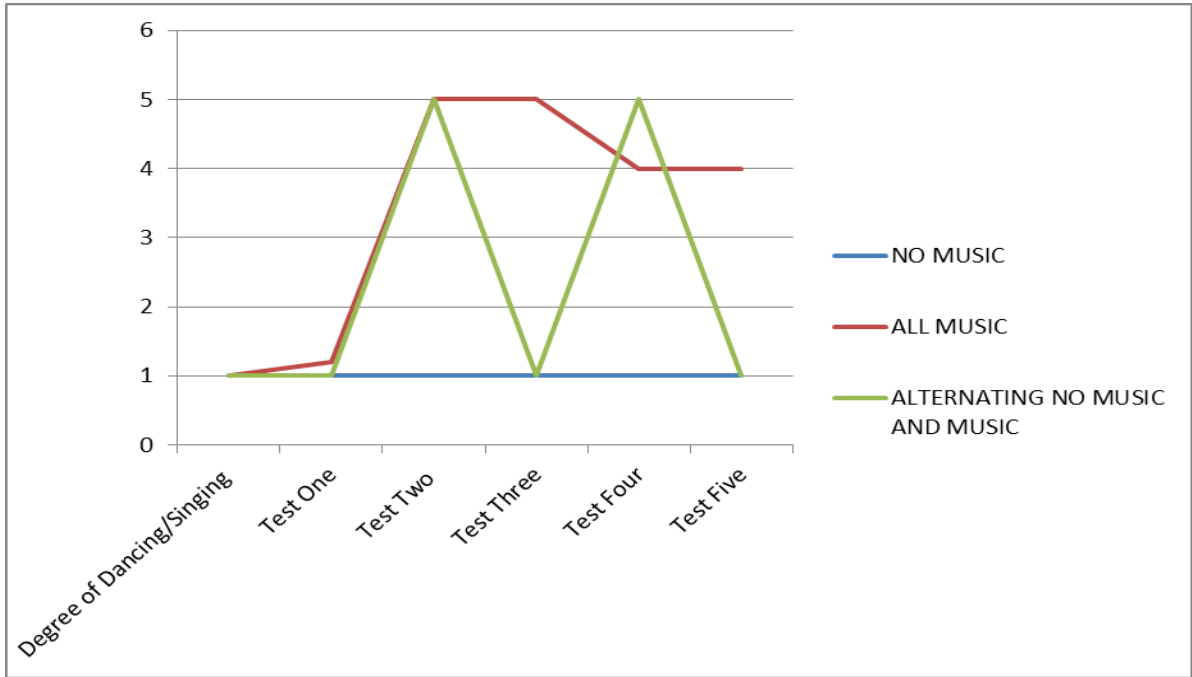
**Table 2. Teacher Rating of Frequency of Class Complaining During Administration of Five PACER Test Trials for Middle School Students in NO MUSIC, ALL MUSIC, and ALTERNATING NO MUSIC/ALL MUSIC Groups**



Scale: 1 = No occurrence 5 = Very high frequency of occurrence



**Table 3 Teacher Likert Scale Rating (1-5) of Frequency of Singing or Dancing During Administration of Five PACER Test Trials for Middle School Students in NO MUSIC, ALL MUSIC, and ALTERNATING NO MUSIC/ALL MUSIC Groups**



Scale: 1 = No occurrence 5 = Very high frequency of occurrence