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PEDAGOGY

Effects of Music on Physical Activity Rates of Elementary Physical Education Students

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Abstract

Music is a pervasive presence in society and is routinely used to influence human behavior in a variety of settings and for a variety of purposes including exercise behaviors and physical education (PE) classes. However, little evidence exists to support what effect, if any, music has on learner outcomes in PE. The effects that playing music during elementary PE lessons had on children's physical activity (PA) rates were examined in this study. Physical activity rates (via pedometry) of elementary PE students (Grades 3 to 5, n = 115) were measured under two treatment conditions (music or no music) and across two lesson types (walking or Frisbee) in a crossover design. Data were analyzed using a within-and-within repeated measures ANOVA. Findings indicate that including music throughout PE lessons significantly increases PA for both genders and across both activities ($p < .000$). Also, a significant music-by-activity type interaction effect was noted ($p < .000$), indicating that music has an increased effect as the nature of the activity becomes more vigorous. A significant gender effect ($p < .000$) was also noted. Using music may be a beneficial environmental change that will increase PA in elementary PE and is more pronounced as intensity increases.

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Music can be heard at the workplace, at the local mall—in just about any facet of a person's life. The effects of music have been studied with considerable interest in many fields, especially sport and exercise (Karageorghis, Jones, & Low, 2006; Pates, Karageorghis, Fryer, & Maryland, 2003; Priest-Lee, Karageorghis, & Sharp, 2004).

Karageorghis, Terry, and Lane (1999) conducted much of the research dealing with music in sport and exercise. Karageorghis et al. (1999) presented a conceptual framework predicting the effects of asynchronous (i.e., absent of conscious synchronization between physical movement and accompanying musical rhythm) motivational (i.e., stimulates or inspires physical activity) music in the context of exercise and sport. From previous work and a review of literature, four factors have been identified that contribute to the motivational qualities of a given piece of music: rhythm response, musicality, cultural impact, and association. Rhythm response is the response to the rhythmical elements of music—the key characteristics of music for eliciting a bodily response. Musicality is the response to the pitch-related elements of music such as harmony and melody. Cultural impact is the pervasiveness of the music within society (i.e., the more culturally central is music within society). The association factor is the personal music association that may evoke bodies to be physically active. The four factors were different in the extent to which they contributed to the motivational qualities of music with rhythm response found to exert the greatest influence on bodily responses and association the least. Karageorghis et al. (2006) proposed that asynchronous motivational music leads to three psychophysical responses, namely, arousal control, reduced ratings of perceived exertion (RPE), and improved mood. Karageorghis et al. (2006) provided practitioners with guidelines to facilitate the prescription of music that may ultimately impact exercise.

Researchers examining music in sport and exercise have investigated variables such as the effects of tempo during exercise (Priest, Karageorghis, & Sharp, 2004). For this study, participants at a health club were asked to respond to a survey assessing the type of music played at the health club. The results of the study indicated the members of the health club wanted a variety of louder music that was upbeat and motivational during their workout.

Accordingly, Karageorghis et al. (2006) investigated the relationship between heart rate and music tempo. College-aged students (n = 128) picked their top-three artists for use in the study and then walked on a treadmill at three levels of intensity while wearing a

heart rate monitor and listening to the selection of music. Overall, results indicated (a) that fast-tempo music was preferred and (b) and increased preference for fast-tempo music accompanied increases in workload intensity. Similarly, Copeland and Franks (1991) compared music with a soft, slow tempo to music with an upbeat, fast tempo. Results indicated that the exercise group listening to the soft, slow tempo music generally exhibited a lowered heart rate compared with an exercise group that listened to upbeat, fast-tempo music.

Although researchers have investigated the effects of music and tempo on the physical activity (PA) behaviors of exercisers in commercial settings, little has been done in the physical education (PE) setting. This is surprising for two reasons. First, music is not an uncommon component of public school PE offerings, particularly in weight training classes and elementary PE. Second, PE students represent perhaps the largest body of potential exercise participants in the United States.

Deutsch (2008), for example, investigated the effects of music on elementary-aged students being tested during the Progressive Aerobic Cardiovascular Endurance Run (PACER) test. Sixty-nine fourth and fifth grade students (males, 37; females, 32) participated in this study. The PACER test is an age- and developmentally appropriate aerobic capacity fitness test recommended for all ages, but particularly for elementary-aged students. The Cooper Institute (2005) produces a CD that has three versions of the test: one with faster tempo music, one with a mild tempo, and one version without music. The results indicated that PACER scores increased in males and females when administered with music. Males performed better with mild-tempo music and females with the faster tempo music, and the authors of this study recommend using both. Furthermore, student comments indicated that they enjoyed participating more when music accompanied the test.

However, although it is hoped that the use of music in elementary physical education (EPE) will elicit specific behavioral responses in students (e.g., increased PA), it is most often used simply as an element of the content (e.g., the music that accompanies a dance or the timed music that assists in the time management of a fitness routine; Pangrazi, 2007). Although it appears that including music can affect PE students' PA behaviors in the PACER, its effects on PA behaviors throughout a lesson remain unexamined. Therefore, the purpose of this study was to examine the effects of using music on the PA rates (measured via pedometry) of elementary school children during entire physical education lessons.

Methods

Participants and Setting

Participants were 115 elementary-aged students (Grades 3 to 5; males, 48; females, 67) from an elementary school located in the southern plains of the United States. The EPE teacher in this study taught for 15 years. A typical lesson comprised four parts (Pangrazi, 2007): (a) an introductory activity, (b) a fitness activity, (c) the lesson focus, and (d) a game. The introductory activity is to prepare students for activity. In many cases, students have been sitting in classes previous to their physical education class, and thus students get quickly into activity through introductory activities. The introductory activities require minimal organization and place demands on large muscle movement. The fitness activity is next, which lasts 6 to 8 min. Typically, fitness activities are focused on developing physical fitness. Instruction is centered on developing major components of flexibility, muscular strength, and cardiovascular endurance. The lesson typically lasts 12 to 15 min, with the focus on the skill or activity for students to learn. The concluding game/activity takes the last 5 min of the lesson (Pangrazi, 2007).

Pedometer Instrument

One method of measuring the effects of music in EPE is with pedometers (Vincent-Graser, Pangrazi, & Vincent, 2009; Vincent & Pangrazi, 2002). Pedometers are practical, easy to use, and cost effective (Barfield, Rowe, & Michael, 2004; Beighle, Pangrazi, & Vincent, 2001; Welk, Corbin, & Dale, 2000) and have been found to be reliable and valid instruments to measure activity in EPE. The Yamaz Digi-Walker LS 2525 was the pedometer used to collect student step counts and time in activity (LeMasurier et al., 2005).

Procedures and Data Collection

Students participated in three 30-min EPE lessons per week. During the first of the preceding three PE lessons to data collection, students were introduced to the pedometer, shown how to wear it (Vincent & Pangrazi, 2002), and shown how to reset it to 0. For the next two lessons, students practiced the procedure of coming into class, selecting a pedometer, resetting it to 0, and putting it on for the class activities. On the days of data collection, students repeated these procedures. Once all students had completed these procedures, the teacher would begin a 30-min lesson. When the lesson was fin-

ished, students would record the number of steps and time in activity. Only the teacher and the researchers had access to the student record sheet. Pedometer data were collected for two intact classes from each grade participating in a Frisbee lesson and walking activities lesson, each taught with and without music.

On the days when music was used, the teacher would play music throughout the lesson except when giving instruction. Instructions were designed to be kept to a minimum, and then the music was immediately turned back on. Instructions were also designed to be consistent across conditions.

Data Analysis

Data were analyzed using a 2 (conditions: music/no music) × 2 (activity types: walking/Frisbee) within-and-within repeated measures (RM) ANOVA. Step count via pedometry was the dependent variable. Mean step counts and standard deviations are displayed by condition, activity, gender, and overall in Table 1. Effect sizes (ES) were calculated using Cohen's d $[(M_1 - M_2)/SD_{pooled}]$ (Cohen, 1990). The results of the RM ANOVA comparing the effects of music on both conditions and both activities are displayed in Figure 1. Overall gender effects were also examined using a one-way ANOVA.

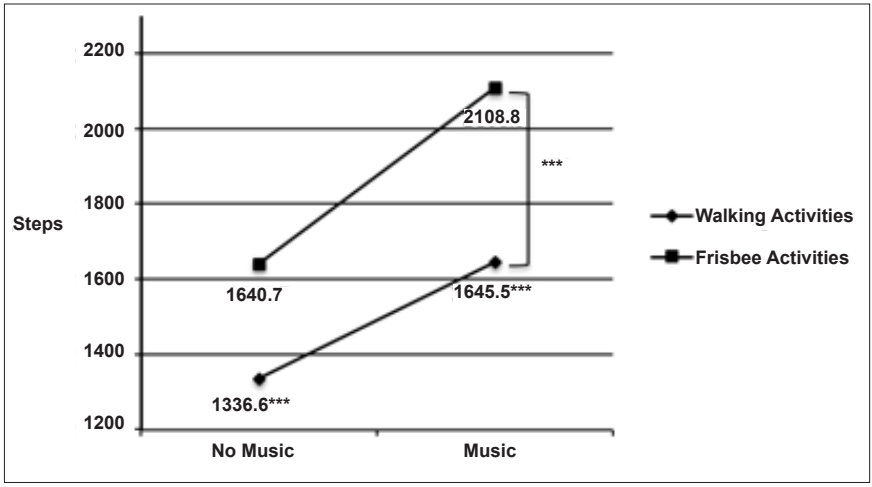

Figure 1. Mean steps taken in each lesson under each condition (no music and music) for each activity (walking and frisbee).

Results

Mean step counts indicated consistent gender-specific activity patterns, as is customary, with boys being significantly more active, $F(1, 128) = 12.48$, $p < .000$, across all conditions and activities (see bottom right in Table 1). Effect size calculations indicated a moderate gender effect (ES = .47).

Results from the RM ANOVA indicated that PA rates via step counts were significantly higher when (a) music was used, $F(1, 228) = 267.89$, $p < .000$, and (b) in different activities (walking vs. Frisbee), $F(1, 228) = 85.74$, $p < .000$. Also, an interaction effect was noted between using music and activity type with music exerting a significantly greater effect as the type of activity moved from the more sedate walking activities to the more vigorous Frisbee activities, $F(1, 128) = 13.717$, $p < .000$. Calculations revealed moderate (.41–.70) or large (> .70) effect sizes for music in the walking activities (ES = .55) and in the Frisbee activities (ES = .74) and overall (ES = .81), lending support to the notion that adding music to these activities had an important effect on PA rates.

Discussion

The purpose of this study was to examine the effects of using music on the PA rates (measured via pedometry) of EPE students. Deutsch (2008) used music only during the PACER test and found that male and female students' scores increased with music, whereas in the present study, it seems that music may also be used throughout the lesson, resulting in increased PA outcomes. Although music is somewhat common as an occasional curricular element in the public school setting, and even more so in EPE, its effects on student behaviors such as PA throughout the lesson have remained undetermined. In the present study, the same lessons were conducted with and without music, and this revealed important insights about the effects of music on PA rates.

First, regardless of the activity, students in lessons with music were more active. This was true in both the more sedate walking activities and the more vigorous Frisbee activities. Implications for teachers seem fairly straightforward—using music generally throughout the lesson and across a varied curriculum will have a positive effect on PA rates.

Table 1
Means, Standard Deviations, and Effect Sizes

Treatment condition	Step count											
	Walking activities $n = 115$				Frisbee $n = 115$				Both activities $n = 115$			
	M		*SD*		*M*		*SD*		*M*		*SD*	
No music	1336.6		552.6		1640.7		560.1		1488.6		443.7	
	Step count by gender											
	Male $n = 48$		Female $n = 67$		Male $n = 48$		Female $n = 67$		Male $n = 48$		Female $n = 67$	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
	1404.6	524.3	1287.8	568.9	1709.0	610.3	1591.7	517.9	1556.8	461.9	1439.7	425.3
Music	*M*		*SD*		*M*		*SD*		*M*		*SD*	
	1645.5[a]		562.8		2108.8[a]		694.9		1877.1[a]		512.7	
	Step count by gender											
	Male $n = 48$		Female $n = 67$		Male $n = 48$		Female $n = 67$		Male $n = 48$		Female $n = 67$	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
	1781.6	551.8	1547.9	552.3	2313.9	749.4	1961.9	615.0	2047.7	543.9	1754.9	453.1
	ES = .55[b]				ES = .74[c]				ES = .81[c]			
									Overall gender means			
									Male		Female	
									M	*SD*	*M*	*SD*
									1802.3a	475.71	1597.4	401.3
									ES = .47[b]			

[a]$p < .000$ for each music condition compared with the respective no music condition. [b]Effect sizes (Cohen's *d*) are considered moderate for (.41–7.0). [c]large for (> .7).

Next, one of the most interesting and potentially meaningful findings was the presence of a music-by-activity type interaction. The data indicate that as the intensity of the activity increases, the effects of the music become more pronounced. Karageorghis et al. (2006) had similar results with college-aged students walking on a treadmill at three levels of intensity. They found that fast-tempo music was preferred, and when students picked fast-tempo music, their workload intensity increased. The implications of this particular finding seem to indicate that when planning a lesson that includes activities of higher intensity, teachers should consider not only including music but also using music with a faster tempo.

Last, gender effects in this study were as expected; male students were more active than female students. These finding support those in many studies, in different settings, and with different populations (Sallis, 1993; Trost, 2001; Trost et al., 2002). Implications are similarly straightforward: Music is good for all.

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