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ARTICLE

Effects of Asynchronous Music on Students' Lesson Satisfaction and Motivation at the Situational Level

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The aim of this study was to examine the effects of asynchronous (background) music on senior students' motivation and lesson satisfaction at the situational level. A counterbalanced mixed-model design was employed with two factors comprising condition (three levels) and gender (two levels). Two hundred students (82 boys, 118 girls; M_{age} = 16.3 years) volunteered to participate in the study. A lesson was developed and delivered under three experimental conditions: a) teacher-selected music condition; b) student-selected music condition; and c) a no-music control condition. Mixed-model 3 (Condition) × 2 (Gender) ANOVAs were applied to examine the effects of experimental manipulations. No Condition × Gender interaction was observed, although there was a main effect for Condition. When the lesson was delivered under the two music conditions, students scored significantly higher in lesson satisfaction, intrinsic motivation, identified regulation and reported lower scores for external regulation and amotivation. The present results support the notion that the use of background music has potentially positive effects on students' lesson satisfaction and intrinsic motivation, although neither gender nor who selected the music (teacher vs. students) had any moderating influence on the results.

Keywords: Intrinsic motivation, physical education, rhythm

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There has been a long and sustained research effort to ascertain environmental and pedagogical interventions that might enhance the motivation of students in physical education classes (e.g., Berghe, Vansteenkiste, Cardon, Kirk, & Haerens, 2014; Braithewaite, Spray, & Warburton, 2011; Ntoumanis & Standage, 2009). Within this corpus of work, researchers who espouse the Self-Determination Theory approach refer to three basic types of motivation: intrinsic motivation, extrinsic motivation, and amotivation (e.g., Ryan & Deci, 2000). Deci (1975) explained that intrinsically motivated behavior is associated with humankind's inherent need to feel capable and autonomous within their environment. The more autonomous and able to cope with environmental demands an individual feels, the higher his/her intrinsic motivation is likely to be. For example, students who participate in physical education classes because they either enjoy the experience or are interested in learning new techniques, are typified by an intrinsically motivated state.

Initially, Deci (1975) argued that extrinsic motivation is derived from external sources such as grades, a smile or praise from the teacher, money, medals, awards, public recognition, etc. As their research evolved, Deci and Ryan (1985) asserted that extrinsic motivation may have its origins in external sources or be self-determined. Deci and Ryan (1985), as well as Ryan and Connell (1989), proposed four types of extrinsic motivation: a) external regulation, where behavior is modulated by external sources, such as rewards from the teacher or coercion; b) introjected regulation, which refers to partial internalization of extrinsic motives wherein a student may feel motivated to demonstrate ability in class to maintain self-worth; c) identified regulation, where a student is motivated toward a specific behavior because she/he considers it important to what she/he does (e.g., being a soccer player), without necessarily enjoying the activity; and d) integrated regulation, where a behavior is an accepted part of a student's identity. Finally, amotivation refers to unintentional behavior that lacks any motive (Ryan & Deci, 2000). It is associated with feelings of isolation or helplessness and is often exemplified by nonattendance and low involvement in physical education (Ntoumanis, Pensgaard, Martin, & Pipe, 2004). In the Self-Determination Theory literature, terms such as "self-determined types of motivation", "autonomous motivation", and "self-determined motivation" (e.g., intrinsic motivation, identified regulation) are often used interchangeably (Deci & Ryan, 2008). The same applies to terms such as "controlling motivation", "non-autonomous motivation", and "controlled motivation (e.g., introjected, external regulation).

Based on the assumptions of Self-Determination Theory (Deci & Ryan, 1985), Vallerand (1997, 2001) advocated a hierarchical model of motivation comprised of three levels: a) global or personality level, which refers to a general motivational orientation; b) contextual level, which refers to an individual's usual motivational orientation toward a specific context (e.g., in education in general, during physical education lessons, etc.); and c) situational level, which concerns motivation under specific situations or activities, the "here and now" of motivation. The proposition of these levels entailed the development of measurement scales for each (Guay, Vallerand, & Blanchard, 2000; Papaioannou, Milosis, Kosmidou, & Tsigilis, 2007; Vallerand, 1997, 2001). The present study was set at the situational level.

There is widespread support for Deci and Ryan's (1985) theory according to which one's degree of perceived autonomy is a powerful indicator of intrinsic motivation (e.g., Deci & Ryan, 2008; Guay, Boggiano, & Vallerand, 2001). One particularly salient example concerns a study by Goudas, Biddle, Fox, and

Underwood (1995), wherein the degree to which perceived autonomy determines intrinsic motivation was examined in a physical education context. Their results indicated that perceived autonomy at the beginning of a series of lessons was positively related to students' intrinsic motivation at the end of the series.

Previous studies examining age-group differences have shown that senior high school students have lower intrinsic motivation scores when compared with junior high school or primary school students (Digelidis & Papaioannou, 1999; Papaioannou, 1997). In addition, exercise frequency is lower among the senior group. A subsequent longitudinal study conducted with students of 13–15 years showed significant decreases in identified regulation and intrinsic motivation over time, while there were significant increases in amotivation (Ntoumanis, Barkoukis, & Thøgersen-Ntoumani, 2009). Studies examining causal relationships provide strong indications that the cultivation of intrinsic motivation helps to promote sport and exercise participation during adolescence (Papaioannou, Bebetsos, Theodorakis, Christodoulidis, & Kouli, 2006).

Ntoumanis and Standage (2009) reviewed several studies that provided strong evidence in a physical education context, suggesting that the promotion and enhancement of students' intrinsic motivation results in considerably greater psychological and behavioral benefits than the promotion of extrinsic motivation. For example, autonomous motivation in physical education has been associated with self-reported levels of concentration and task challenge (Standage, Duda, & Ntoumanis, 2005), and perceptions of learning (Dupont, Carlier, Gerald, & Delens, 2009). Along similar lines, Goudas, Biddle, and Fox (1994) showed that the stronger the intrinsic motivation of students for activities in a particular lesson, the stronger was their intention to continue with that lesson.

Accordingly, a worthwhile research endeavor is to examine strategies that are likely to enhance intrinsic motivation in physical education and in school more generally. There is a wealth of empirical research supporting the application of Self-Determination Theory for classroom practice and educational reform policies (e.g., Deci, 2009; Reeve & Halusic, 2009; Vansteenkiste, Soenens, Verstuyf, & Lens, 2009). It is stressed that intrinsic motivation is important for learning in all educational settings (Niemiec & Ryan, 2009; Ryan & Niemiec, 2009). Some studies have emphasized the importance of choice in students' motivation (e.g., Prusak, Treasure, Darst, & Pangrazi, 2004) and in self-reported physical activity (e.g., Chatzisarantis & Hagger, 2009).

The use of music to make physical education more fun and exciting and to increase students' interest and motivation has been suggested by several authors (e.g., Colleran & Lipowitz, 1997; Greci, 1997; Konukman, Harm, & Ryan, 2012; Sariscsany, 1991). To date, research addressing the use of music in physical education contexts has been somewhat limited and focused on aspects such as whether it has an effect on junior high school girls' heart rate and blood pressure (Uppal & Datta, 1990) or the stylistic aspects of movement in gymnastics (e.g., Chen, 1985). The findings of such studies as well as those from psychomusicological interventions in the sport and exercise domain (e.g., Beisman, 1967) have seldom been tested in real-life physical education settings (e.g., Greci, 1997) and the current study is one of only a handful that examines the effects of music on students' situational motivation.

The Influence of Music in Physical Education and Sport

Music has the propensity to influence behavior, emotions, and cognition (Karageorghis, 2008; Karageorghis & Terry, 1997, 2009, 2011). In the presence of music, people can experience a range of emotions including enthusiasm, happiness, and relaxation (Bishop, Karageorghis, & Loizou, 2007; Chen, 1985; Lundqvist, Carlsson, Hilmersson, & Juslin, 2009). Research studies have shown that, in broad terms, loud and fast music (more than 120 beats per minute [bpm]) stimulates the human organism, while soft and slow music relaxes the organism (e.g., Copeland & Franks, 1991; Edworthy & Waring, 2006).

Musical accompaniment in the exercise domain has attracted the interest of many researchers in recent years (see Terry & Karageorghis, 2011 for a review). Some studies have shown that music promotes psychophysical and ergogenic effects (e.g., Anshel & Marisi, 1978; Copeland & Franks, 1991), while others show no significant benefit derived from musical accompaniment (e.g., Dyrlund & Wininger, 2008; Schwartz, Fernhall, & Plowman, 1990).

Ergogenic effects of music concern an increase in work output and such effects are particularly apparent when the physical activity is synchronized with musical tempo (Anshel & Marisi, 1978; Karageorghis et al., 2009), while psychophysical responses entail changes in affect and perceived exertion (Boutcher & Trenske, 1990; Copeland & Franks, 1991). Satisfaction and motivation are variables that have been relatively under-researched in the music and physical activity literature (Karageorghis et al., 2013).

The degree of music's efficacy in terms of conferring significant benefits to the listener has been ascribed to "how effectively it is selected" and to "who selects it" (Karageorghis, Priest, Terry, Chatzisarantis, & Lane, 2006; Karageorghis, Terry, & Lane, 1999); having an element of self-determination through the ability to self-select music is likely to increase intrinsic motivation (Karageorghis, 2008; Terry & Karageorghis, 2011). The reason for this is that music is strongly tied to young people's sense of "self" and personal identity within broader society (see North & Hargreaves, 2008). Accordingly, the self-selection of music affords young people an opportunity to assert and reinforce their sense of identity.

In a small number of studies, music has been used to expedite the acquisition of motor skills. For example, Spilthoorn (1986) investigated the influence of music on the development of gymnastic skills among female physical education students over a 3-month period. One group of students learned the skills with a musical accompaniment and the other without. The music did not influence technical aspects of the skills but did influence stylistic aspects. Interestingly, participants' musical perception abilities were found to contribute significantly to the efficacy of the music.

Allied to the issues surrounding psychological and physical performance outcomes is the possible moderating influence of gender. Research that has employed relatively complex motoric tasks (e.g., circuit-type exercises) has shown that females have a tendency to derive greater psychological benefits from music than males (e.g., Karageorghis et al., 2010). Given that Karageorghis et al. (2010) employed a young adult sample, it is not known whether their findings are generalizable to other age groups (e.g., school children). This factor contributed to the rationale underlying a test of the moderating influence of gender in the current study.

Although there is much research into motivation in the physical education context and in the exercise-to-music domain, to date no studies could be identified that have examined the influence of music in physical education at a situational level using the spectrum of motivation posited by self-determination theorists (e.g., Deci & Ryan, 1985; Ryan & Deci, 2000; Vallerand, 1997). The present study aimed to examine the effect of music on lesson satisfaction and four types of motivation (intrinsic, identified regulation, external regulation, and amotivation), while including sex as a moderating variable. In accordance with the extant literature (e.g., Lundqvist et al., 2009; Terry & Karageorghis, 2011), it was predicted that the use of music would have a beneficial effect on lesson satisfaction and increase self-determined types of motivation (e.g., intrinsic motivation and identified regulation), while reducing controlling types of motivation (e.g., extrinsic motivation) or amotivation at the situational level. It was also hypothesized that student-selected music would be more effective than teacher-selected music based on the tenets of Self-Determination Theory regarding the effects of choice on the sense of autonomy, which, in turn, can influence intrinsic and extrinsic motivation. Gender was predicted to have a moderating influence on lesson satisfaction in accordance with recent affect-related findings from work that used a young adult sample (Karageorghis et al., 2010). Specifically, it was predicted that the female students would report higher satisfaction than their male counterparts in both music conditions.

Method

Participants

Following appropriate ethical procedures in line with the Pedagogical Institute of Greece guidelines, the research team approached 200 senior high school students (82 boys and 118 girls), all of whom volunteered to participate in the study. The students came from eight classes associated with two public secondary schools in Greece and were in 10th grade (M_{age} = 16.3 years, SD = 1.1 years). Physical education is mandatory for all students attending Greek schools and senior high school students attend two 45-min physical education sessions per week.

Measures

A number of questionnaires were administered immediately on conclusion of the lesson. In order not to delay the students' transition to their next lesson, suitably brief psychometric instruments were selected to tap the outcome variables.

Physical Education Lesson Satisfaction at the Situational Level. This scale was developed by Duda and Nicholls (1992) to assess the degree of intrinsic satisfaction in senior high school physical education students. It was adapted for the Greek population by Papaioannou et al. (2007), and is composed of five items that focus on the construct of enjoyment in a wider sense (e.g., "Today I found the physical education lesson interesting"). Students responded on a 5-point Likert-like scale ranging from 1 (*Totally disagree*) to 5 (*Totally agree*). The scale is scored by summing the responses to the five items and dividing this number by five.

Intrinsic-Extrinsic Motivation at the Situational Level. The Situational Motivation Scale (SIMS) developed by Guay et al. (2000) and adapted for the Greek population by Papaioannou et al. (2007), is the only instrument that was specifically created to capture intrinsic, extrinsic motivation and amotivation at the situational level of generality. This scale is composed of 16 items that load onto four factors. Students are invited to respond to each item following the stem "I participated in the activities of today's lesson…" Examples of items from each factor include, intrinsic motivation ("because I believe that they were pleasant"), identified regulation ("because I did it for my own good"), external regulation ("because I felt that I had to do it"), and amotivation ("I don't know; I can't understand what I am doing in physical education"). Students responded on a 5-point Likert-like scale ranging from 1 (*Totally disagree*) to 5 (*Totally agree*). Each factor of the SIMS is scored by adding the four items together and dividing that number by four.

The validation study for the Greek population conducted by Papaioannou et al. (2007) regarding the intrinsic-extrinsic motivation measure revealed the following goodness-of-fit indices for the 4-factor model (intrinsic, identified, external, amotivation): $\chi^2 = 332$, $df = 98$, TLI = .89, CFI = .91, RMSEA = .06. The alpha reliabilities were .76, .75 and .73 for intrinsic motivation, external regulation, and amotivation, respectively. The alpha reliability for identified regulation was slightly low (.68). The originators of the measure considered these indices to be supportive of the factorial validity and internal consistency of the instrument.

Procedure

Design and Characteristics of the Lesson. A physical education lesson was designed using a circuit-type mode of exercise, which had the following structure: 5-min warm up, 20-minute exercise program (circuit-type exercise in time with or without music), and 5-minute cool down. The main part of the lesson was organized using six stations and students completed one exercise at each station. The six exercises comprised: a) bicep curls using low-weight bar bells (2.5 kg each); b) sit ups; c) push-ups; d) lower back hyperextensions; e) overhead soccer-type throws with a medicine ball (3 kg) using both hands; and f) skipping with a jump rope. Each exercise was of 15 seconds duration and between exercises there was a 30-second recovery interval. The same female physical education teacher delivered this standardized routine to all classes that participated in the study.

Piloting. The lesson was delivered to two classes that did not participate in the experimental phase to test its feasibility, identify any potential logistical problems, and prepare the physical educator for the experimental phase. The procedures were also standardized during this pilot phase.

Experimental Conditions and Measurements. The standardized lesson was delivered once a week, at the same time of the week, under three conditions: a) no-music control (NMC); b) with teacher-selected music (TSM); and c) with student-selected music (SSM). The order of conditions administered to each class was counterbalanced to avoid order effects. There were three measurements; one after the end of each lesson (e.g., one measurement after NMC, one after TSM, and another after SSM). Students spent the last 10 min of each lesson completing the questionnaires after receiving brief verbal instructions from one of the researchers. There was a 1-week interval between the administration of each condition.

Music Selection. Under the TSM experimental condition, an audiocassette with moderate-to-fast tempo (> 120 bpm) tracks representing the pop music genre (e.g., *Let's Get Loud* [131 bpm], *It's Raining Men* [124 bpm]) was recorded. For the application of the SSM experimental condition, the teacher surveyed the students in their previous lesson on their musical preferences. Subsequently, the favored musical selections of each class were recorded onto an audiocassette. Western musical pieces from the pop and rock genres of moderate-to-fast tempo (> 120 bpm) were the most preferred.

Data Analysis

Data were screened for univariate outliers using z scores $> \pm 3.29$ and for multivariate outliers using the Mahalanobis distance method with $p < .001$ (Tabachnick & Fidell, 2007, pp. 224–227). Normality was checked for in each cell of the analysis (Std. skewness/kurtosis > 2.58) and transformations were applied where violations were found. A two-factor mixed-model 3 (Condition) by 2 (Sex) ANOVA was used to analyze perceived lesson satisfaction. Mauchly's test of sphericity was used to identify the need for Greenhouse-Geisser adjustment to F tests. Where significant F values were found, pairwise comparisons with Bonferroni adjustment were used to identify where differences lay. Partial eta-squared (η_p^2) was used to evaluate the meaningfulness of any observed differences. According to Cohen (1988, pp. 184–185), η_p^2's of .01–.03, .06–.09 and above .14 indicate a small, medium and large effect, respectively. Due to serious violations of normality (significant standard skewness and standard kurtosis; $p < .001$) that could not be remedied by transformation, nonparametric analyses were applied to the motivation variables. These comprised a series of Friedman ANOVAs for each variable followed by a series of Wilcoxon matched-pairs signed ranks tests to identify where differences lay.

Results

Lesson Satisfaction

Initial examination of the perceived lesson satisfaction for univariate outliers showed five univariate outliers (three for TSM and two for SSM) and the cases associated with these values were excluded before statistical analysis. Examination of the standard skewness and kurtosis values in each cell of the analysis revealed major violations for skewness ($p < .001$) in TSM for the entire sample and for females ($p < .01$; see Table 1). As plots of the distribution curves generally revealed a negatively skewed profile with one instance of positive kurtosis (see Table 1), a *reflect and square root* transformation was applied to the data (Tabachnick & Fidell, 2007, p. 86–91).

The two-factor ANOVA on perceived lesson satisfaction showed that the Condition × Gender interaction was nonsignificant, $F(1.64, 315.90) = 1.34$, $p > .05$, $h_p^2 = .01$, observed power [OP] = .26. The main effect for condition was significant, $F(1.64, 315.90) = 94.82$, $p < .001$, $\eta_p^2 = .33$, OP = 1.00, with the independent

Table 1 Descriptive Statistics for all Dependent Variables (Pretransformation)

Condition	Variables	*M*	*SD*	Std. Skewness	Std. Kurtosis
Lesson satisfaction					
NMC	Entire Sample	3.60	.90	-2.28*	-1.18
	Females	3.70	.88	-1.77	-1.15
	Males	3.43	.90	-1.56	-0.53
TSM	Entire Sample	4.40	.57	-3.81***	-0.51
	Females	4.54	.49	-2.86**	-2.30*
	Males	4.19	.62	-1.65	-0.22
SSM	Entire Sample	4.36	.54	-2.06*	-1.89
	Females	4.42	.51	-1.97*	-1.26
	Males	4.27	.57	-0.73	-1.38
Amotivation					
NMC	Entire Sample	2.47	.87	2.63**	0.39
	Females	2.31	.81	2.31*	0.91
	Males	2.72	.91	1.06	-0.13
TSM	Entire Sample	2.06	.73	3.32***	0.15
	Females	1.93	.72	3.25**	0.96
	Males	2.25	.69	1.87	-0.34
SSM	Entire Sample	2.14	.70	4.39***	3.01**
	Females	2.01	.60	1.79	1.86
	Males	2.34	.80	2.78**	0.53
External regulation					
NMC	Entire Sample	2.88	.84	1.00	-0.63
	Females	2.77	.76	1.35	-0.59
	Males	3.06	.93	-0.41	-0.27
TSM	Entire Sample	2.48	.82	0.97	-1.63
	Females	2.39	.83	0.67	-1.18
	Males	2.63	.80	0.93	-1.38
SSM	Entire Sample	2.65	.80	1.73	-1.38
	Females	2.55	.78	1.40	-1.14
	Males	2.81	.81	1.00	-0.88
Identified regulation					

(continued)

Table 1 (*continued*)

Condition	Variables	*M*	*SD*	Std. Skewness	Std. Kurtosis
NMC	Entire Sample	3.39	.84	-1.03	-2.19
	Females	3.51	.79	-1.33	-0.75
	Males	3.19	.89	0.27	-2.02*
TSM	Entire Sample	4.20	.63	-2.58**	0.07
	Females	4.25	.60	-2.58**	1.04
	Males	4.11	.66	-0.93	-0.64
SSM	Entire Sample	4.19	.65	-3.31***	0.96
	Females	4.23	.65	-2.82**	0.46
	Males	4.14	.65	-1.87	1.25
Intrinsic motivation					
NMC	Entire Sample	3.48	.88	-1.65	-1.50
	Females	3.60	.88	-1.36	-1.20
	Males	3.30	.84	-1.32	-1.04
TSM	Entire Sample	4.35	.58	-2.79**	-0.90
	Females	4.45	.51	-1.92	-1.50
	Males	4.18	.64	-1.12	-0.85
SSM	Entire Sample	4.30	.61	-3.05**	-0.41
	Females	4.38	.54	-1.99*	-0.87
	Males	4.17	.68	-1.54	-0.68

Note. NMC = No-music control, TSM = Teacher-selected music, and SSM = Student-selected music.
* $p < .05$, ** $p < .01$, *** $p < .001$.

variable manipulation accounting for 33% of the variance. Pairwise comparisons indicated that students in NMC reported significantly ($p < .001$) lower satisfaction when compared with TSM and SSM (see Table 1). There was also a significant main effect for sex, $F(1, 93) = 15.27$, $p < .001$, $\eta_p^2 = .07$, OP = .97, wherein the male students reported greater lesson satisfaction overall than their female counterparts. Sex accounted for 7% of the variance in lesson satisfaction.

Situational Motivation

Screening for outliers among the subscales of the Situational Motivation Scale revealed five cases with multiple univariate outliers, six cases with univariate outliers, and five cases that were multivariate outliers. All cases identified as outliers were excluded from the inferential analysis, reducing the sample size to 184.

Mean scores, standard deviations, standard skewness and kurtosis of the motivation dimensions across the three experimental conditions are presented in Table 1. Examination of the standard skewness and kurtosis scores revealed severe skewness ($p < .001$) in a number of variables, hence a *reflect and square root* transformation was applied. This did not remedy the instances of nonnormality, therefore a more extreme transformation (*reflect and logarithm*) was applied. This also did not normalize the data given that previously normally-distributed cells exhibited nonnormal distribution, therefore a series of Friedman nonparametric ANOVAs was used to analyze the data.

The Friedman tests indicated significant differences among conditions in each dependent variable (amotivation, external regulation, identified regulation, and intrinsic motivation; all at $p < .001$). Friedman's test does not allow gender to be included as an independent variable. A visual examination of the means and standard deviations for males and females (see Table 1) indicated no differences; therefore, no further independent samples nonparametric tests were applied for sex.

To identify where differences lay following each Friedman test, follow-up Wilcoxon tests were used and these indicated that: for amotivation, scores were lower for TSM than NMC ($p < .001$) and lower for SSM than NMC ($p < .001$); for external regulation, scores were lower for TSM than NMC ($p < .001$), lower for SSM than NMC ($p < .01$), and lower for TSM than SSM ($p < .01$); for identified regulation, scores for TSM were higher than NMC ($p < .001$) and higher for SSM than NMC ($p < .001$); for intrinsic motivation, scores were higher for TSM than NMC ($p < .001$) and higher for SSM than NMC ($p < .001$). Collectively, these results indicate differences in the motivation variables between both experimental conditions and control, but no differences between experimental conditions.

Discussion

The aim of this study was to examine the effect of asynchronous music on lesson satisfaction and the intrinsic/extrinsic motivation of secondary school students in physical education classes. A secondary aim was to examine the influence of sex (male/female) on the responses to music. The results confirm findings from related studies in the physical activity sphere concerning the influence of music on affective and motivational variables (see Karageorghis & Terry, 1997, 2011 for review). This only provides partial support for our research hypothesis given that music selected by the students did not have a superior effect when contrasted with that selected by the teacher. Sex did not moderate responses as it did in a recent study with adults who were engaged in comparable motor tasks (Karageorghis et al., 2010); therefore, the secondary hypothesis was not supported.

With regard to students' lesson satisfaction, differences were evident across conditions. More specifically, in the NMC (no music) condition, the level of students' satisfaction was lower when compared against the two experimental conditions (TSM and SSM). Lesson satisfaction is seminal in terms of sustaining students' motivation for physical education. Ryan and Deci (2000) contented that individuals are highly motivated on an intrinsic level toward activities that are novel, challenging, or possess aesthetic value. Accordingly, the music intervention used in the current study may have increased intrinsic motivation by introducing novelty and aesthetic value into the lessons. The present findings show that teaching physical education with musical accompaniment has a measurable positive influence on lesson satisfaction. This lends support to the notion that the use of music creates a pleasant atmosphere, enhances students' mood, and is thus likely to motivate them to engage in the task with greater intensity (Chen, 1985; Sariscsany, 1991; Spilthoorn, 1986).

In the current study, amotivation was lower in the music conditions when compared with the no-music control. Taking an idiographic approach with a sample of amotivated students, Ntoumanis et al. (2004) reported that a possible remedy for reducing amotivation in physical education was the enhancement of positive affect. The present study confirms a consistent finding within the sport and exercise psychology literature; namely, that music has the capacity to increase positive affect (Boutcher & Trenske, 1990; Karageorghis et al., 2009).

The students reported lower levels of external regulation in the two music conditions when compared with the control, and the teacher-selected music yielded lower scores than the student-selected counterpart. In the control condition, students' sense of obligation to engage in the class was greater as reflected in their external regulation scores. It is conceivable that the musical accompaniment increased participants' inherent satisfaction with the activity, thereby allaying their focus on the outcome of the session; a hallmark of extrinsic motivation (Ryan & Deci, 2000). The present results revealed significant differences in students' identified regulation across the three conditions, with the highest levels evident in the experimental conditions; a pattern that was repeated in respect to intrinsic motivation. The latter finding is encouraging, as intrinsic motivation has been recognized to be one of the main determinants of sport and exercise participation during adolescence (Papaioannou et al., 2006).

Contrary to the research hypothesis, there were no differences in intrinsic motivation observed between the two experimental conditions. It was expected that if the students were asked to select the musical accompaniment for the lesson, then this would enhance their sense of autonomy (Ryan & Deci, 2000). The lack of differences between the two experimental conditions on several of the measures may be attributable to variability in music selections within each condition, particularly the pieces selected by the students. Equally, it might be that the different types of music selected by the teacher and the students exerted similar effects; perhaps this is as a consequence of both music conditions being in the moderate-to-fast tempo band (> 120 bpm; cf. Karageorghis & Jones, 2014). It is possible that two selections that differ in their musical and associational properties may have different effects, which ultimately enhance intrinsic motivation (for example) to the same degree. A possible explanation for the lack of differentiation in autonomy between the two music conditions is that, in the student-selected condition, a group process took place and hence no *individual* would have had ownership of the music selections.

One of the main limitations of the current study is that, based on the measures employed, it is challenging to deduce the precise mechanisms underlying the findings. Future work might use a broader range of measures that perhaps tap attitudes, enjoyment, emotion, and affect in the physical education context to shed light on such mechanisms. In addition, future research could explore the effects of music on different types of physical activity (e.g., a range of sports, recreational swimming, stationary cycling, walking, etc.). Nevertheless, the present results indicate that, as has been previously suggested (Chen, 1985; Spilthoorn, 1986), the motivational and experiential effects of music have a role in terms of creating an optimal teaching and learning environment in a physical education context.

The present study employed a short-term repeated measures-type design and so the long-term impact and utility of asynchronous music in physical education is unknown. Future studies need to examine the longitudinal effects of music-related interventions given that if students are desensitized to the music and the "novelty effect" wears off, the benefits that are expounded in the current study might dissipate. It is not known whether the benefits persist or what the optimal ratio of classes with music to classes without is. Such knowledge would enable teachers and pedagogues to maximize the benefits of musical accompaniment. Furthermore, in educational settings, the presence of highly intrinsically motivated students is always desirable as this leads to superior learning outcomes (Niemiec & Ryan, 2009; Ryan & Deci, 2009; Sun & Chen, 2010).

The use of music not only increases students' lesson satisfaction but also their intrinsic motivation. In tandem with this, amotivation is reduced. Accordingly, physical educators can use music as a way by which to improve children's intrinsic motivation and lesson satisfaction. Vallerand and Rousseau (2001) detailed how increased levels of self-determination can lead to more positive emotions that, in turn, serve to bolster motivation at the situational level. In closing, the findings of the current study are of particular merit for those physical educators who struggle to sustain students' intrinsic interest in exercise and physical activities (e.g., Tessier, Sarrazin, & Ntoumanis, 2010). Educators need to keep in mind that many educational aspects and of course some of the physical education content might not be inherently fun or intrinsically motivating for students (Niemiec & Ryan, 2009). Based on the results of the current study, the use of asynchronous music during regular lessons seems a relatively simple and inexpensive intervention that might help teachers in bolstering students' motivation and level of engagement.

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