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The relation between student motivation and student grades in physical education: A 3-year investigation

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Enhancing students' academic engagement is the key element of the educational process; hence, research in this area has focused on understanding the mechanisms that can lead to increased academic engagement. The present study investigated the relation between motivation and grades in physical education (PE) employing a 3-year longitudinal design. Three hundred fifty-four Greek high school students participated in the study. Students completed measures of motivation to participate in PE on six occasions; namely, at the start and the end of the school year in the first, second, and third year of junior high school. Students' PE grades were also recorded at these time points. The results of the multilevel growth models indicated that students' PE grades increased over the 3 years and students had better PE grades at the end of each year than at the beginning of the subsequent year. In general, students and classes with higher levels of controlling motivation achieved lower PE grades, whereas higher levels of autonomous motivation were associated with higher PE grades. These findings provide new insight on the associations between class- and individual-level motivation with objectively assessed achievement in PE.

The prediction of school students' academic engagement and achievement is a focal issue in educational psychology. Most of the research in this area aims to understand the variety of mechanisms (e.g., motivational climate, motivational regulations, learning strategies) that can lead to increased academic engagement and achievement (e.g., Boiché et al., 2008; Liem et al., 2008; Vansteenkiste et al., 2009). Tucker et al. (2002) argued that motivation is one of the most important factors that can affect academic achievement. Yet, longitudinal research evidence exploring the effects of different types of motivation on indices of academic achievement is limited. The present study attempted to examine longitudinally the effects of different motivational regulations, as conceptualized by self-determination theory (SDT; Deci & Ryan, 2000), on students' grades in school physical education (PE) lessons.

According to SDT, motivation should be viewed from a multidimensional perspective. Specifically, SDT differentiates among intrinsic motivation, extrinsic motivation, and amotivation. Intrinsic motivation reflects engagement in an activity due to inherent interest, and for the pleasure and satisfaction of performing it. When intrinsically motivated, students act out of choice, for the pleasure derived during class participation, and the sense of satisfaction in completing the taught tasks (Deci & Ryan, 2000). For instance, an intrinsically motivated student participates in the PE lesson for the fun and the pleasure of performing different sporting activities.

Extrinsic motivation refers to engagement in an activity in order to obtain outcomes separate from the activity itself. Extrinsic motivation comprises three types of behavioral regulation[1] that represent different levels of self-determination, namely external, introjected, and identified regulations (Deci & Ryan, 2000). Identified regulation is a self-determined type of extrinsic motivation and refers to involvement in an activity because the specific activity is valued and considered important for the individual. An example of this type of motivational regulation would be of a student who participates in PE lessons to improve his/her health, because this is important to him. Introjected regulation refers to involvement in an activity in order to avoid negative feelings, such as guilt, or to attain self-worth. For instance, some students may participate in PE in order to avoid the feeling that they have let their parents down. External regulation is the least self-determined type of extrinsic motivation as it refers to engagement in an activity in order to gain rewards or social approval, to avoid punishment or to

[1]According to SDT, the most self-determined type of extrinsic motivation is integrated regulation, a regulation reflecting the integration of behavior within the self (Deci & Ryan, 2008). Integrated regulation was not measured in the present study as there is no established questionnaire that assesses this regulation in PE or education in general.

comply with external norms. For example, a student who participates in PE purely because it is a compulsory subject is motivated by external regulation. Finally, amotivation represents the absence of intrinsic and extrinsic motivation. When amotivated, students do not have any motivation to engage in PE, feel incompetent, without control, and are unwilling to exert effort (Deci & Ryan, 2000).

Intrinsic motivation and identification are considered autonomous types of motivation, whereas introjected and external regulations are considered as controlling types of motivation. Importantly, motivational regulations explain the "why" of involvement and not just the decision to engage in an activity. For instance, although school attendance is compulsory, there are students who enjoy participation (intrinsic motivation), whereas others participate due to obligation (extrinsic motivation).

Motivational regulations have different cognitive, affective, and behavioral consequences. In a review of the application of SDT in PE, Ntoumanis and Standage (2009) showed that autonomous motivation is related to more adaptive responses during PE lessons, compared with controlling motivation. For example, autonomous motivation positively correlates with positive affective responses during PE, such as enjoyment, vitality, and positive affect (Standage et al., 2005; Mouratidis et al., 2008; Ullrich-French & Cox, 2009). On the contrary, controlled motivation is positively associated with lower enjoyment, higher boredom, and unhappiness (Ntoumanis, 2001; Standage et al., 2005; Mouratidis et al., 2008; Ullrich-French & Cox, 2009). In addition, autonomous motivation is positively associated with cognitive outcomes such as valuing of physical activity and concentration during lessons (Ntoumanis, 2005; Ullrich-French & Cox, 2009). Furthermore, in contrast to controlling motivation, autonomous motivation is a more positive predictor of behavioral indices such as effort and persistence (Ntoumanis, 2001; Ullrich-French & Cox, 2009). Finally, autonomous motivation has positive relations with health-related constructs such as leisure time physical activity intentions and health-related quality of life (Standage et al., 2003; Standage & Gillison, 2007).

In addition to the aforementioned outcomes, it is important to also examine student achievement and grades. Research evidence with university students has indicated that autonomous motivational regulations correlate with higher grades in law and economics (Ahmed & Bruinsma, 2006), and organic chemistry (Black & Deci, 2000). Similarly in secondary education, autonomous motivational regulations have been associated with higher academic achievement (Fortier et al., 1995; Ratelle et al., 2007; Vansteenkiste et al., 2009). On the contrary, controlling motivation and amotivation have been found to negatively predict academic achievement (Lepper et al., 2005; Legault et al., 2006).

A drawback of research examining the relations among motivational regulations and academic achievement is the lack of assessment of the dynamic relation between the two constructs. Researchers have usually assessed these constructs at one point in time. For example, Boiché et al. (2008) measured high school students' motivation at the beginning and their performance at the end of a 10-week gymnastics cycle. They provided evidence that highly autonomously regulated PE students applied more effort, performed better, and had higher grades in gymnastics compared with moderately autonomously regulated and controlling regulated students. Importantly, moderately autonomously regulated students showed higher effort, performance, and grades than controlling regulated students.

However, longitudinal studies in this area are important because the relation between motivation and PE grades may fluctuate. Past evidence revealed a decrease in autonomous motivation and an increase in amotivation in PE lessons from the beginning to the end of junior high school (Ntoumanis et al., 2009). However, to date, there is limited evidence on the trajectory of motivational regulations across school years and their longitudinal association with school grades. Outside PE, Makri-Botsari (1999) demonstrated that intrinsic motivation is positively related to achievement in mathematics, science, and language (ancient and modern Greek), but this relation declines during the transition from elementary to high school. In a 3-year longitudinal study examining the transition from junior to senior high school, Otis et al. (2005) revealed that students' intrinsic motivation and extrinsic motivation decreased gradually and these declines were associated with less educational adjustment.

The extent to which such longitudinal findings generalize to PE is unknown. There is substantial research evidence (Bong, 2001; Gottfried et al., 2001; Guay et al., 2010) indicating that motivation can vary across different school subjects. For instance, Guay et al. (2010) investigated the differences in motivation in three school subjects (reading, writing, and mathematics). The results of the study indicated that several motivational regulations were more salient in some school subjects but not others. Similarly, Bong (2001) suggested that motivation-related variables, such as achievement goals, self-efficacy, and task value show high subject specificity (i.e., Korean, English, mathematics, and science) in middle and high school Korean students. Thus, it is important to examine the relation between motivation and achievement in specific school subjects. PE is an interesting subject to study because, contrary to other school subjects, it requires physical competence from the students. Usually there is a wide variation in students' physical competence levels due to out-of-school participation in organized sport by some of the students. These differences might impact upon both the motivation of the students and their achievement in the subject. Understanding motivation in PE is also important from a public health perspective as PE-related motivation can

predict intentions for leisure time physical activity (see Barkoukis & Hagger, 2009; Barkoukis et al., 2010).

In brief, this study extends past literature in two ways. First, it examines the relation between motivation and achievement in a school subject in which there is only scarce evidence so far regarding this relation (e.g., Boiché et al., 2008). Second, it employs a 3-year longitudinal design (i.e., from the beginning to the end of Greek junior high school), which is significantly longer than designs used by many other studies looking at the relation between motivation and school achievement (e.g., Boiché et al., 2008; 10 weeks). We did not explore the temporal patterns of students' motivational regulations, as these have been reported elsewhere (Ntoumanis et al., 2009). Thus, the purpose of the study is to examine changes in grades in PE and how motivational regulations in PE predict these changes.

Based on the aforementioned research evidence, the following hypotheses were made. In terms of PE grades, it was assumed that they will increase over time (H1). This is because, according to the Greek PE curriculum for junior high school (see Tsorbatzoudis et al., 2008), an emphasis is placed on skill development in the first year of junior high school. In subsequent years, it is assumed that motor skills have been developed and emphasis is placed on teaching game tactics (for team sports). Students apply in competitive situations the tasks they have already learned in previous years. Thus, it is assumed that grades will increase as students perform the same tasks and tactics already taught in the previous years.

With respect to intrinsic motivation and identified regulation, they were expected to be positive predictors of PE school grades (H2). With respect to introjected regulation, research evidence has provided contradictory findings as to how this regulation relates to achievement (Vansteenkiste et al., 2004; Otis et al., 2005). Nevertheless, as it is a controlling type of motivation, in this study it was expected to negatively predict PE grades (H3). External regulation and amotivation were also hypothesized to be negative predictors of PE grades (H4), as these motivational variables reflect little or no self-determination in behavior. These hypotheses were made with respect to three different levels of analysis. Within-person relations, as well as between-person and between-class differences in motivation were investigated as predictors of PE grades because they represent statistically and conceptually different types of association (Curran & Bauer, 2011; see Results section for more details). We expected the relations between motivation and grade to be of the same direction at all three levels (within-students, between-students, and between-classes), as the motivation variables proposed by SDT are purported to predict motivation-related outcomes in the same way at all levels of a generality hierarchy (Vallerand, 1997). However, we did not make any hypothesis as to the strength of the predicted relations at the three levels.

Method

Sample

Three hundred fifty-four Greek students (males = 185; females = 169) from 17 classes in five schools in a large city in the north of Greece took part in the study. The PE curriculum was delivered by eight PE teachers with more than 15 years of experience in teaching school PE. The curriculum was standard across all classes and conformed to the curriculum provided by the Ministry of Education. To ensure a consistent application of the curriculum and to minimize inter-rater differences on student grades, we selected schools in which the teachers taught the same students throughout the 3 years of the study. All students were Caucasians and were attending typical coeducational Greek schools. The students' grades and motivation were recorded at the start and at the end of the school year in the first year (i.e., age 12), second year (i.e., age 13), and third year (i.e. age 14) of Greek junior high school. Three hundred thirty-three students completed the questionnaires on the first measurement occasion, 280 on the second and third occasions, 235 on the fourth occasion, and 281 on the fifth and sixth occasions. Drop out of students across the measurement occasions was due to absence of the students during the days of data collection (e.g., because of illness or participation in other school activities) or because they had moved to another school. The participants were drawn from a large longitudinal study, findings from which (pertaining to different research questions) have been published elsewhere (Ntoumanis et al., 2009; Barkoukis et al., 2010).

Measures

Motivational regulations

A PE-adapted version of the Self-Regulation Questionnaire and the amotivation subscale of the Academic Motivation Scale (Vallerand et al., 1992) developed by Goudas et al. (1994) were used to measure motivational regulations in PE. The questionnaire measures intrinsic motivation (example item: "because it is fun"), identified (example item: "because I want to improve in sport"), introjected (example item: "because I would feel bad about myself if I didn't") and external regulations (example item: "so that the teachers won't yell at me"), and amotivation (example item: "but I can't see what I am getting out of PE"). The participants responded to the item "I take part in this PE class . . ." on scales ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Previous research has supported the validity and reliability of the questionnaire with both British (Goudas et al., 1994) and Greek high school students (Kiriakidis et al., 2007).

PE grades

According to the Greek curriculum, students' grades are based on a composite score which should reflect: (a) psychomotor development (i.e., whether the students have developed taught skills or improved their level of their fitness; 40% of total grade); (b) emotional involvement (i.e., positive attitudes, effort, perceptions, and values developed through the lesson; 40% of total grade); and (c) knowledge gained during the lesson (i.e., game rules, historical aspects of sport, benefits of exercise; 20% of total grade) (see Tsorbatzoudis et al., 2008). PE grades theoretically range from 0 to 20, but in practice they often range from 12–13 to 20. Ikonomopoulos et al. (2004) stated that this is a common practice in grading students in PE classes in several educational systems (see also Klein & Hardman, 2008). In this sense, the grades do not simply reflect psychomotor development, but rather an index of achievement relevant to the aims of the national curriculum. Hence, it seems that PE teachers place more emphasis on students' effort and participation in the lesson, rather than on physical

performance only. In each trimester, students are graded on these three domains with respect to the content of the lesson. Students are graded three times per year: December (i.e., grading period from September to November), March (i.e., grading period from December to February), and June (i.e., grading period from March to May). The grades of the first and third trimesters were used in this study to investigate the effect of motivation on students' grades in each of the 3 years of high school.

Procedure

Informed consent to participate in the study was obtained from Head of School and PE teachers in all schools involved in this study. Written information about the purposes of the study and consent forms were also provided to parents and students. Those students who returned both forms participated in the study (97% response rate). The students completed the questionnaires in a quiet environment under the supervision of experienced research assistants. Both verbal and written instructions were given to the students regarding the content and the completion of the questionnaires. The students were reassured about the confidentiality of the responses and were informed that they could withdraw at any time during the completion of the questionnaires. The completion of the questionnaire was performed twice a year; on late-October and mid-May. At the end of each school year, the first author contacted the schools and obtained the PE grades for all the students for that year. Students' questionnaires and grades were matched up across the measurement occasions by school personnel using demographic information regarding students' PE class, gender, and date of birth.

Results

Descriptive statistics and reliability

Table 1 shows the means, standard deviations and Cronbach's alpha coefficients of the motivational regulations and PE grades across all time points. Internal consistency of all subscales was acceptable across all time points. In general, students reported levels of intrinsic and identified regulation above the midpoint of the scale, and levels of introjected regulation, external regulation and amotivation below the midpoint of the scale. Students' mean PE grades reflected high achievement scores across the course of the study.

Changes in PE grades over time

PE grades were modeled across the six measurement times (i.e., the beginning and end of three consecutive school years) using MLWin 2.10 Multilevel Modelling software (Rasbash et al., 2009), with repeated time points (Level 1) nested within students (Level 2), which were nested within classes (Level 3). Prior to constructing models exploring the research hypotheses, we constructed a model which included age and gender (entered as a dummy variable; male = 0, female = 1) as predictors of PE grades. This model showed no significant effects of age or gender; hence, we did not include these variables in any further models.

To explore hypothesis 1, three unconditional growth models were constructed (see Table 2). The first included four time-variables modeled as fixed effects within the level 1 equation, which aimed to test: (a) a linear annual effect of time (i.e., changes in PE grades year on year; time was centered at the beginning of the study); (b) a quadratic annual effect of time; (c) a within-year effect of time (i.e., changes in PE grades from the beginning to the end of the year; coded as beginning = 0, end = 1); and (d) an interaction between the linear between-year variable change and the within-year variable change. This latter variable was included to test if the linear annual effect was different at the beginning or at the end of the year. Results revealed that grades generally increased linearly over time and grades were higher at the end of year than at the beginning; however, this latter trend became weaker over the course of the study (see Fig. 1).

In the second and third models, random effects were considered to assess inter-individual and inter-class variability in the rate of change of PE grades, respectively. Results revealed significant inter-individual and inter-class variability in the linear and quadratic effects of time, as well as the within-year effect of time.

Motivational regulation as predictors of PE grades

To examine the predictive effects of motivation on grades, a conditional growth model was constructed for each motivational regulation (see Table 3, models 4–8). Building upon the unconditional growth model reported above (i.e., model 3), the respective motivational regulation was centered on each student's unique mean score and entered into the level 1 equation. This predictor

Table 1. Descriptive statistics of the motivational regulations and physical education grades

	Lowest α across time points	Mean (Standard deviation)					
		Time 1	Time 2	Time 3	Time 4	Time 5	Time 6
Intrinsic	0.86	5.45(1.41)	5.32(1.46)	5.02(1.43)	5.05(1.49)	4.88(1.46)	4.89(1.46)
Identified	0.72	5.57(1.19)	5.33(1.32)	5.06(1.32)	5.04(1.43)	4.87(1.47)	4.83(1.46)
Introjected	0.80	3.49(1.52)	3.30(1.52)	3.49(1.35)	3.24(1.38)	3.44(1.41)	3.40(1.38)
External	0.79	2.99(1.56)	2.91(1.57)	3.15(1.58)	3.02(1.63)	3.20(1.60)	3.17(1.57)
Amotivation	0.73	2.19(1.44)	2.13(1.44)	2.55(1.47)	2.28(1.41)	2.35(1.43)	2.48(1.48)
PE grades	–	18.18(1.10)	19.04(1.13)	18.32(1.28)	19.20(1.35)	18.78(1.15)	19.25(0.96)

Note. Times 1, 3, and 5 represent the beginning of the first, second, and third school year, respectively. Times 2, 4 and 6 represent the end of the school year.

Table 2. Modeling change in physical education grades across time

	Model 1		Model 2		Model 3	
Fixed Effects	*b*	SE	*b*	SE	*b*	SE
Intercept	18.16*	0.11	18.17*	0.11	18.17*	0.13
Linear time	0.19*	0.07	0.20*	0.08	0.19	0.16
Quadratic time	0.04	0.03	0.04	0.03	0.05	0.06
Within year	0.92*	0.05	0.92*	0.04	0.94*	0.07
Linear * Within	–0.17*	0.04	–0.17*	0.03	–0.18*	0.03
Random Effects						
Level: Classes						
Intercept	0.14*	0.06	0.14*	0.06	0.22*	0.09
Linear time					0.34*	0.15
Quadratic time					0.04*	0.02
Within year					0.06*	0.03
Level: Student						
Intercept	0.59*	0.05	0.80*	0.08	0.74*	0.07
Linear time			0.92*	0.16	0.63*	0.14
Quadratic time			0.15*	0.03	0.12*	0.03
Within year			0.07*	0.02	0.01	0.02
Level: Occasion						
Intercept	0.45*	0.02	0.29*	0.02	0.29*	0.02
-2 Log-likelihood	4706.16		4497.34		4377.10	

Note: Covariances between random effects are not shown to simplify the presentation of the results. * $P < 0.05$.
Model 1 examined fixed effects only, model 2 examined variability of slopes across students, and model 3 examined variability of slopes across classes.
SE. standard error.

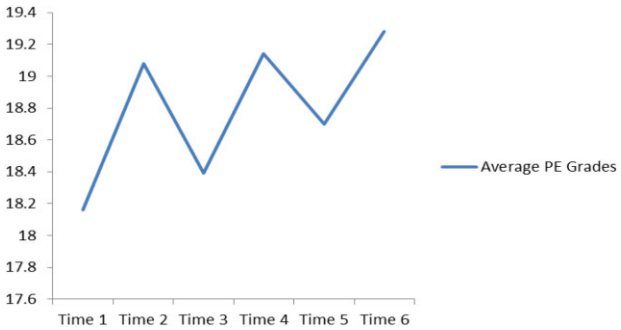

Fig. 1. Change in physical education (PE) grades over 3 years of junior high school.

explored whether changes in students' motivation were associated with changes in PE grades. Additionally, students' mean score was centered on the respective class mean and entered into the level 2 equation to examine the relation between students' average motivation relative to their classmates and PE grades. Finally, each class mean was entered into the level 3 equation to investigate whether class average motivation was associated with PE grades[2].

[2]Due to the centering strategy of the time variables, the coefficients for the motivational regulations in the conditional models refer to associations between these regulations and grades at the beginning of the study. However, we also explored growth models that included regulation × time interaction terms to assess the variability of these relations over time. These models revealed that all the relations were stable across time with the exception of the within-person relation between external regulation and PE grades which became stronger over the course of the study.

Intrinsic motivation

Results for model 4 showed no significant within-person relation between intrinsic motivation and PE grades. However, students who reported higher average levels of intrinsic motivation relative to their classmates achieved higher grades, compared with students who reported lower average levels of intrinsic motivation relative to their classmates. Moreover, classes with high average levels of intrinsic motivation achieved higher grades, compared with classes with lower average levels.

Identified regulation

Results for model 5 showed that students who reported higher average levels of identified regulation relative to their classmates (i.e., Level 2) achieved higher grades, compared with students who reported lower average levels of identified regulation. No significant within-person or between-class relations between identified regulation and PE grades were found.

Introjected regulation

Results for model 6 showed that increases in students' introjected regulation were associated with lower PE grades. No significant between-person or between-class relations between introjected regulation and PE grades were found.

External regulation

Results for model 7 showed no significant within-person relation between external regulation and PE grades.

Table 3. Conditional growth models exploring motivational regulations as predictors of physical education grades

	Model 4 Intrinsic motivation		Model 5 Identified motivation		Model 6 Introjected motivation		Model 7 External motivation		Model 8 Amotivation	
	b	SE	*b*	SE	*b*	SE	*b*	SE	*b*	SE
Intercept	16.57*	0.07	16.51*	1.14	19.24*	0.68	19.76*	0.44	19.53*	0.38
Linear time	0.07	0.17	0.06	0.17	0.06	0.17	0.07	0.17	0.08	0.17
Quadratic time	0.11	0.06	0.11	0.06	0.11	0.06	0.11	0.06	0.10	0.06
Within year	0.97*	0.08	0.97*	0.08	0.97*	0.08	0.97*	0.08	0.97*	0.08
Linear * Within	–0.22*	0.03	–0.22*	0.03	–0.21*	0.03	–0.22*	0.03	–0.22*	0.03
Regulation at level 1	0.01	0.02	–0.01	0.02	–0.04*	0.02	–0.02	0.02	–0.04*	0.02
Regulation at level 2	0.11*	0.04	0.15*	0.04	–0.06	0.04	–0.17*	0.04	–0.20*	0.04
Regulation at level 3	0.32*	0.15	0.33	0.22	–0.31	0.20	–0.51*	0.14	–0.58*	0.16
-2 Log-likelihood	3623.45		3617.09		3622.73		3601.18		3592.88	

Note: To simplify the presentation of the results only fixed effects are shown; $*P < 0.05$.
SE, standard error.

However, students who reported higher average levels of external regulation relative to their classmates achieved lower PE grades, compared with students who reported lower average levels of external regulation. In addition, classes with higher average levels of external regulation achieved lower grades, compared with classes who reported lower average levels.

Amotivation

Results for model 8 showed that increases in students' amotivation were associated with lower PE grades. In addition, students who reported higher average levels of amotivation relative to their classmates achieved lower PE grades, compared with students who reported lower average levels of amotivation. Finally, classes with higher average levels of amotivation achieved lower grades, compared with classes who reported lower average levels.

Discussion

The present study investigated the longitudinal relations between motivational regulations in PE and students' PE grades. A 3-year framework was employed spanning across Greek junior high school. With respect to the PE grades' trajectory, the findings of the study support our hypothesis that students' grades would improve each year, although the trajectory varied across individuals and classes. This finding could be attributed to the change of the PE curriculum from teaching skills in grade 7 to understanding game tactics in grades 8 and 9. Teachers may be grading skill performance more strictly because it may be easier to spot mistakes when students are practicing skills in a drill, compared with general game play. In addition, mistakes in game play may be harder to spot, for example, in team games a tactical mistake (e.g., poor defensive positioning) might not be easily identifiable. Other possible reasons for the yearly improvement in students' grades could be the familiarization of the teacher with the students and the possibility that students simply improved over time.

In addition, students' grades improved within the same year, although this pattern was variable across individuals and classes. According to the national curriculum, in each trimester different teaching material is provided to the students and they should be graded according to their performance on this material (see Tsorbatzoudis et al., 2008). Hence, students should be graded independently from their performance on the previous trimester. Yet, these results imply that teachers are heavily influenced by their interactions with the students during the previous trimester. Therefore, it seems that teacher–student familiarization influences the grading process, albeit, this trend was weaker in the last year of junior high school.

However, it should be noted that at the beginning of each year the grades were lower than those at the end of the previous year. This finding indicates that at the beginning of the year PE teachers are more conservative when grading their students. Taking into consideration that in practice PE teachers rarely grade a student below 16, this grade becomes 17 or 18 at the end of the year, assuming the student improves over the year. Hence, in the next year the PE teacher will not grade this student with 19 as there would be no sufficient grade range to reflect the improvement of the student.

Regarding intrinsic motivation, the results of the analyses indicated a significant and consistent effect on PE grades for students and classes, but not at the intraperson level. Students and classes with high average levels of intrinsic motivation reported higher grades throughout the 3 years of high school. This finding supports our hypothesis and SDT. It is plausible that intrinsically motivated students try harder during the lesson, pay more attention, and persist more in order to learn the skills and game tactics taught compared with less intrinsically motivated students. If this is the case, these students are graded higher in the emotional and knowledge gained parts of the evaluation. In addition, as a result of enhanced participation, they are more likely to perform better on the various criteria included in the psychomotor part of their evaluation. At the class level, students in intrinsically motivated classes obtain higher grades,

compared with students in less intrinsically motivated classes. This may signify that teachers' evaluations of achievement may be influenced by the overall levels of motivation within the class, in addition to individual factors. The lack of significant effect at the intraperson level implies that relative changes in intrinsic motivation (or identified regulation, as discussed below) may not be of sufficient magnitude to change student achievement from students' own baseline scores, possibly due to ceiling effects with regard to the scores of these two types of motivation.

The results for identified regulation also revealed a positive and significant between-person effect of this type of motivation on PE grades. This finding is in congruence to our hypothesis and theoretical predictions (Deci & Ryan, 2000). As an autonomous type of regulation, identified regulation was expected to positively influence students' grades. It is possible that students high in identified regulation value the benefits from PE participation and put more attention and effort in the lessons. If this is the case, the teachers may have positively graded these elements of student participation. Also, similar to the intrinsic motivation, it is assumed that students' effort and persistence, because they value PE, may have led to higher performance in the taught activities, resulting in higher grades in the evaluation. In contrast to intrinsic motivation, however, no class-level associations between identified regulation and achievement emerged. It is plausible that teachers can easily notice behavioral indicators of intrinsic motivation (e.g., enthusiasm, happiness) and their assessments are subsequently (implicitly or explicitly) influenced by such manifestations in the class. In contrast, the behavioral expression of classes that place value on the PE activities may not be so easy for teachers to discern and acknowledge.

The results pertaining to introjected regulation were consistent with our hypotheses and theoretical predictions. Specifically, students who experienced higher introjected regulation than normal levels obtained lower grades in PE. Introjected regulation is an extrinsic motivation dimension and as such it is expected to have a negative association with academic achievement. Although Guay et al. (2008) pointed out that introjected regulation has often been related to higher levels of persistence in school, it is likely that this persistence will be rigid and will not result in adaptive cognitive and affective experiences that facilitate performance (Ryan et al., 1991). The longitudinal design of the present study supported this argument. However, the lack of significant effects at between-person and between-class indicates the need for further research on this topic.

With respect to external regulation, the findings of the present study showed a significant and negative effect on PE grades at the individual- and class-level. This is in congruence to our hypothesis and previous research suggesting that external regulation has a negative association with students' achievement (Vansteenkiste et al., 2004; Ratelle et al., 2007). External regulation actually describes two types of behaviors: an approach (try to obtain rewards) and an avoidance one (avoid punishment). Students adopting the approach behavior put effort and try hard during the lesson. However, it seems that for several reasons (e.g., small range of grades in PE) they do not persist long in their pursuits and over time their grades decrease. For students adopting an avoidance behavior, their participation in the lesson ensures the avoidance of punishment. Thus, no extra effort is required to achieve their main objective. This, however, may result in low interest towards the lesson and low performance, and consequently in low grades. Our findings suggest that in both cases, students participating in PE due to external regulation show a maladaptive association with achievement in PE. Similar to intrinsic motivation and identified regulation, the lack of effect at the within-person level could be ascribed to the small changes from students' own baseline scores.

Findings pertaining to amotivation are consistent with our hypotheses and previous research findings (Lepper et al., 2005; Legault et al., 2006; Ratelle et al., 2007). A negative relation between amotivation and PE grades was found at all three levels of analysis. Highly amotivated students are characterized by helplessness, show no interest, and do not attend PE lessons (Ntoumanis et al., 2004). Amotivated students in the Ntoumanis et al. study reported not exerting effort in the lessons because they did not think they had the competence to do well in PE, or because they did not consider it personally important. As a result, it is likely that these students receive lower grades from their teachers. Further, Ntoumanis (2005) found that amotivated students were more likely to opt out from non-compulsory PE.

Overall, the results of the present study indicated that all motivational regulations contribute to the prediction of grades in PE. Autonomous motivational regulations have positive effect, whereas controlling ones a negative effect. These findings are in accordance with SDT (Deci & Ryan, 2000), and Koestner and Losier's (2002) suggestions about motivation in compulsory settings. Intervention studies are available in the literature to indicate how to structure PE lessons in ways that promote adaptive motivation. For example, providing students with an autonomy supportive environment, in which they are given choices and opportunities for decision making, may have positive effects on autonomous motivation (e.g., Chatzisarantis & Hagger, 2009).

A limitation of this study was that the range of grades was rather small. This is an inherent problem of the grading system in Greece seeking to cover simultaneously different aspects of student performance. For instance, a highly skilled student might find the activities of a lesson too boring/unchallenging and might not apply much effort, yet he/she could obtain a high grade due to his/her competence levels. Another, less-skilled but intrinsically motivated student might try hard during the

lesson and get a high grade due to his/her effort. Although similar grading issues exist in many countries' curricula (see Klein & Hardman, 2008 for an overview of PE curricula in Europe), in the future, research would benefit by decomposing the grading criteria and investigating the separate effects that motivation-related variables have on each criterion. Further, an interesting approach for future research would be to investigate the association of students' performance with cognitive and affective experiences during lessons. Finally, although the temporal ordering of our hypotheses (i.e., motivation predicting grades) was based on a well-supported theory, the direction of causality cannot be established with the longitudinal data used in the study. Despite these limitations, the present study offers new insight into the temporal relation between motivation and achievement. Specifically, the findings suggest that encouraging students' intrinsic motivation to gain knowledge, while minimizing internal pressures to participate, may influence student achievement in PE classes.

Perspective

There is a well-established belief within SDT that autonomous forms of motivation have a positive influence on performance (Ratelle et al., 2007). This belief was largely based on cross-sectional evidence with scarce longitudinal evidence regarding the dynamic relation between motivation and performance (Boiché et al., 2008; Vansteenkiste et al., 2009). Past research has indicated that motivation in junior high school years fluctuate (Ntoumanis et al., 2009). Hence, it is important to investigate how changes in motivation influence students' grades. This evidence will provide insightful information on the factors predicting a decline of achievement and how to tackle this decline. The present study fills this gap in the literature by providing information on the dynamic relation between school motivation and achievement, with respect to the specific subject of PE. Autonomous forms of motivation were found to have positive effect on students' achievement in PE. This is in congruence with prior research on the effect of autonomous motivation on cognitive and affective aspects of the PE lesson (Hagger & Chatzisarantis, 2007). Thus, the structure and teaching methods used in PE lessons should foster students' autonomous motivation.

Key words: Motivational regulations, achievement, grades, physical education, longitudinal, multilevel modeling.

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